

# IWMC2015 ABSTRACTS

## V<sup>th</sup> International Wildlife Management Congress



**July 26-30  
2015  
Sapporo  
Japan**

**Sunday, July 26, 2015**

## **Public Plenary**

### **Session 01: Urban and Suburban Wildlife Management: Common Trends and Issues of International Society**

#### **0101 Urban Wildlife Management in the United States and Canada**

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Urban wildlife management is growing in importance in Canada and the U.S. This paper describes the archetypical history of wildlife population exploitation, recovery and impact management, and the anthropogenic root-causes for management of many species in urban environments. Although urban and traditional wildlife management situations differ in many ways, in both contexts some species are welcome to co-exist with humans, while other species are considered intolerable. Relatively speaking, management approaches and techniques tailored to urban situations are still in early days of development. Management of urban wildlife exhibits four traits: extensive stakeholder engagement, frequent reliance on community-based co-management, individual incident mitigation, and novel population reduction techniques. Urban wildlife management issues tend to be “wicked problems” (problems where disparate human values lead to different interpretations of desirable outcomes and acceptable means of achieving them). People sharing the same space with each other and with wildlife inevitably perceive different impacts from wildlife. Experience has amply demonstrated the difficulty of finding a management response that is accepted across all segments of an urban community. Conditions required to achieve co-existence may include: reasonable expectations regarding wildlife behavior toward people, pets and property; acceptable human interactions with wildlife; new norm for boundaries of space and place for wildlife in the urban landscape; a net positive balance among the negative and positive impacts of wildlife; individual and social (or collective) efficacy of management efforts; and effective communication to improve risk perceptions held by urban residents vis-à-vis wildlife. Arguably, urban wildlife management ranks with species imperilment as one of the greatest conservation challenges of our time, but for a very different reason. Anyone concerned about wildlife conservation should worry that the problems people experience with urban wildlife, if not curbed, could lead to popular backlash against wildlife and habitat conservation within or proximate to urban areas.

#### **0102 Urban Ungulates in UK and Continental Europe: Issues and Options**

**Rory Putman**, University of Glasgow, UK / University of Utrecht, Glasgow, United Kingdom. Contact: roryputman@btinternet.com

Deer and wild boar are increasingly becoming established within urban areas in a number of European countries, where their impacts may cause potential conflict with human activity. In addition conflicts are occurring in peri-urban areas where human activities and habitation impinge on historic and current wildlife range. In this paper I offer a review of conflicts associated with deer and other ungulates in the urban and peri-urban environment within the UK and elsewhere in

Europe before reviewing available options for control of ungulates and their impacts in the developed landscape.

Within fully urban areas - rather than peri-urban environments - concern is expressed in relation to damage by ungulates to gardens or urban parks, golf courses, structural damage to fences, increased risk of vehicle collisions involving ungulates, as well as about the potential implication of deer and boar in the transmission of disease to both humans, livestock and domestic pets. On the other hand many people regard these wild animals as a welcome addition to the urban/peri-urban environment, and the resultant resistance to management is among one of the challenges for control of ungulates in these situations.

In many European situations, conflicts with ungulates in the urban environment have arisen quite recently, and neither expertise nor legal frameworks have had time to develop and be applied under effective management strategies. In rural areas or peri-urban areas, culling with a high powered rifle is the generally accepted method of controlling numbers of wild ungulates. However, discharge of high-velocity weapons poses significant problems of safety in built-up, truly urban environments and is in consequence illegal in many countries. In addition, many urban residents enjoy seeing wildlife in residential areas and thus experience some conflict in understanding the need for control.

In the urban and occasionally in the peri-urban environment other methods are used by a variety of agencies, including fertility control, capture and translocation, capture and humane dispatch and sharp-shooting. I review the costs and consequences of these different approaches to control. I emphasise a need for involvement from the wider human community in decision-making and suggest that the choice and implementation of effective control methods face a number of key obstacles: public attitudes to culling may constrain any lethal control; legislation does not recognize the issues involved in urban control of ungulates; there is a lack of awareness by practitioners of these legislative constraints.

### **0103 The Challenge to Reduce Human-Wild Boar Conflicts in Kobe**

**Mayumi Yokoyama**, University of Hyogo, Tanba-city, Hyogo, Japan. Contact: yokoyama@wmi-hyogo.jp

In Hyogo Prefecture, wildlife has encroached and caused damage to the urban areas. Of particular concern are Japanese wild boars (*Sus scrofa*) along the southern slope of Mt. Rokko, which traverses the cities Kobe. Mt. Rokko, their habitat has recovered from its overuse by human activities around 100 years ago. Mt. Rokko even became a suitable habitat for wild boars in recent years. And the population of wild boar around Mt. Rokko would be increasing. The problems with wild boars at Mt. Rokko are caused by humans feeding these animals. Feeding activities have tamed wild boars, which has attracted their attention to human food, scavenging in garbage dumps and eventually attacking people. The first ordinance in Japan was enacted to prohibit feeding wild boars; 'Kobe City ordinance on wild boar roaming and prevention of harm caused by wild boars' in 2002. Although the damage continues because the prime cause, feeding activities, has never stopped. Some problematic tamed boars were captured and encroachment and damage stopped for a while. However, feeding activities continued to tame other individuals and to create new problematic animals. The more damages were happened when the damage points were close to the feeding points. The attitude survey about wild boar-conflict revealed that the people living in the city have wrong recognition why wild boar encroached and caused damage to the urban areas. To prevent from the damage, it was important to educate the people living near the feeding point about the factor of wild boar encroaching in the city and need for population control.

#### **0104 Urban and Suburban Brown Bear Management in Depopulating Society Sapporo, Japan**

**Yoshikazu Sato**, Rakuno Gakuen University, Ebetsu, Japan. Contact: ysato@rakuno.ac.jp

Sapporo is Japan's 5th biggest city with a population of 1.9 million people spread over a 1,121km<sup>2</sup> area. This area is also inhabited by various wildlife, including brown bears *Ursus arctos*. Conservation of nature, biodiversity, and maintaining a green network between forest and urban areas are high-priority issues for Sapporo City in order to build a good life for Sapporo's citizens and fulfill the administrative responsibilities towards the international society as a global perspective. Sapporo City developed a vision for biodiversity conservation in 2013. Promoting such conservation activities, however, would bring an increase in undesirable human-wildlife relationships, such as infection risks of parasitic zoonosis, wildlife-vehicle accidents and wildlife damages to human life and properties in urban and suburban areas. Brown bears had decreased its geographic range and population since the 1970s, and the local population in the western Ishikari area, including Sapporo, is listed as Threatened Local Population (LP) in the Red List by Ministry of the Environment, Japan since 1991. Since the 2010s, however, brown bear invasions into urban areas have increased as a result of geographic range expansion into the adjacent human residential areas in Sapporo. The necessity for brown bear management as a local perspective has risen not only in suburban but also in urban area in Sapporo. Now we need to present a grand design for brown bear management and launch its implementation structures in Sapporo that aims to both conserve the local population listed on the Red List and manage human-bear conflicts. Various stakeholders live in Sapporo, there are those who have interests in conservation with a global perspective, and also those with whose interest lies solely in management with a local perspective. In the coming decade, we are facing a depopulating society, with an increase in population ages and a hollowing out of human presence in marginal areas, whereas wildlife distribution expand and population increase. Since we never get away from human-bear conflicts, we must understand the cause and risk of the conflicts. Continuous monitoring, and proper preparations to deal with upcoming conflicts are required. I recommend making an original management plan for living with brown bears in green and beautiful Sapporo.

**Monday, July 27, 2015**

# Plenary

## Session 02: Education for the Future

### **0201 Learning for the Future: Educating Career Fish and Wildlife Professionals**

**Dan Edge**, Oregon State, Corvallis, OR. Contact: [daniel.edge@oregonstate.edu](mailto:daniel.edge@oregonstate.edu)

In my presentation, I examine current models for educating fish and wildlife professionals and suggest changes that are likely to be needed in order for natural resources professions to meet the grand challenges of the future. I look at who we will teach, how they will learn and what they will need to know to be successful. The rapidly expanding knowledge concerning organisms, ecological relationships and the human dimensions of conserving these resources will challenge educators to design curricula that provide students with basic concepts while instilling transferable skills required to perform a wide array of jobs. The natural resources professions must strive to become more inclusive if we are to serve a global constituency. Successful educators of the future will need to engage students in learning about natural history while developing the transferable skills of critical thinking, team work and leadership, and all forms of communication. Educators will employ new technologies in classrooms, laboratories and in the field to engage students in developing both their knowledge of natural history and skill sets needed to perform essential functions of most jobs. Experiential learning will become increasingly important at the baccalaureate level and will include two or more 3- to 6-month assignments. Educational institutions, professional societies and NGOs should work together to expand international experiences so that students of the future live, and not just learn about global challenges. Advanced degrees will become increasingly important for employers who need specialized knowledge or more refined skills for specific positions. Advances in technologies such as molecular methods and autonomous systems will place a premium on skills related to big data acquisition and analytics.

### **0202 Thematic Training for a World of Wicked Problems in Wildlife Management**

**Stephen Sarre**, University of Canberra, Canberra, Australia. Contact: [Stephen.Sarre@canberra.edu.au](mailto:Stephen.Sarre@canberra.edu.au)

Wildlife Management issues arise frequently in modern society and often invoke intense public interest and even conflict. Effective management of such issues draws on quality science to inform actions undertaken by those charged with management. Those actions may be contentious, often incorporating the application of lethal approaches and involving commercial and public organizations in addition to government and regional agencies. Therefore, the solutions to most wildlife management problems are best resolved through multifaceted and interdisciplinary approaches that involve cooperation between researchers, managers, community, government, and industry. Wildlife scientists of the future must be trained to be capable of leading and participating in the application of such multifaceted solutions.

In many countries and institutions, there is a yawning gap between training as it practiced at universities and the skill requirements of graduates when faced with wildlife management problems.

Graduate and postgraduate programs in wildlife management or environmental science are rightly focused on producing scientists of quality, but rarely do they seek to train scientists who have the ability to convert their work into implemented solutions. Here, I will outline a thematically based approach for university level training that recognizes the broader skills required by scientists. Ideally, such an approach draws students from multiple institutions around a common theme and aims to build skills in research leadership, team building and research management, as well as science. I will draw on seven years of experience as Program Leader Education of the Invasive Animals Cooperative Research Centre running the Balanced Scientist Program, a program which was aimed at providing a rounded education for research based students and featured high completion rates, enhanced collaboration, retention of graduates within the industry and a strong sense of belonging to a common research community. Postgraduate training programs of the future must work to provide the skills and opportunities necessary for the creation of networks of collaborators across universities and industry beyond that which is currently achieved. The approach outlined here provides a promising model for thematic and collaborative postgraduate science education.

# Symposia and Contributed Papers

## Session 03: Deer and Forest Management

### 0301 The Management of Deer and Forests in the UK

**Robin Gill**, Centre for Ecosystems, Society and Biosecurity, Forest research, Farnham, Surrey, United Kingdom. Contact: Robin.Gill@forestry.gsi.gov.uk

Deer numbers have been steadily rising in recent years and are likely to continue to increase in the near future. In common with many other industrialized countries, various factors have caused this increase. In Britain, four non-native species are now present in addition to the 2 native species. Recent studies show that the densities of deer in Britain are very variable, ranging from 0 to >100 km<sup>-2</sup>.

In state-owned forests, deer numbers are controlled using both employed and fee-paying stalkers, to a level where damage is acceptable and regeneration can be achieved with little or no fencing. Ancient native woodlands have the greatest importance for wildlife and many are fragmented and in private ownership. Amongst private landowners the approach to deer management is very variable with the result that many woodlands are still subject to a high browsing pressure. Efforts to promote more effective management have been partially successful, however deer management is a complex social issue and more could be done to foster cooperation.

The management of deer has been improved by the adoption methods to estimate population density, impacts on vegetation, as well as the use of models to predict population growth rates. Recent application of this approach at a landscape scale indicates that it can reveal information about dispersal which improves the effectiveness of management.

Further research providing more evidence of the impacts of deer and how they relate to deer densities, and more efficient methods for monitoring numbers, dispersal and impacts would help promote better management.

### 0302 Sika Deer Impacts on Forests and Forestry in Japan

**Nobuhiro Akashi**, Hokkaido Research Organization, Bibai, Hokkaido, Japan. Contact: akashi-nobuhiro@hro.or.jp

Forests, ranging from subtropical to boreal, cover 69% of Japan. Of these, 41% are planted, of which 41% are 31-60 years old. Timber production by clear-cutting in mature stands is increasing, but regeneration is difficult due to browsing by overabundant sika deer. Many natural forests are also affected by browsing and bark stripping. Various methods have been developed to evaluate deer impacts on forests, and the full extent of deer impacts has become clear. Because forests constitute primary deer habitat, deer population management should be incorporated into forest management. Sika deer can survive on lower-quality forage than red and white-tailed deer can, and they cause severe damage to vegetation. The forest floor of Japanese cool-temperate forests is often dominated by dwarf bamboo that prevents forest regeneration and confounds hunters searching for deer. Deep snow also prevents hunters from accessing forests where deer overwinter. Despite damage to trees, forest managers and forestry employees have been reluctant to allow hunters access to their work sites. However, it is necessary to manage deer populations to maintain forest vegetation and promote forestry. Thus, forest managers should play a central role in coordinating

stakeholders and promoting deer population management in forests. We must establish a Japanese model of deer management based on an understanding of the unique characteristics of sika deer and Japanese vegetation, combined with lessons from advanced cases worldwide.

### **0303 A New Chapter in Deer Management of Japan**

**Toru Koizumi**, Forestry and Forest Products Research Institute, Tsukuba, Japan. Contact: koizmy@affrc.go.jp

The high reproductive rates and low mortality rates of sika deer indicate that their populations have the potential to increase dramatically if unmanaged. Long-term protection of females during 1945-1994 brought this possibility into reality. Sika deer occupy more than 40% of Japanese land and continue to expand their range. The Ministry of Environment estimates the number of deer at about 3 million across the country, and has made the prediction that the deer will increase despite the annual harvest exceeding 400,000 individuals. The Forestry Agency has been recording forest inventories on 15,700 sites every 5 years since 1999. Their survey reports that deer damage (browsing, bark peeling, fraying) is recorded in 30% of Japanese forests and extends from plantations into natural forests. Forest understories are changing in overpopulated areas, with the disappearance of the original vegetation and/or the influx of unpalatable plants due to selective deer grazing. The government traditionally has expected sports hunters to control deer numbers. The total number of hunters in Japan is 180,000 as of 2010, which is less than half of that in 1963. Also, the proportion of hunters exceeding 60 years old has increased to 70% by 2010. Drive hunting using dogs, the traditional hunting style in Japan, is becoming increasingly difficult to carry out. The amendment of the Wildlife Protection and Hunting Law in 2014 was expected to found organizations responsible for the management of deer populations. It will be necessary to collaborate with these professional hunters to deal with deer locally.

### **0304 Integrating Social Organization into Deer Population Management in Forested Systems: Examples and Implications of Variable Success of Localized Management**

**Karl V. Miller**, University of Georgia, Athens, GA, Contact: kmiller@warnell.uga.edu

In North America, recreational hunting can effectively reduce the impact of ungulate browsing in forested ecosystems, particularly when local stakeholders are engaged. Population management of white-tailed deer (*Odocoileus virginianus*) has historically focused on regulating harvest of female (or antlerless) deer as the key driver of population trajectory. Although population goals are often achieved, demographic, social, reproductive, and morphological consequences of traditional management strategies have been documented. Management prescriptions based on socio-spatial organization of deer populations have been proposed, but field evaluations are few and have met with variable success. The high plasticity of white-tailed deer social behavior in response to environmental variables such as habitat productivity/stability, landscape features, seasonal variability, and predation context, as well as the demographic legacy of prior management clearly drive these variable responses. Whereas the concept of localized management is a leap toward integrating the social biology of deer into population management prescriptions, understanding these factors is requisite toward developing site-specific recommendations. As all management prescriptions are objective-driven, population density targets should acknowledge demographic consequences that may impact deer ecology.



## Session 04: Ecology, Conservation, and Management of Reptiles and Amphibians

### 0401 Nocturnal Activity Records of the Kishinoue's Giant Skink (*Plestiodon kishinouyei*) on Iriomote-Jima Island

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Kishinoue's giant skink (*Plestiodon kishinouyei*) is the largest skink in Japan and is endemic to the Yaeyama and Miyako Islands in the southern part of the Ryukyu Archipelago, Japan. It is considered to be heliothermic and thus exclusively diurnal. It is designated as vulnerable in the Japanese Red Data Book and is protected by law. This study was conducted during prey surveys for Iriomote cat (*Prionailurus bengalensis iriomotensis*) on Iriomote-jima Island. Surveys were conducted on foot along road transects at night and in the mornings. Road-kill surveys were conducted along the road transects by driving after midnight. *Plestiodon kishinouyei* was observed more frequently during the day, although it was also recorded at night. Nocturnal activity was recorded mostly on rainy nights and exclusively in fall, whereas most daytime activity was observed on non-rainy days and in the summer. Results of the present surveys suggest that this skink is occasionally active at night. Nocturnal activity could be associated with suitable ecological and or physiological conditions. To better understand its ecology, further studies of the nocturnal habits of *P. kishinouyei* that take into account suitable biotic and abiotic factors should be initiated. Additionally, one-third of the night observations were of road-killed skinks. Therefore, it would also be important to evaluate the effects of roads and traffic on the populations of this threatened species.

### 0402 Predicted Increases in Nest Temperatures Affect the Survival of Hatchling Velvet Geckos

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Climate warming is predicted to cause higher temperatures inside lizard nests. Long-lived lizard species that lay eggs inside communal nests may be particularly vulnerable to increases in nest temperatures, particularly if females show little plasticity in maternal nest site selection. In south-eastern Australia, female velvet geckos (*Oedura lesueurii*) lay eggs communally inside rock crevices. At our study sites in Morton National Park, female geckos have laid eggs inside the same nest sites since 1992, suggesting that eggs might be exposed to higher nest temperatures in future. To investigate how predicted increases in nest temperatures affect the morphology and survival of hatchling geckos, we incubated eggs inside programmable incubators at two fluctuating temperature regimes (current and hot, respectively) to mimic current (mean = 23.2°C, range 10-33°C) and future (mean = 27.0°C, range 14-37°C) nest temperatures. Hatchlings from eggs incubated under current temperature regime were larger and heavier, and had longer limbs, than hatchlings from the hot incubation treatment. We released hatchlings at two field sites in south-eastern Australia, and monitored the geckos' survival over 10 months. In the wild, hatchlings from the current temperature incubation treatment had higher monthly survival rates than did hatchlings from the hot incubation treatment. These results suggest that future increases in nest temperatures may negatively affect the survival of hatchling velvet geckos. Such changes in demography could

have long-term effects not only for the persistence of velvet gecko populations, but also for populations of the endangered broad-headed snake that rely on velvet geckos as a food source.

#### **0403 Dead or Alive? Factors Affecting the Survival of Victims during Attacks by Saltwater Crocodiles in Australia**

**Yusuke Fukuda**<sup>1</sup>, Charlie Manolis<sup>2</sup>, Keith Saalfeld<sup>1</sup>, Alain Zuur<sup>3</sup>, <sup>1</sup>Department of Land Resource Management, Northern Territory Government, Palmerston, NT, Australia; <sup>2</sup>Wildlife Management International Pty. Limited, Karama, Australia; <sup>3</sup>Highland Statistics, Newburgh, United Kingdom. Contact: yusuke.fukuda@nt.gov.au

Conflicts between humans and crocodilians are a widespread conservation challenge and the number of crocodile attacks is increasing worldwide. We identified the factors that most effectively decide whether a victim is injured or killed in a crocodile attack by fitting generalized linear models to a 42-year dataset of attacks by saltwater crocodiles (*Crocodylus porosus*) in Australia. The models showed that the most influential factors were the difference in body mass between crocodile and victim, and the position of victim in relation to the water at the time of an attack. Victims in the water (e.g., diving, swimming, and wading) had a higher risk than those on the water (e.g., boating) or on land (e.g., fishing, hunting) positions. In the in-water position a 75 kg person would have a relatively high probability of survival (0.81) if attacked by a 300 cm crocodile, but the probability becomes much lower (0.17) with a 400 cm crocodile. If attacked by a crocodile larger than 450 cm, the survival probability would be extremely low (<0.05) regardless the victim's size. These results indicate that larger crocodiles can drag a victim more easily into deeper water and the main cause of the victim's death during a crocodile attack is drowning. A higher risk associated with a larger crocodile in relation to victim's size is highlighted by children's vulnerability as victims of fatal attacks. The average body size of crocodiles responsible for these fatal attacks was considerably smaller (384 cm) than that of crocodiles which killed adults (450 cm) during the same period (2006-2014). These results suggest that culling programs targeting larger individuals may not be an effective management option to improve safety for children.

#### **0404 Rice Field as a Refuge for Freshwater Turtle Nesting and Conservation in Thailand**

**Noppadon Kitana**<sup>1</sup>, Yupaporn Visoot<sup>1</sup>, Rangsimma Pewphong<sup>1</sup>, Sarun Keithmalesatti<sup>2</sup>, Kumthorn Thirakhupt<sup>2</sup>, <sup>1</sup>Chulalongkorn University, Bangkok, Thailand; <sup>2</sup>Khon Kaen University, Khon Kaen, Thailand. Contact: noppadon.k@chula.ac.th

Central Thailand is well known as a fertile area for rice cultivation, and seems to be unfit for wildlife. However, an exception is found with *Malayemys macrocephala*, a common freshwater turtle living in rice fields, rather than the protected areas. The nesting biology of *M. macrocephala* were compiled based on field surveys in central Thailand during 2005-2014. Nesting season of *M. macrocephala* was between November and April, with the peak of nesting in February-March. Turtle nests were u-shape holes with covers made from soil and plant debris, and mainly found on the rice field ridge. Analysis of nest soil revealed that silt-clay and clay were major soil type of the nest. Clutch size ranged from 3 to 10 eggs with an average of 6 eggs per clutch. Although turtle eggs have been collected by farmers and available commercially at the local market, turtle populations in this area are still stable judging from stable number of eggs harvested. This is possibly due to local management plan where the farmers made a common agreement to harvest eggs only in certain

times of year and made a strict prohibition not to harvest egg during the waning moon and the Buddhist holy day (4 times/month). Because *M. macrocephala* is not a protected species by any national or international law, mitigation measures to secure nesting site in the rice fields during the nesting season could be regarded as an effective conservation measure for this turtle species.

#### **0405 Wood Turtle Ecology on Private Property Near the Southern Extent of Their Range in the Central Appalachians, United States of America**

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Wood turtles (*Glyptemys insculpta*) are a species of high conservation priority in the United States and little is known about their ecology near the southern extent of their range. To aid management of wood turtles we evaluated home range sizes, habitat, activity cycles, and diet of wood turtles along a 14-km reach of the Cacapon River, West Virginia, USA from 2009 to 2011. We captured 137 adult males, 88 females, and 59 juveniles. Home ranges averaged 5.75 ha (SE = 1.46); male home ranges were elongated along river and riparian corridors, but female and juvenile home ranges encompassed a greater degree of terrestrial habitat. Low bare ground, rock cover, and high vertical vegetative density were associated with the turtles' habitat compared to random plots. Wood turtles were more terrestrial during spring and summer, but more aquatic in autumn and winter. Mating occurred from late March to early June after hibernation emergence and again from late August to early November. Of all mating observations, 64.3% occurred in autumn, 75% occurred after 1300 hrs, and 35.7% were terrestrial. Nesting attempts were made in late May to early June in the early morning and early evening on sandy substrates. In October, turtles began entering the river and by mid-November, they were hibernating. Turtles primarily consumed slugs (67%), although worms, small mammal and bird remains, and a variety of berries and forbs also were consumed. This study aids in filling geographic information gaps and in planning management strategies for southern wood turtle populations.

### **Session 05: Conservation Policy, Ethics, and Education**

#### **0501 Medical Care for Injured Wild Animals Performed by the Wild Animal Medical Center of Rakuno Gakuen University and Its Application for Educational Activities**

**Ayumi Furuse**<sup>1</sup>, Mitsuhiko Asakawa<sup>2</sup>, <sup>1</sup>Rakuno Gakuen University, Ebetsu, Japan; <sup>2</sup>Rakuno Gakuen University, Ebetsu, Japan. Contact: ayumile.furuse@gmail.com

Since 2003, Wild Animal Medical Center (WAMC) which is in the Teaching Animal Hospital of the School of Veterinary Medicine, Rakuno Gakuen University (RGU), Japan, has admitted wild animals from surrounding area for treatment as a part of its activities. Patient records were summarized between 2003 and 2014 to evaluate the wildlife rescue activities and the utilization of injured wildlife for environmental education. In total, 90 birds and 16 mammals were brought into WAMC including a Peregrine falcon (*Falco peregrines*) and an Ussuri tube-nosed bat (*Murina ussuriensis*) which are in the Red Data Book issued by the Ministry of the Environment. The median of annual number of patients was about ten individuals. Most cases were caused artificially, for example, collisions with buildings (39%), traffic accidents (19%) and so on. Almost 25 % of a total of birds

could be released. The treatments and care activities were performed by 42 undergraduate veterinary students of WAMC and many non-member students of RGU. Because mostly common avian species (non-endangered species) were cared for at WAMC, there were no significant effects on the ultimate goal of conservation of natural ecosystem or a direct improvement for ecosystem management, but the program had a positive educational effect. For example, the injured Peregrine falcon was used for lectures to primary and high school students.

### **0502 The Evolution of Officially Recognized Tertiary Level Vocational Nature Conservation Training in South Africa**

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The study was undertaken to determine the development of the curriculum for studies in the three-year National Diploma in Nature Conservation and subsequent Post-Diploma studies to meet both the needs of the National Qualifications Framework and the employers within the Nature Conservation industry. The history of the Nature Conservation program since its inception in 1974 and personal experience of the author as Head of the Department of Nature Conservation at Mangosuthu University of Technology for the past twenty-five years was documented and analyzed. Changes in the curriculum were investigated to ascertain the source of the identified needs for such change and the response of curriculum developers to meet these needs. The investigation indicated clearly the pursuance of international trends in diversifying technical skills provided based on a sound scientific foundation, but also in the significant increase in provision of interpersonal skills. The first major national revision of the curriculum in 1988 resulted in a significant change from basic mechanical and technical skills to scientifically-based technical skills and the introduction of some interpersonal skills. The termination of the national curriculum in 1996 resulted in individual educational institutions adapting their curriculum to the needs of their specific context, and the promulgation of the new National Qualifications Framework in 2012 added impetus to this diversification. The study indicates clearly the trend to ensure that graduates meet the needs of employers by developing diverse skills required in the workplace.

### **0503 Chicken or the Egg? Possibility of New Wildlife Job or Reforming Academic Curriculum in Japan**

**Shoko Hosoda**<sup>1</sup>, Takeshi Akasaka<sup>2</sup>, Hiromasa Igota<sup>2</sup>, Yoshikazu Sato<sup>2</sup>, Hino Takafumi<sup>2</sup>, Tsuyoshi Yoshida<sup>2</sup>, <sup>1</sup>Department of Environmental and Symbiotic Science, Rakuno Gakuen University, Ebetsu, Japan; <sup>2</sup>Rakuno Gakuen University, Ebetsu, Japan. Contact: hosoda@rakuno.ac.jp

Wildlife professionals are responsible for sustainable resource management in many countries. The educational standard for training wildlife professionals is also common in many countries. Some studies suggested that wildlife professionals need to have diverse knowledge and skills such as wildlife management techniques, understanding of aspects of human dimensions and interpersonal skills. In recent years, there has been an on-going debate in Japan on whether creation of wildlife-related jobs comes first or reforming academic curricula comes first; chicken or the egg problem. Even though wildlife-related problems are increasing drastically, only a few wildlife professionals exist and most jobs are not permanent. In addition, the educational system for wildlife professional training is still limited. There are few colleges and universities offering wildlife management but

these academic institutes have only focused on teaching students about only science based wildlife knowledge. In this study, we analyzed the educational system of Rakuno Gakuen University to see if it meets the requirement of knowledge and techniques for wildlife professionals. As a result, the university did not offer enough lectures in interpersonal skills. The university cooperated with local communities to offer on-site practical training to enable students to improve interpersonal and communication skills. Consequently, the cooperation between academic institutions and local communities are the most significant steps that lead to sufficient wildlife professional training and wildlife jobs.

#### **0504 Natural Areas for Creative Solutions: Integrating Art and Science to Improve Conservation Education and Communication**

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Many management issues affecting wildlife, such as climate change and ecosystem restoration, are controversial despite consensus in the scientific community. This study reviewed literature on a spectrum of art approaches to enhance conservation education. We designed a multi-day module for use at biological stations that included an integrated set of activities including creative and critical thinking skills development, art-making, science-inquiry, public communication, and reflection/ evaluation. The goal was improvement in student learning in a suite of skills necessary for addressing significant wildlife-environment-society problems. Our research question was to determine if the integrated art and biology field trip module increased student knowledge about complex management issues such as ecosystem restoration and climate change, creative problem-solving processes, and public interpretation techniques. Six college classes with 64 students in both arts and biological sciences participated in a field trip to the University of Florida Seahorse Key Marine Laboratory. The students had group discussions, lectures and activities by scientists and educators, artist-led projects, and small group work on interpretive material for the station's public visitors. We assessed both student learning activity and the interpretive products using pre and post and retrospective participant surveys, focus group discussions, tests of critical and creative thinking dispositions, and critiques by art and science area experts. Surveys revealed significant knowledge improvement. Retrospective reflection journals demonstrated new understanding of environmental risk and ecosystem restoration processes. Incorporating the arts into this field station module helped engage multiple senses and social interaction, as well creative problem-solving.

#### **0505 Case Study on Typical Volunteer Tourism in China's Nature Reserves**

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Urbanization in China is gradually widening the gap between the development of cities, nature reserves and surrounding countryside. Therefore, it is of top priority to explore sustainable volunteer tourism development pattern and management skills to achieve the goal of educating tourists, local people, protecting nature, and to promote healthy development of nature reserves. After carrying out 20 cases, we selected Liziping Nature Reserve volunteer tourism project in Sichuan

and Yinggeling Nature Reserve volunteer tourism project in Hainan as typical cases to conduct a follow-up and in-depth analyses. Over the past three years, we provided 522 print and online questionnaires (effective returns-rate is 94%), and 9 interview records of tourists, local residents, urban residents and managers. The findings of the questionnaires and interview surveys showed that: 1) about 87% of all the respondents agreed that nature reserve volunteer tourism should be developed; 2) of all kinds of tourists, volunteers had the highest rate of satisfaction, which is 96%; 3) the main contradiction for volunteer tourism is the difference between the intention of the locals and the volunteer; and 4) one in four volunteers received professional training. As a result, most projects imparted basic skills, rather than correct values. The result covered four major aspects including social values, individual values, ecological benefit and economic benefit. Based on case studies and foreign experiences, we attempt to put forward a suitable volunteer tourism pattern for nature reserves in line with China's specific conditions, realize a win-win situation that integrates ecological, economic, and social benefits, and encourages more people to preserve nature.

## Session 06: Wildlife Habitat Management –1

### 0601 Population Ecology of the Taiwanese Pangolin

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The ecology of Taiwanese pangolins (*Manis pentadactyla pentadactyla*) was studied in rural habitats in southeastern Taiwan between 2009 and 2014. Radio-tracking revealed that average adult home range size (95% MCP) was 106.9 ha ( $\pm 32.8$ ) for 6 males and 25.1 ha ( $\pm 8.2$ ) for 8 females, core area sizes (50% MCP) were 35.1 ha ( $\pm 13.8$ ) and 6.0 ha ( $\pm 2.9$ ), respectively. Male home ranges did not overlap much, but each contained several extensively overlapping female home ranges. Population density was estimated to be 12.8 pangolins/100 ha. Pangolins used environments with low- (secondary and bamboo forests, tall grass- and shrub-lands) to medium levels of disturbance (orchards, short grasslands, managed forests) without preference. Individual pangolins used a limited number of permanent burrows for resting (*ca.* 30-90 burrows), and some co-inhabit resting burrows, but not simultaneously. Eighty-one percent of the resting burrows were found in low-disturbance environments. Pangolins also created many burrows when searching for termites; mainly during winter when ants were not readily available at ground surface. The burrow density was estimated to be 110.8 burrows/ha, comprised predominantly of food searching burrows in all environments. Adult body weight was heavier in summer and 20-25% lighter in winter, which is consistent with their seasonal changes in activity levels. Seventeen single births were recorded from September to March, but 65% occurred between December and January. Molecular analysis indicated this population is geographically isolated and likely inbred, and although they are principally polygynous, females mated with different males in different years.

## **0602 Landscape Fragmentation and Land Use Composition Effects on Taiwanese Pangolin Distribution**

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Due to overharvesting and habitat destruction in the past few decades, the Taiwanese pangolin (*Manis pentadactyla pentadactyla*) population that was once widely distributed in lower elevations in Taiwan has decreased dramatically. The southern Coastal Mountain Range, a fragmented landscape composed of secondary forests, agricultural land and small villages, is one of the few areas in Taiwan that a viable pangolin population still persists. To determine a conservation strategy, it is crucial to understand environmental factors that affect population status and habitat selection. In this research, 138 camera traps were distributed in 10 sections of the Southern Coastal Ridge and the occurrence index was calculated as an indicator of relative abundance. Kriging analysis of camera trap data was used to develop current density distribution of pangolins. The density distribution was further divided into high, medium, and low density classes. In each density class, habitat sampling areas were randomly selected and habitat patches were extracted from the national land use investigation database and redefined according to pangolin habitat preferences such as secondary forest, dry farming, wet farming and man-made constructions. The relationship of land use composition and pangolin habitat were assessed using patch and landscape fragmentation indices. The landscape fragmentation and land use composition are correlated with pangolin habitat and population distribution. For pangolin population restoration, it is crucial to incorporate land use pattern in conservation planning.

## **0603 To What Extent Do Human-Altered Landscapes Retain Population Connectivity?: Historical Change in Gene Flow of Wetland Fish**

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Population connectivity of wildlife has been historically altered by agricultural developments. Understanding the limits and potential of the altered connectivity would be valuable for conservation planning in the human-dominated landscapes. While riverine wetlands are particularly threatened worldwide, little is known about the historical change in population connectivity of wetland organisms. Here, we assessed the historical change in gene flow of the ninespined stickleback (*Pungitius pungitius*) using Bayesian techniques. Eight polymorphic microsatellites were used for genetic analyses. We predicted that contemporary gene flow is maintained by an artificial watercourse network may be restricted to smaller spatial scales compared to the historical patterns of gene flow and that historical gene flow exhibited both upstream and downstream flow, by contrast, contemporary gene flow may be more dominated by downstream flow due to construction of low-head barriers. In addition, we evaluated potential source populations (i.e., net exporter of migrants) on both historical and contemporary time scales. We found that contemporary gene flow has been restricted to smaller spatial scale although the historical change in flow direction was not found. Furthermore, we consistently found same potential source area of migrants from past to present, and the source area was characterized by relatively large amount of remnant wetlands connected by artificial watercourses. Our findings highlight that artificial watercourse network can sustain short-distance migration of wetland fish, which contribute to maintaining potential source

populations. However migration at the landscape scale ensuring longer species persistence has been prevented by agricultural developments.

#### **0604 Immigration Potential Explains Variable Species' Response to Physical Habitat Conditions**

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Improvements of local habitat conditions have been a common practice in riverine restoration projects. However, resulting recovery of biological communities varies, calling for further exploration on how species' response to such efforts is determined. We investigated how immigration potential influences the magnitude of species-habitat associations at a local scale for four migratory fish species (i.e., sculpins, goby, and lamprey). Our nested sampling design (i.e., 47 reaches consisting of 1-5 local habitats) and multilevel modeling approach enabled us to uncover the potential interaction across spatial levels. As expected, immigration potential drastically changed the magnitude of habitat associations at the local level. At reaches with high immigration potential (i.e., closer to the sea), all the fish species strongly responded to fine-scale environments (e.g., water depth, current velocity, and substrate), attaining their greatest density with favorable physical conditions. However, such patterns have diminished as immigration potential decreased. Local habitats with high immigration potential should be prioritized in conservation activities.

#### **0605 Managing Threatened Wildlife in Fragmented Habitats: Connectivity May Be the Enemy**

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Threatened wildlife populations in fragmented habitats are often managed by improving habitat quality in fragments, and or improving connectivity among fragments. The former might involve pest control, whereas the latter might involve planting corridors or conducting translocations. In theory, species may decline from fragmented habitats solely due to metapopulation dynamics, thus it may be possible to recover populations by improving connectivity even if it is not feasible to improve habitat quality. However, this strategy may backfire if it facilitates movement to low-quality fragments, something that is difficult to predict due to the challenges involved in assessing habitat quality. We conducted a 12-year experimental study designed to assess the relative benefits of connectivity and local habitat quality for a native New Zealand bird species, the North Island robin (*Petroica longipes*), in a fragmented landscape. The species tended to be absent from isolated fragments, and radio-tracking of juveniles showed that the pasture matrix was a significant barrier to dispersal. Local reintroductions successfully re-established robins in 11 previously unoccupied fragments, and these subpopulations had similar reproductive success to natural subpopulations. However, long-term monitoring throughout the landscape revealed inter-fragment variation in adult survival that explained the original absences, and metapopulation modelling predicted that increased connectivity would negatively impact the population by facilitating movement to those sites. In contrast, improving local habitat quality through predator control was extremely effective, but was predicted to be most effective if concentrated in semi-isolated fragments to reduce the rate of emigration to the surrounding unmanaged landscape.



## Session 07: Population Census Techniques –1

### 0701 The Development of a Rat Re-Setting Toxin Delivery Device to Assist with Island Biosecurity

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Globally, invasive mammals are a major threat to island biodiversity and introduced rodents are one of the greatest causes of species extinctions and ecosystem change. Islands now present unique opportunities. Where rodents can be eradicated, species can recover or be introduced. From the 1980s rodent eradications on islands using bait stations and or baits applied from the air have been spectacularly successful. However, rats can re-invade and ensuring the islands remain rat-free is an ongoing issue. We are developing a re-setting toxin delivery device (Spitfire) that would assist with island biosecurity. The Spitfire works by firing a paste containing a toxin on to the belly of rats as they pass through a tunnel. The device then resets. When rats groom the paste from their fur, they ingest the toxin. Each Spitfire is capable of approximately 100 doses and is fitted with a counter and a delay mechanism. The Spitfires are expected to last for at least a year without being serviced. We have been testing a variety of toxins, sodium fluoroacetate (compound 1080), zinc phosphide, cholecalciferol and brodifacoum, in order to provide a choice of toxins to suit the circumstances. Keeping islands free of introduced rats once they have been cleared will require a range of biosecurity measures and the Spitfire would be a valuable addition.

### 0702 Spotlight Surveys Using Distance Sampling to Estimate Abundance and Density of Deer

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Whidbey Island is the largest island in Washington (437 km<sup>2</sup>), USA. Local wildlife managers and stakeholders are concerned that Columbian black-tailed deer (*Odocoileus hemionus columbianus*) on the island have exceeded biological and social carrying capacity. Wildlife managers, however, are not certain of the current deer population size or whether current mortality rates from hunting and vehicle collisions are controlling population growth. To address these concerns we designed a research project to estimate deer abundance and density on Whidbey Island. We used road-based spotlight surveys in a distance sampling framework. We used a distance sampling framework because it is robust to violations of statistical assumptions that occur while sampling from roads. Specifically, by adjusting how we account for observations near roads we can reduce bias caused by deer movement toward or away from the road. Additionally, the construction of roads on the island are not generally driven by topography or vegetation change that would cause differences in deer space use. We surveyed 10% of the roads within the North, Central, and Southern portions of the island and selected roads in proportion to available land cover types across the island. This research demonstrates that spotlight surveys combined with appropriate statistical analysis can be a viable tool for wildlife managers struggling with cryptic species inhabiting dense vegetation. Locally this research provides data that has not been available to wildlife managers and will assist in their efforts to manage deer on this and nearby islands.

### **0703 Developing a Method for Estimating Red Fox Population from Feces Count in Nemuro Peninsula, Japan**

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Japan enjoys a rabies-free status but needs risk assessment in dogs and wildlife populations. This study was conducted to develop a method to estimate red fox population using feces counts. To develop this method we needed to determine: 1) where foxes defecate, 2) where they make dens, and 3) find parameters which predict the gaps between defecation and den sites because the population can be estimated using the number of dens. In this study, we sought to determine the location and characteristic of defecation and den sites. In Nemuro Peninsula where distributions of red fox dens are available, 32 sampling points were randomly generated on the paved roads. Transects of 500 m centered by these points were visited and feces were counted in June 2014, when families live in breeding dens. For ecological comparisons, 72 random points were generated within 1 km from sampling points for feces, and 256 among study areas for dens. We incorporated geographical information of rivers, slope and land use. Foxes tended to defecated near rivers ( $P = 0.04$ ), preferred forests ( $P < 0.01$ ), avoided residential areas ( $P < 0.01$ ), but far defecated far from breeding dens ( $P = 0.01$ ) by comparisons with random points. Foxes made dens far from roads ( $P < 0.01$ ), near rivers ( $P = 0.01$ ), preferring forests ( $P < 0.01$ ) with steeper slope ( $P < 0.01$ ), and avoided residential areas ( $P < 0.01$ ), similarly. We found gaps between where foxes den and defecate, and trying resolve these differences is the next step.

### **0704 Improving Aerial Surveys for Large Mammals: A Double Observer Approach to Distance Sampling**

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Aerial surveys are an efficient technique to estimate population trends in large mammals. Unfortunately, population estimates from aerial surveys are consistently biased low and one must sacrifice accuracy for efficiency. Distance sampling with a double-observer technique offers a means to correct for the under-count. During 2013 and 2014, we performed 3 sets of surveys for white-tailed deer (*Odocoileus virginianus*) and nilgai antelope (*Boselaphus tragocamelus*) over 81,000 ha in southern Texas, USA, to evaluate the efficacy of the double-observer distance sampling technique. Data were analyzed in Program Distance 6.2. Detection rates on the transect line ( $g(0)$ ) were high, and estimates ranged from 89-97% (CV 0.7-4.3%). Detections by front and rear observers ranged from 42-56% and 50-56%, while 44-58% and 44-50% were seen by both observers for white-tailed deer and nilgai, respectively. We detected 60-80% of white-tailed deer and 52-66% of nilgai within the covered region for all surveys (CV 3.1-4.1% and 6.5-10%). Our median effective strip widths were 70 m for white-tailed deer and 63 m for nilgai. There was no significant difference between population estimates for either species across all surveys. Furthermore, the CV values for density estimates of white-tailed deer were low (5.6-8.1%) and increased for nilgai (20.4-26.7%). Our results suggest the double observer distance sampling approach corrects for persistent under-counts, yielding more accurate population data and spatially explicit estimates of population density. This

method could be used as a rapid way to assess population size on large tracts of land in steppe and rangeland ecosystems.

## Session 08: Ecology and Management of Ungulates

### 0801 Extreme Precipitation Variability, Forage Quality and Large Herbivore Diet Selection in Arid Environments

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The drive to meet nutritional requirements underpins many aspects of ungulate ecology. Forage conditions in arid regions are driven by rainfall, which is unpredictable and highly variable in quantity and distribution. Previous studies on forage quality for desert bighorn sheep (*Ovis canadensis mexicana*) did not include periods with widely varying rainfall and were limited in duration. Our objectives were to: 1) investigate how precipitation variability influences forage nutritional content; and 2) assess changes in diet breadth and forage selection in response to precipitation-induced shifts in forage quality during periods ranging from severe drought to abnormally wet. Nutritional quality and moisture of trees was high and consistent across climatic periods, whereas succulents were low in nutritional content, but high in moisture. Grass, forbs, and shrubs were variable, but generally increased in nutritional content with increasing precipitation. Diets were dominated by trees and shrubs, with cacti being more prevalent during drought, and forbs and grasses increasing during fall and winter seasons and during wet periods. Forage selection shifted in association with nitrogen, digestibility (DMD), and moisture across climatic periods. Tree selection increased with moisture and nitrogen across all climatic periods. Selection of shrubs was associated with increasing N and moisture and negatively related to DMD. Selection of succulents decreased with increasing moisture and DMD. Grass selection increased with moisture during drought. Protein and moisture are likely more nutritionally limiting for desert bighorn sheep than digestible energy. Specific tree species served as key resources, providing a relatively stable source of nitrogen during droughts.

### 0802 Space Use and Habitat Selection of Sambar Deer in Taroko National Park, Taiwan

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The sambar deer (*Rusa unicolor*) is protected under Taiwan's Wildlife Conservation Act because of human overexploitation. However, its population has rapidly recovered in recent years, becoming regionally overabundant in some protected areas. Assessing how the sambar deer uses its habitat and which factors affect its habitat selection will be helpful for the conservation and management of this species and its habitats. We tracked 12 deer (6 males and 6 females) using global positioning system telemetry between December 2009 and October 2013 in Taroko National Park. The mean annual 95% fixed kernel home ranges were  $101 \pm 24$  ha for males and  $70 \pm 45$  ha for females. The

deer used higher elevation areas in the hot/wet season (May-October) than in the cold/dry season (November-April), indicating seasonal movement behaviors. At the home range scale, the deer preferred broadleaf forest, mixed forest, open habitat, and hemlock forest in the cold/dry season, and fir forest, grassland, and hemlock forest in the hot/wet season. In addition, the deer preferred flatter areas and mesic aspects (338-67°). Habitat selection also exhibited temporal variation; the deer were significantly closer to forested habitat in the daytime than at night in the hot/wet season (Wilcoxon signed-rank test,  $P = 0.006$ ), highlighting their requirement for forest. This study provides detailed information on the sambar deer's space use and habitat selection in its native range. We suggest that monitoring deer damage in different types of forest at different elevations would be important for future management.

### **0803 Combined Effect of Land Use and Climate Change May Accelerate Range Expansion of Sika Deer in Japan**

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To understand range use changes of wildlife and forecast future changes in distribution, it is necessary to disentangle the effect of land use change and climate change. In this study, our goal was to evaluate the relative importance of land use change and climate change on range expansion of sika deer in Japan and forecast future changes in their distribution range. Using 5-km resolution distribution data from two periods, we modeled local extinction and colonization dynamics of sika deer between 1978 and 2003 from neighborhood occupancy and change in habitat suitability, which is estimated from land use and climatic variables. We also conducted simulation to forecast future range change under land use and climate change. In our final model, proportion of forest area, snow period, and difference between body size of sika deer (Hokkaido vs other islands) were selected as variables to calculate habitat suitability. In northern Japan and high mountains, decrease in snow period contributed to increase habitat suitability, while encroachment of forest contributed in southwestern Japan. Results of simulation indicated that the scenario considering land use change, climate change, and combination of two drivers increased sika deer range by 1.3-2.4%, 4.3-12.4%, and 5.8-14.5% in 2103, when compared to baseline scenario. Our result showed that both drivers contributed to range change of sika deer in last decades. Both drivers may accelerate range expansion of sika deer in coming century, with increasing importance of the effects of climate change in the future.

#### **0804 Breeding Strategies of Male White-Tailed Deer: The Role of Fat Reserves**

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In most portions of the species' range, male white-tailed deer (*Odocoileus virginianus*) accumulate large fat reserves during autumn which they use during the rut. Because movement rate increases during rut, fat may be used to fuel breeding movements. Alternatively, males may use fat reserves to reduce time spent feeding, thereby increasing time available to find, court, and breed females. To understand the role of fat reserves in white-tailed deer breeding, we used movement rates of male deer fitted with GPS collars in southern Texas to calculate energy necessary for rut-based movement. Using rump-fat thickness in mature bucks during a year with high precipitation and good forage, we determined male deer have 25% body fat which, for a buck weighing 80 kg, translates to 20 kg of body fat pre-rut. Increased movement during rut requires 173 kcal/day of additional energy. Losing 20% body mass during rut releases >110,000 kcal (depending on the percent fat post-rut), which during a six-week rut provides >2,640 kcal/day. Most energy derived from body reserves during rut appears to be used to reduce feeding time, thereby enabling males to devote more time to breeding. Energy from body reserves reduces a male deer's foraging time by >58% over a six-week rut, or more if reserves are used primarily during 2-3 weeks of peak rut. We predict male deer that acquire large fat reserves before rut are more likely to sire fawns because fat reserves relieve foraging constraints.

#### **0805 Predicting Long-Term Population Dynamics of an Ungulate in an Arid Environment in Response to Climate Change**

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Response of animal populations to changes in climate is complex, especially in arid regions where precipitation patterns are highly variable. Developing a better understanding of the impacts of climate on populations is critical for conserving and managing species. Using pronghorn (*Antilocapra americana*) as an ecological model, we examined historical relationships between environmental factors and population dynamics to gain insight into the potential response of pronghorn populations to predicted changes in climate. We adopted an information-theoretic approach in a Bayesian framework to analyze long-term data from 17 pronghorn populations in the southwestern United States to determine climatic factors that predict annual rate of population growth ( $\lambda$ ). We used these explanatory variables to project pronghorn population trends to 2090 in response to climate change under high and lower atmospheric CO<sub>2</sub> concentration scenarios using region-specific downscaled climate projection data. Climate projections on pronghorn range indicate increased temperatures across the region, and direction and magnitude of precipitation changes show high area-specific variance. Twelve populations demonstrated significant positive relationships between precipitation and  $\lambda$ , with late gestation and lactation being important periods, whereas temperature relationships were highly variable. We found little difference in pronghorn population projections

between atmospheric CO<sub>2</sub> concentration scenarios. Our models predict that about half of the pronghorn populations examined will be extirpated or approaching extirpation by the end of the century. Findings will contribute to a better understanding of ungulate response to a changing climate, which will benefit development of conservation and management strategies for species on arid lands.

## Session 09: Ecology and Management of Bears

### **0901 Conservation Strategies for the Europe's Largest Brown Bear Population in the Carpathians via Landscape Resistance Modeling**

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One of the largest populations of brown bear (*Ursus arctos*) in Europe is in the Romanian Carpathians, more than 6,000 individuals occurs at the highest densities reported in Europe, 9-24 bears/10,000 ha. Large carnivores need large areas to satisfy their ecological and ethological needs. At the moment, human activities, infrastructure development and habitat fragmentation give birth to major challenges for developing conservation strategies. To mitigate these pressures, a long-term conservation strategy is compulsory and should take into consideration the influence of anthropogenic and ecological factors on the species ecology and ethology. This study highlights the power of landscape genetics for detecting fine scale structuring within one large continuous population demonstrating that the landscape composition becomes an important predictor of spatial genetic variation in brown bear populations. Assessment studies of environmental impact, using gene flow modelling, field observation, individual movements (telemetry) and protection of identified corridors and buffer zones should be implemented in mitigation measures. These management strategies should be adopted for conserving Europe's largest brown bear population in the Carpathians and to assist in mitigating planned infrastructure development in the next decade.

### **0902 Hair Snares for Grizzly Bears: Population Monitoring in Southwestern Alberta**

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In southwestern Alberta, conflicts between grizzly bears (provincially threatened) and agricultural land uses have increased over the last 15 years. In our study area, the last population estimate, completed in 2007, was 51 grizzly bears. To evaluate the hypothesis that an increasing grizzly bear population is driving increasing conflicts, we used non-invasive genetic methods to estimate grizzly bear density and abundance. Our study area is a multi-use landscape; agriculture is the dominant land use, and 60% of our study area is privately owned. We established 899 bear rub objects across the study area by surveying trail networks, using GIS layers and working with over 70 landowners to identify priority sampling areas. We visited rub objects every 3 weeks from late May through mid-November for a total of 8 visits (7 sampling occasions) per field season. We also allowed for opportunistically collected hair samples (e.g., trapped bears and hair at agricultural bear-conflict sites). We sent hair samples to Wildlife Genetics International to identify species, individual identity,

and gender via analysis of nuclear DNA extracted from hair follicles. From 2011 through 2013, we identified 177 individual grizzly bears (71 males and 57 females), indicating more bears are using the study area than previously estimated. These grizzly bears are part of a larger regional population which includes British Columbia and Montana. We will present density and abundance estimates for our study area based on spatially explicit capture recapture models, and discuss potential explanations for the apparent discrepancy between our numbers and the previous estimate.

### **0903 Estimating Density of American Black Bears in New Mexico, United States of America**

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One of the main challenges for wildlife management agencies is to set harvest levels that ensure the long-term persistence of populations. The New Mexico Department of Game and Fish (NMDGF) currently manages black bear populations at 9 and 17 bears/100km<sup>2</sup> depending on the population. Various public interest groups feel these density estimates are too high and the black bear populations in the state are being over harvested. Our objectives were to estimate abundance and density of American black bears (*Ursus americanus*) in the Sangre de Cristo and Sacramento Mountains, NM, USA. We sampled the populations using two concurrent sampling methods: hair traps and bear rubs. We supplemented our sampling with genetic samples collected from hunter-harvested, depredation, road killed, research, and management handled bears. We estimated abundance using Huggins closed-population capture-recapture models. Density was estimated using two approaches: adjusting the effective trapping (ETA) area by the one-half mean-maximum distance moved (MMDM) and using spatially-explicit capture-recapture (SECR) models. Density estimates differed depending on the statistical method with SECR estimates higher than ETA estimates (17-25 bears/100 km<sup>2</sup> (SECR) vs. 8-20.5 bears/100 km<sup>2</sup> (ETA)). Our results suggest that the black bear populations in New Mexico are at a higher density than the level currently managed by the NMDGF. These estimates have been provided to the NMDGF, and will aid them in setting harvest limits for American black bears.

### **0904 Home Range Overlap among Female Asian Black Bears: The Influence of Kinship and Food Availability**

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Most female mammals are philopatric and more related individuals are closer to each other in space than unrelated individuals. Although the benefits of female philopatry are expected to also occur in solitary mammals, the relation between kinship and space use is still poorly understood. We investigated the effect of kinship on space use between females for periods of different food availability in a solitary large carnivore, Asian black bear (*Ursus thibetanus*). We used location data from GPS collars and genotypes of microsatellite DNA for 13 female bears in the Ashio-Nikko

Mountain, central Japan. We also investigated hard mast (Japanese oak, *Quercus crispula*) productivity. Home range (HR) overlap was used as an index of spatial proximity between individuals. We found that close family members (i.e., mothers, daughters, and granddaughters) established their home ranges close to each other. We also found the effect of degree of kinship on HR overlap varied according to mast productivity. In poor mast years, females moved widely and the overlap of close-family pairs was also small. However, females came back to the area they used from spring to summer. Locations of females' HR were stable across seasons and years excluding the fall season. Thus kin-related HR use did not disappear as a whole. These results bring us new knowledge on female kin structure in the solitary large carnivore. Movement of females back to the natal range area, even after the seasonal shifts of HR location might support that females benefited from remaining in the natal range.

#### **0905 Railway Infrastructure Increases the Abundance and Speeds the Phenology of Grizzly Bear Forage Plants in a Mountain Park**

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Throughout their distribution, the movement of grizzly bears (*Ursus arctos*) depends largely on the distribution, abundance and phenology of forage plants. These factors are influenced by roadside habitats where many of the foods consumed by bears are advantaged by increased disturbance, light and temperature, which contributes to bear mortality through vehicle collisions. Although not yet tested, similar effects on vegetation likely occur along railways, where the attraction of bears could contribute to train strikes. Such strikes have become the leading cause of mortality for grizzly bears in the Canadian mountain parks of Banff and Yoho where the local population is declining and at risk of regional extinction. This study tested the hypothesis that the rail enhances the growth of bear forage plants with predictions of greater abundance, higher productivity, and earlier maturation of plants near the rail relative to adjacent areas, and a more pronounced effect at higher elevations where vegetation productivity tends to be lower. Our results showed that several species were more abundant and productive near the rail, but the effects of phenology and elevation varied. The most important forage plant to bears, Buffaloberry (*Shepherdia canadensis*), matured more rapidly along the rail, but its berries also appeared to dry and drop from bushes sooner. Our findings provide evidence that railways change adjacent plant communities in diverse ways that may be difficult to predict for researchers, as well as bears and other herbivores. Mitigation of rail-associated changes in vegetation will likely require substantial site-specific knowledge and explicit management goals.



## Session 10: Marine Mammals –1

### 1001 Stable Isotopes in Harbor Seal Whiskers as Indicators of Seasonal Feeding Patterns

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Harbor seal (*Phoca vitulina*) haul-out at rocks located along the Oyashio coast of Hokkaido, Japan. After depletion because of over exploitation, they have been protected as endangered species since the mid-1980s. With recent recovery of the population, the reports of damage to salmon stocks by seals has increased at Cape Erimo, the largest haul-out site in Hokkaido. However, previous scat analysis suggests seals mainly feed on non-commercial fish, such as Gadoids, sculpins, flatfish and snailfish. There is no information about how much seals depend on salmon. For coexistence of endangered species and human activity, it is necessary to understand actual feeding habits. In this study, we analyzed stable isotopes along the length of harbor seals whiskers to describe feeding history. In situ, Japanese sand lance (*Ammodytes personatus*) was fed to the captive seals ( $n = 4$ ), and whiskers were sampled. Isotopic fractionation values between sand lance ( $\delta^{13}\text{C} = -18.3 \pm 0.2 \text{‰}$ ,  $\delta^{15}\text{N} = 10.5 \pm 0.1 \text{‰}$ ) and whiskers were  $+2.6 \pm 0.2 \text{‰}$  for  $\delta^{13}\text{C}$ , and  $+3.3 \pm 0.1 \text{‰}$  for  $\delta^{15}\text{N}$ . Estimated turnover rates were  $46.8 \pm 23.5$  days for  $\delta^{13}\text{C}$ , and  $36.3 \pm 7.1$  days for  $\delta^{15}\text{N}$ . We collected whiskers from wild seals ( $n = 5$ ) and 14 possible prey species. Oscillation of stable isotopes in their whiskers may indicate seasonal changes in feeding habits in harbor seals: consuming benthic animals, such as octopus, flatfish, and cottid fish, having higher isotopic values ( $n = 30$ ;  $\delta^{13}\text{C} = -16.1 \pm 0.6 \text{‰}$ ,  $\delta^{15}\text{N} = 14.0 \pm 0.8 \text{‰}$ ) in spring, and altered diet with lower isotopic values such as chum salmon (*Oncorhynchus keta*;  $n = 6$ ;  $\delta^{13}\text{C} = -20.7 \pm 0.5 \text{‰}$ ,  $\delta^{15}\text{N} = 9.8 \pm 0.7 \text{‰}$ ) and Japanese flying squid (*Todarodes pacificus*;  $n = 2$ ;  $\delta^{13}\text{C} = -18.4 \pm 0.2 \text{‰}$ ,  $\delta^{15}\text{N} = 11.9 \pm 0.3 \text{‰}$ ) in summer and fall.

### 1002 Larga Seal Long Term Population Dynamics on the Russian Side of the Sea of Japan

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Long-term monitoring of larga seal (*Phoca largha*) was conducted from 1958 to 2013 in Sikhote -Alin Biosphere Reserve (SABR) and Lazovsky State Nature Reserve (LR). Results include 1253 and 478 visual observations of seals from SABR and LR respectively. The coordinates of each sighting was mapped using the program Arc View GIS 3.2a. We constructed 2 maps representing the 2 protected areas. Weekly surveys were conducted on haul-out sites irrespective of weather, and surveys by boat were carried out in summer. The larga population dynamics (1986-2000) shows that maximum numbers occurred in November and minimum in June. The use of remote cameras placed on haul-out sites of larga seal provided year-round monitoring of seal numbers. Five Bushnell Trophy Cam digital camera-traps were placed on two islands and two coastal seal haul-out sites of the Sea of Japan. Camera-traps were programmed to scan seal habitat every 30 minutes during daylight hours and photographs were used to count the number of seals present at each site. Over a 2-year period and 1432 camera-traps days, seals were absent on 639 days and present during 793 days. Results show 2 seal population peaks occurring in May and November and corresponding with spring larga

concentrations during migration to the north in Tatar Strait and autumn-winter concentrations when seals move to south in Peter the Great Bay.

### **1003 A Versatile Method of Risk Evaluation Based on the Future Predictions for the Various Narrow-Ridged Finless Porpoise Populations**

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Narrow-ridged finless porpoise (*Neophocaena asiaorientalis sunameri*) is a small toothed whale inhabiting the coastal waters in East Asia. Although the porpoise can be critically affected by various human activities, no quantitative risk evaluation based on the future predictions has been conducted for most populations. In this study, we proposed a versatile method for evaluating the human-induced impacts on various populations whose biological information is limited. According to the criteria in the IUCN Red List for threatened species, the future risk was assessed under Criterion A4 (population size reduction) and Criterion E (extinction probability). We showed a simple procedure to predict the risk using the estimates of annual human-induced mortality rate and abundance, under the assumptions that the values of life history parameters are common among the populations and that the value of human-induced mortality rate is equal for all ages. Human-induced mortality rate can be estimated from the decreasing rate in abundance between two times, using a reported estimate of annual population growth rate. Estimates of abundance are available for most populations. As for Criterion A4, when the human-induced mortality rate is higher than 5.3, 6.0 or 7.7%/year, the population will decrease to 70, 50 or 20% after three generations, and will meet the “Vulnerable”, “Endangered” or “Critically Endangered” category, respectively. As for Criterion E, when the abundance is as small as 187 individuals and the human-induced mortality rate is higher than 7.3%/year, the extinction probability will exceed 10% within 100 years and the population will meet the “Vulnerable” classification.

## **Session 11: Invasive Species**

### **1101 High Reproductivity and Short Longevity in Norway Rats on Uninhabited Islands, Yururi-To and Moyururi-To in Hokkaido**

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We analyzed body mass, reproductivity, longevity, and food habit in Norway rats (*Rattus norvegicus*) on two islands, Yururi-to (168 ha) and Moyururi-to (31 ha) in the subarctic climate zone in Hokkaido. The data were combined as those of Yururi-Moyururi-to, and compared with those of rats from Hahajima Islands in the subtropical climate zone. Body weights of 3 month-old rats (estimated from eye-lens weight), for example, on Yururi-Moyururi-to were nearly twice that of rats on Hahajima Islands. The age at which 50% of rats were sexually mature was 1.0 month old for the rats on Yururi-Moyururi-to, which was 9-10 months younger than that for the rats on Hahajima Islands. Rats on Yururi-Moyururi-to were 8.4 months old or less. Some of them were born under snow cover. Sixty percent of the rats from Hahajima Islands were 12 months old or more. The rats on Yururi-Moyururi-to preyed mainly on animal matter (av. 72.4% by volume) such as lepidopterous larvae and seabirds. Rats on Hahajima Islands fed mainly on plant matter (av. 95.2%). Active rats on the snow cover on

low vegetation were vulnerable to attacks from accipiters. Therefore, vegetation and snow cover seem to be one of the causes of the short longevity in Yururi-Moyururi-to. Dietary differences can be responsible for growth rates and sexual maturity in rats.

### **1102 Invasive Species in the United Arab Emirates: Challenges and Issues in a Hyper-Arid Climate**

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An assessment of terrestrial and freshwater invasive alien species (IAS) of the United Arab Emirates was conducted through various techniques such as a questionnaire, fieldwork data, networking with relevant professionals, and a detailed literature review. The results of the initial assessment show that there are 148 IAS recorded in the following eight major taxonomic groups: invertebrates 49 species, freshwater fish 5 species, amphibian 1 species, reptiles 6 species, birds 70 species, mammals 6 species and plants 11 species. There have been some initiatives to control IAS such as introduced ants and agricultural pests. Non-native freshwater fish have been controlled in freshwater wadi systems by chemical and mechanical methods. Avian alien species have been captured in traps and some alien trees have been physically removed. The challenges posed by a hyper-arid climate to IAS are discussed.

### **1103 Effects of Experimental Removals of an Invasive Competitor on Space Use of an Endangered Tree Squirrel**

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Invasive species comprise a major threat to isolated populations, but mechanisms of impact are not always clear. In the Pinaleño Mountains, Arizona, USA, introduced Abert's squirrels (*Sciurus aberti*) overlap in space use with endangered Mount Graham red squirrels (*Tamiasciurus hudsonicus grahamensis* [MGRS]), but extent and effects are unknown. We used experimental removals of Abert's squirrels, and space use measurements, to test hypotheses on impacts of syntopy with MGRS. We predicted if spatial overlap was high, post-removal space use would change. Radio-collared individuals were monitored in adjacent 100-ha treatment and control areas, 2011-2014. We euthanized Abert's squirrels in the treatment area, March-September 2012 and 2014. All MGRS home ranges were overlapped extensively by Abert's squirrels, and post-removal home ranges increased significantly in the treatment area but not in the control area in 2012. During 2013, treatment area MGRS home ranges decreased significantly as Abert's squirrels recolonized the area, but did not increase following removals in 2014; no significant changes occurred in control home ranges. Initial MGRS home range expansions may have resulted from a combination of sudden release from competition with the invasive squirrel and low MGRS population density during 2012. Higher 2013-2014 MGRS density may have limited the opportunity for a space use response to the second removal. Further analysis is required to untangle the complex interactions between these ecologically similar native and invasive species, and to determine how this study can provide new insight on invasive species effects.

#### **1104 Integrated Management of Invasive Cattails as Biofuel and a Wetland Management Strategy in the Northern Great Plains of the United States and Canada**

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On many public and private lands in the Great Plains region of northwest Minnesota, North Dakota, and Manitoba, cattail growth has far exceeded the 50:50 distribution recommended for optimum wetland wildlife habitat. Often the coverage of this mostly hybrid cattail (*Typha latifolia* X *T. angustifolia*) is over 90% and while a problem for wildlife, represents a substantial biofuel resource. In the 10 counties of northwest Minnesota, available biomass is estimated to be 18.5 M kg distributed on 38,000 hectares of natural and created wetlands assuming a 50% harvest rate. Cattail control using mowing, herbicides and burning methods is expensive and if harvest logistics can be improved along with the development of biofuel markets, management would become much more affordable. Cattails have been demonstrated to have energy values comparable to wood pellets at 17 MJ/Kg. Thus, cattails could be simultaneously managed for wetland wildlife, harvested for biofuel, generate carbon credits (at least in Canada), and serve as a partial substitute for fossil fuels to help mitigate climate change. Cattails may also extract phosphorous from runoff water in rivers feeding lakes and flood control impoundments that could be used for agricultural fertilizer; 20 to 60 kg of phosphorous have been removed per hectare of harvested cattails in Canada. Additionally, local rural economies could be boosted by harvesting a renewable energy resource, especially in states such as Minnesota which have no fossil fuels. Along with evaluation of harvesting techniques, responses of wetland wildlife to these management applications are being measured.

#### **1105 Seeking a Robust Approach to Manage Invasive Signal Crayfish in Japan**

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Although a strong cohesion between scientific researchers, regional stakeholders, and policy makers lies at the root of successful implementation of sustainable management practices for wildlife, only a limited numbers of studies have assessed the social concept of sustainability in relation to invasive species management. This is particularly challenging but necessary for aquatic invertebrates such as signal crayfish (*Pacifastacus leniusculus*), because of many uncertainties on ecosystem impacts. In this study, we assess social and environmental burdens of invasive crayfish management in Japan, and seek a robust approach in region-based sustainable management. Our study was based on a 10 year management scheme for controlling crayfish in Lake Toya, Hokkaido. We showed that community-based programs with a strong conceptual framework was a key for success of sustainable management of signal crayfish. We first adapted a volunteer monitoring program in 2005-2008; however, only a limited number of crayfish (i.e., 222 in 2005, 10,936 in 2008) were caught by volunteers. The Emergency Package of Employment Measures by the Government of Japan was implemented in 2009 for a contract of two to six employments for trapping crayfishes. As a result, we succeeded in reducing the population and reducing the average body size of signal crayfish in recent years. For example, 100,114 crayfish were trapped in 2011. The average body weight of a crayfish declined from 28.3 g in 2009 to 24.9 g in 2013. Our study also demonstrated that

the incorporation of stakeholders into future research and invasive species awareness education and administrative supports are essential for successful control of invasive signal crayfish.

## Session 12: Population Genetics

### 1201 Molecular Phylogeography of the Japanese Weasel, *Mustela itatsi*, and Siberian Weasel, *M. sibirica*, Revealed by Complete Mitochondrial DNA Sequences

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To further elucidate the divergence process of mammalian species endemic to continental islands and their relationships to the closely related continental ones, we determined the complete mitochondrial DNA (mtDNA) sequences on the endemic Japanese weasel *Mustela itatsi* with the closely related Siberian weasel *M. sibirica*, and are investigating the molecular phylogeography of both species. The Japanese weasel is endemic to the Japanese main islands, including Honshu, Shikoku and Kyushu, excluding Hokkaido Island, whereas the Siberian weasel is distributed in the continental China, Taiwan, throughout Russia (from Urals to Far East) and a remote island Tshushima in Japan. In this study, 27 Japanese weasels were analyzed, covering the species distribution, together with 19 Siberian weasels from the distribution of Tshushima Island, Taiwan and the Eurasian Continent. The previous study of the mtDNA control region reported that two main clades geographically separated were identified from *M. itatsi*, and four clades were from *M. sibirica* with the lower genetic divergence than the former. In the present study, we would like to examine the precise phylogeographic status within each species using genetic information of complete mtDNA sequences. In addition, the application of the abundant genetic data will be able to make possible to deeply re-examine the divergence time between the two species, which was reported to be about 1.7 million years ago based on the mtDNA control region data. Our study could provide insights to understanding the migration history, speciation, and diversification of the endemic species and closely related species.

### 1202 Population Genetic Status of Invading Species in Japan

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Invading mammalian species often become a major threat to endemism and biodiversity. To investigate processes of invasion and to evaluate possible genetic influences on endemic species, we carried out case studies on three invading species that are rapidly expanding their distribution in Japan: wild pig (*Sus scrofa*), sika deer (*Cervus nippon*) and mongoose (*Herpestes javanicus*). Using mitochondrial DNA (mtDNA) and nuclear microsatellite DNA (msDNA) markers, we detected a sign of gene introgression from European breeds of pigs to native populations of Asian wild boar in

southern Tohoku area. In the sika deer study, we used mtDNA marker to identify the source population of rapidly spreading sika deer in Yamagata. In the mongoose study, we used msDNA markers to compare changing patterns of census and genetic population sizes over 10 years on Amami-Oshima Island where a mongoose eradication program have been continued. We will discuss these results in the context of management of invasive species as well as usefulness and limitations of genetic approaches in the wildlife studies.

### **1203 Finding the Genetic Loci Associated with Tameness Using the Combination Method of Selective Breeding and Computer Simulation in Mice**

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Tameness is one of the major elements in domestication and defined as increased interaction of animals with human. To identify genes associated with tameness in mice (*Mus musculus*), we established a new method using wild-derived heterogeneous stock (WHS), which has high degree of genetic diversity because the stock derived from 8 wild strains originated from various geographic regions. The allele frequency associated with tameness should be increased significantly by selective breeding for tameness, and the loci can be identified by comparing with hypothetical allele frequency determined by computer simulation. At first we conducted selective breeding for tameness using WHS. Second, we obtained 16,328 single nucleotide polymorphism (SNP) data in the 8 founder strains of WHS and 32 WHS mice in both selection and control line. Third, using computer simulation based on non-selection model, we determined genome-wide thresholds ( $p=0.05$ ) for significant increase of allele frequency in each SNP. Finally we applied the threshold to observed data. As a result, approximately 3 Mb region on chromosome 7 was reached at the threshold in HMI/Ms strain, one of the founder strain of WHS, specific SNP of selection line although there is no genetic locus over the threshold in the control line. The data showed our method is useful to detect the selected locus. No strong candidate gene was so far found in the locus in Mouse Genomics Informatics database, suggested that unknown function of known genes or unknown elements such as enhancers including the candidate locus might be associated with tameness.

## **Session 13: Invasive Amphibians and Reptiles: Problems and Countermeasures**

### **1301 Frogs Native to Honshu but Invasive in Hokkaido?**

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Although amphibian diversity is high in Japan, only two native frogs, *Hyla japonica* and *Rana pirica* are inhabiting Hokkaido, the northernmost island of Japan. Five species of non-native frogs, *Lithobates catesbeianus*, *Bufo japonicus formosus*, *Pelophylax nigromaculatus*, *P. porosus* and *Glandirana rugosa* have established in the ecosystems of Hokkaido. Excluding *L. catesbeianus*, all other four non-native frogs are native to Honshu Island. One of the most significant impacts by invasive frogs on the ecosystem is known to be the predation impacts. However, these Honshu native frogs have not been considered as invasive species until recent years. Therefore, only few

studies are available on these species impacts. We assessed predation impacts of four non-native frogs in Hokkaido by examining index of relative importance (IRI). Despite low predation impacts on ground insects and spiders by native frogs, *B. japonicus formosus* and *G. rugosa* preyed strongly on ground insects in Hokkaido. *P. nigromaculatus*, *P. porosus* preyed on a variety of insects including odonata and hemiptera. Our study also indicated these non-native frogs preyed on threatened and endangered species. The high predation pressures caused by these non-native frogs may cause serious ecological damages to Hokkaido's ecosystem. The Invasive Alien Species Act regulate the breeding, transportation and releasing of invasive fauna and flora; however, there is nothing to regulate transportation of domestic species to other regions of Japan. It is urgent to promote adequate regulations and countermeasures to prevent further expansion of native frogs into Hokkaido.

### **1302 Cane Toad Invasions on the Ryukyu Islands, Japan: Conservation Actions and the Consequences of Each Invasion Stage**

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Invasive cane toad (*Bufo marinus*) was introduced to seven islands on Ryukyu Islands, Japan. The statuses of introduced individuals/populations vary between the islands: "recently detected but not established" on Yonaguni and Hateruma Islands, "prevented before establishment" on Iriomote Island, "established and abundant" on Minamidaito, Kitadaito and Ishigaki Islands, "near-eradicated" on Okinawa Island, and "eradicated" on Hatoma Island. Here, we introduce various actions associated with these invasion stages, particularly those of Iriomote and Okinawa Islands, where the conservation actions are coming to significant consequences. On Iriomote Island, 28 individuals have been observed since 1986. The early actions seem to succeed in preventing the toads from reproduction and there has been no observation for 10 years. Because absence data is accumulated monotonously in this program, it tends to become difficult to sustain public concern, motivation of staffs, and budget size. On Okinawa Island (Urasoe city), first individuals were detected in 2011 and around 700 individuals were captured by organizations concerned, including US Marine Corps and Ministry of the Environment, and local people. There is no observation record since December 2013. Based on the analysis of captured toads by US Marine Corps, the early action taken soon after the discovery of the first individual is likely to prevent toads from the second reproduction, making them nearly eradicated. A challenge is when to regard the toad population as "eradicated" based on the monitoring data. In both cases, beyond control stage, establishment of appropriate evaluation criteria, and promotion of awareness should be more prioritized.

### **1303 Feral Snakes of Okinawa-Jima, with Special Reference to the Status and Predicted Impact of *Elaphe taeniura* (Squamata: Colubridae)**

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Okinawa-jima is the largest island (ca. 1,200 km<sup>2</sup> in area; ca. 500 m in maximum height) of the Ryukyu Archipelago, southern Japan. Due to its fairly long isolation from adjacent land-masses, Okinawa-jima harbors many endemic organisms including a number of endangered vertebrates in

relict state. I first review exotic snakes recorded from this island. Except for species recorded on the basis of single individuals, such as *Dinodon rufozonatum walli*, *Elaphe carinata* and *Boiga irregularis*, and for one broadly prevailing human commensal *Ramphotyphlops braminus*, four species, *Elaphe taeniura* (Colubridae, non-venomous), *Naja kaouthia* (Elapidae, venomous), *Protobothrops elegans*, and *P. mucrosquamata* (both Viperidae, venomous) have been recorded, of which three (*Et*, *Pe* & *Pm*) are established as breeding colonies. Besides their harm to inhabitants through envenomation, the latter two species are concerned for their occasional hybridization with the native congener, *P. flavoviridis*, which may lead to change of genetic properties of the latter population through introgression. *Elaphe taeniura*, while being of much less concern for the impact on inhabitants' health, are concerned for predicted impact upon native biodiversity, because of almost complete absence of native predators for endemic endotherms with active wide-foraging tactics both during the daytime and night, and both on the ground and above trees. Diets, current geographic range, and genetic population structure of *E. taeniura* on Okinawa-jima, estimated from data from nearly 800 snakes collected during the past five years are presented. Already-attempted and future-desired approaches to the control and management for this snake, as well as those for *P. elegans* and *P. mucrosquamatus*, are also reviewed and discussed.

#### **1304 Ecological Impacts and Control of the Green Anole, an Invasive Alien Species on the Ogasawara Islands, Japan**

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The green anole *Anolis carolinensis*, an iguanid lizard native to North America, was introduced to the Ogasawara Islands in the 1960s. It now inhabits the whole areas of Chichijima and Hahajima at high population densities. It is recognized as an invasive alien species that has dramatically reduced the numbers of native insects on these two islands through predation. To prevent further impact, control programs have been implemented on both islands. On Chichijima, intensive captures have been conducted to lower the population density around the port so that the anoles will not be transported anthropogenically to islands that have not yet been invaded. On Hahajima, enclosure fences have been built around protected areas to restore the populations of forest insects inside. In 2013, however, green anoles were found for the first time on Anijima, near Chichijima. The anole's distribution area on the island was immediately determined and about 30,000 adhesive traps were set in that area. Simultaneously, enclosure fences (total length 3 km) were installed to prevent spread of the species. Currently, the distribution area of green anoles on Anijima is limited to 136 ha (17% of the island's total area) and the population is confirmed to be dense in an area of approximately 20 ha. Future challenges are to effectively reduce the number of anoles, then eradicate them and prevent another intrusion. Technical developments to address these problems are currently being promoted.



### **1305 Burmese Python in Everglades National Park, Florida**

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The Burmese python (*Python molurus bivittatus*) is a very large (up to 5+ m and 50+ kg) constrictor native to South Asia. It is now well established in South Florida, especially in the park and surrounding areas. Pythons have increased dramatically in both abundance and geographic range since 2000 and are known to consume a wide variety of mammals and birds. Concern has been voiced for many years as to the possible effect of this predation on a variety of threatened and endangered species. More recently, however, studies have suggested that python predation has resulted in an 85+ % decrease in almost all (previously) common medium-size mammals (1 to 10+ kg) in southern portions of Everglades National Park, raising concerns about populations of wading birds, American alligators, and other species known to be prey for pythons. How far will this python invasion spread? Considerable effort has been taken to attempt to project whether changing climate would in the future allow them to move farther north into the (now) temperate areas of North America, but there is little agreement on how best to interpret the results.

### **1306 The Diversity and Endemism of the Amphibian Chytrid Fungus in Japan**

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A serious disease of amphibians caused by the chytrid fungus *Batrachochytrium dendrobatidis* was first found in Japan in December 2006 in imported pet frogs. To inspect the origin and expansion process of the chytrid fungus in Japan, we surveyed the distribution and genetic variation of the fungus among captive and wild frog populations. We established a nested PCR assay that can amplify the internal transcribed spacer (ITS) region of a ribosomal RNA cassette to detect mild fungal infections from as little as 0.001 pg of *B. dendrobatidis* DNA. We collected swab samples from 559 captive amphibians, and more than 5,000 wild collected at field sites from all over Japan. We detected infections in native and exotic species, both in captivity and in the field. Sequencing of PCR products revealed much haplotype variation of the *B. dendrobatidis* ITS region. Phylogenetic analysis for the haplotypes showed that genetic diversity of Bd in Japan was higher than that in other countries. Furthermore, it was suggested that 3 of the haplotypes detected in Japan were specific to the Japanese giant salamander (*Andrias japonicus*) and appeared to have established a commensal relationship with this native amphibian. From these results, combined with no evidence of chytridiomycosis occurrence in the Japanese native species, we considered that the chytrid fungus is native in Japan. To improve chytridiomycosis risk management in the world, we must monitor and control the amphibian trade between the countries.

## Session 14: Towards Sustainable, Knowledge-Based Cormorant Management: Combining Learning and Experiences from North America, Europe, and Japan

### 1401 Towards Sustainable, Knowledge-Based Cormorant Management: Combining Learning and Experiences from North America, Europe, and Japan

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Great Cormorants (*Phalacrocorax carbo*) and Double-crested Cormorants (*P. auritus*) have increased dramatically in North America, Europe, and Japan in recent decades. These changes have brought the birds into conflict with both commercial and recreational fisheries (and, occasionally, other natural resources such as forestry) with accompanying demands for population-level management. The ecology of these two cormorant species and changes in their populations and distributions are similar in the three regions. Historically, cormorants were abundant and widespread, but declined dramatically due to various anthropogenic factors. Recent recoveries and expansions of cormorant populations should be understood in this context, as well as present discussions about suitable management approaches for resolving cormorant-fisheries conflicts. In contrast to similarities in cormorant ecology, the type of fish targeted and fisheries affected by cormorants are different among regions. The magnitude of conflicts and perceptions of cormorants are different among fisheries and between breeding and wintering areas. Moreover, the legal or governmental systems that pertain to cormorant management are different among regions/nations, and often result in conflicts between resource management agencies and stake-holders in the different regions. In order to reduce conflict, it is important to establish an international network of scientists and managers to monitor cormorants, discuss the state of scientific knowledge of cormorant-fisheries conflicts, and plan integrative management approaches, where necessary, both within and among regions. Future challenges will be to implement integrated management plans in each region by coordinating local management initiatives suitable for each locale according to its characteristics, history, and the ultimate management aims.

### 1402 The History of Population Dynamics and Monitoring Methods for the Great Cormorant in Japan

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Great Cormorant is a native species in Japan and historically common and familiar to the Japanese. However, the number of cormorants declined to only 3,000 individuals by the end of the 1970s, followed by a rapid increase after the early 1990s. This recovery has led to growing conflicts between cormorants and inland fisheries. In the Kanto region of central Japan, the numbers of cormorants have doubled from 10,000 in 1994 to 20,000 in 2014, and the number of roost sites has increased eight-fold from 10 to 80 in the same time period. This means that several large roosts or colonies have dispersed to many smaller ones during this period. The number of cormorants keeps

growing and spilling into surrounding regions, causing greater and more frequent conflicts between cormorants and fisheries.

Monitoring efforts conducted by researchers with the help of volunteers have been crucial in revealing the results described above. The Wild Bird Society of Japan, sponsored by the Tokyo Metropolis, started a monitoring program of the cormorants in the roosts and colonies in Kanto region in 1994. Since 2004, the Japan Bird Research Association has taken over this research project. Cormorant counts are now organized three times a year, and efforts have spread to Chubu and Kansai regions of Japan, for broader data collection and scientific understanding of the birds' population dynamics. Building a system of long-term bird monitoring with the cooperation of local authorities, government, and researchers is necessary in order to promote adaptive and knowledge-based management of cormorants.

#### **1403 Historical Background to the Relationship between Freshwater Fisheries and the Great Cormorant in Japan**

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More than ten million years have passed since the ayu (*Plecoglossus altivelis*) has appeared in the proto-archipelago of Japan. This fish has a smelt-like appearance and grazes algae attached to the riverbed in running waters. The introduction of rice cultivation from the continent to Japan occurred about three thousand years ago and the reclamation of flood plains into rice-paddy fields subsequently spread throughout the country. During the early phases of rice cultivation, many ancestral farmers presumably had difficulty in obtaining sufficient protein-rich foods to accompany the rice, although freshwater fishes were abundant in neighboring streams. The Great Cormorant (*Phalacrocorax carbo*) is a predatory bird adept at catching fishes even in swift streams. Archaeological evidence suggests that villagers at that time used cormorants to catch fish, including ayu. Later, human-cormorant relationship developed into ingenious fishery methods commonly known as 'cormorant fishing' ("U-kai" in Japanese) performed by professional fishermen. As every Japanese knows, ayu is much prized for the table because of the delicacy in flavor. However, the recent prevalence of "Tomodsuri" fishing (a method of rod-and-line fishing) to catch ayu has attracted amateur anglers and much of the fishery has become a recreational/sports one. Today cormorants seem to have learned that the majority of people (except some fishermen) are not concerned with them, and this may have contributed to their successful expansion into urban foraging areas.

#### **1404 Cormorant Conflicts and Management in Japanese Inland Fisheries**

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Ayu *Plecoglossus altivelis* is one of the most popular species for commercial and recreational fisheries in Japan. Each spring, ayu migrate from the sea into rivers. At the same time, hatchery-reared ayu are also stocked in most river basins. However, spring coincides with the breeding season of cormorants, and this gives rise to local conflicts. The staff of fishery co-operative associations commonly try to scare cormorants away from stock release-sites, for example by using exploding rockets, stringing lines, and through human patrols. In addition to these measures, a technique for removing newly established roosts and breeding colonies was developed in the Yamanashi Prefecture through the use of plastic tape, thus managing the location and the number of colonies

and roosts. Plastic tapes are hung up in trees where the wind causes them to produce vibratory motion and sound. The number of colonies and roosts at this location has been kept at only one. In addition to preventing further roost and colony establishment, efforts have been made since 2005 to reduce the fledging success of cormorants within the tree-nesting colony. From 2006 to 2014, eggs in almost all clutches were replaced with fake eggs made of gypsum, or were frozen using dry ice. This resulted in a reduction in fledging success as well as a 30% decline in the number of breeding birds from 2005 to 2007 and numbers have stayed low in the years following 2007.

#### **1405 Sharpshooting Can Reduce Cormorant Conflicts: Successful Cases in Japan**

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It was once thought that shooting could not reduce cormorants in number and population control was inappropriate for the species. However, a science-based control by “sharpshooting”, systematical removal by a small team of professionals with highly specialized skills (cullers), proved that the effective management of cormorant populations was achievable.

In the Lake Biwa and the surrounding rivers in Shiga Prefecture, Great Cormorants cause serious damage to fisheries as well as to ecosystems of their colonies including vegetation destruction and soil erosion.

Despite various damage controls, both the cormorant population and the damage kept increasing. We conducted large-scale cormorant removal as a public project under the Fisheries Management Division of Shiga Prefecture. We removed 50,405 birds during 147-day operations, with two or three cullers a day (a total of 330 man-days), in two main colonies (the Chikubu-shima Island and the Isaki Peninsula) in the six breeding seasons of 2009-2014. As a result, the cormorant populations in Shiga in the early (May) and late (September) breeding season decreased from 37,066 (2008) to 8,429 (2014) and from 74,688 (2008) to 6,495 (2014), respectively.

In conjunction with this decline, the fishery damage was reduced and the damaged ecosystem was restored. Due to this, fewer people now are of the opinion that cormorants should be exterminated. The locals who suffer from cormorants have begun to think that they could live with the birds if moderate in numbers. The large-scale removal by sharpshooting is realizing the goal of coexisting with cormorants, which we should aim at.

#### **1406 Population Dynamics and the ‘Management System’ for the Great Cormorant in Europe**

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Only 3,500-4,300 pairs of European Great Cormorants *Phalacrocorax carbo sinensis* bred in a core area (Netherlands, Germany, Denmark, Sweden, Poland) by the early-1960s. Through protection and

high prey availability, numbers had reached 95,000 pairs here by 1995. Simultaneously, the population extended into central Europe and the Baltic Sea, returning to areas where it had been extinct for a century or more. By 2006 numbers across 'all' Europe had reached approximately 219,400 pairs. This count is compared with a subsequent one in 2012, plus complete winter counts in 2003 and 2013, to describe the Cormorant's current status and distribution. Cormorants are accused of damaging fisheries, aquaculture and angling activities, resulting in intense 'human:wildlife' conflicts. Investigations have highlighted the role of socio-cultural issues in these conflicts and their management within legal frameworks and shown that the positions taken often differ between groups (e.g. local stakeholders, policy-advisors, ecologists) and are influenced by people's values, attitudes, experiences and beliefs. Cormorants are protected under the Birds Directive (2009/147/EC) and deliberate killing or disturbance is only allowed by EU Member States under licence. As well as diverse site-specific management actions, some 10,000 nests were reported destroyed and over 75,000 birds killed annually in the non-breeding season (2006-07). The Cormorant 'management system' is thus a complex issue in Europe where conflicts are as much a matter of human interests as they are of biology. Continued integrated interdisciplinary scientific research (biological, social, economic) is needed to develop any sustainable form of collaborative management for Cormorant-fisheries conflicts across Europe.

#### **1407 Population Dynamics and the Management of the Eastern and Central North America Population of the Double-Crested Cormorant**

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During much of the twentieth century, Double-crested Cormorants (DCCOs) existed in marginalized numbers across North America. In the 1970s, DCCOs attained federal protection in the US and greater provincial protection in Canada; concurrently legislation was introduced to reduce contaminants in aquatic environments. These changes facilitated population recovery, and numbers increased dramatically and expanded in breeding and wintering areas where DCCOs had long been absent or undocumented. In the late-1990s, the number of breeding pairs in the central (Interior) and Atlantic regions was estimated at > 257,000. As numbers increased, concerns developed over potential impacts to various resources and led to the establishment of US federal regulations for cormorant management (1998, 2003) for states east of the continental divide. In Canada, management developed under individual provincial policies during mostly the same time period. By 2012, management under US and Canadian regulations resulted in the destruction of more than 576,000 DCCOs, and hundreds of thousands of eggs and nests. Most management occurred in the US, accounting for 85% of birds killed, and was largely undertaken to benefit aquaculture and sport fisheries interests.

Although lethal methods are frequently employed in the US, science-based evidence is not required for management decisions. Review of management programs under US regulations indicates that social values, assumptions and beliefs about cormorants, rather than knowledge of impacts, frequently drives management decisions. Moreover, key uncertainties and root causes to conflicts remain unaddressed, and therefore most management under this model does not lead to knowledge-based solutions or represent sound environmental policy.

#### **1408 Population Dynamics and Management of the Western North America Population of the Double-Crested Cormorant**

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Double-crested Cormorants (*Phalacrocorax auritus*) are a native migratory bird in North America that increased during the last quarter of the 20<sup>th</sup> Century following protection under the Migratory Bird Treaty Act and banning of the pesticide DDT. Two distinct populations of Double-crested Cormorants occur in the conterminous U.S. and southern Canada, and meet at the Continental Divide. The latest estimate of the size of the western North America population is 31,200 breeding pairs, about 70% of which nest along the west coast of North America. The western population is less than one-tenth the size of the eastern/central North America population. Since 2003 the eastern/central population has been subjected to widespread lethal culling, whereas the western population remained protected. Protections for the western population are in transition, however, as U.S. federal government agencies intend to cull about 42% of the breeding colony on East Sand Island at the mouth of the Columbia River. This colony includes about 40% of the western population; thus, the proposed cull of 11,000 cormorants represents about 15% of the western population. The rationale for this population-reducing cull is to reduce consumption of juvenile salmonids (*Oncorhynchus* spp.), many of which are listed as threatened under the U.S. Endangered Species Act. While the need for management of the East Sand Island colony has a scientific foundation, the federal government's selection of a lethal management alternative appears an extension of management policies that have become entrenched in the last decade across eastern/central U.S., relying on large-scale culling of Double-crested Cormorants.

#### **1409 Novel Non-Lethal Approaches to Managing Cormorant-Fisheries Conflicts in Western North America**

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Fisheries managers in western North America are concerned about impacts of predation by Double-crested Cormorants (*Phalacrocorax auritus*) on juvenile salmonids (*Oncorhynchus* spp.) and other fish of conservation concern. Management to reduce the size of the large cormorant breeding colony on East Sand Island in the Columbia River estuary is currently planned. To help inform management, we conducted feasibility studies of non-destructive techniques for managing this cormorant-fisheries conflict: (1) non-lethal methods to reduce the size of the cormorant colony and (2) habitat enhancement and social attraction to restore or enhance alternative cormorant colonies. We tested the combination of on-colony privacy fences and human hazing to reduce the area of available nesting habitat without causing colony abandonment. The area of nesting habitat was reduced by 75% and moved a short distance without causing colony abandonment or impacting nesting success. Habitat enhancement and social attraction (decoys and audio playback systems) at previously unoccupied plots adjacent to the colony were quickly colonized and young successfully raised. Cormorants were also attracted to nest and raised young on similar plots at two islands ca. 25 km from East Sand Island, one with a history of successful nesting and the other with a history of

unsuccessful nesting attempt. Our results suggest that nonlethal dissuasion of nesting cormorants and concurrent attraction of cormorants to nest at alternative sites where cormorant-fisheries conflicts are unlikely could be effective in redistributing cormorants away from areas where fish stocks of conservation concern are susceptible to cormorant predation, thereby resolving some cormorant-fisheries conflicts.

## Session 15: International and Collaborative Approaches to Lagomorph Conservation in a Changing World

### 1501 Landscape Connectivity and Population Viability of Swamp Rabbits: Conservation of a Habitat Generalist at the Range Edge

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Swamp rabbits (*Sylvilagus aquaticus*) in southern Illinois exist as a metapopulation due to loss and fragmentation of the bottomland hardwood forests in which they live, making their persistence at the northern edge of their range uncertain. During 2007-2012, we conducted 2 major sets of analyses [population viability analysis (PVA) and genetics] to assess landscape connectivity and future population trends for swamp rabbits in southern Illinois. Tissue from trapped swamp rabbits and fecal pellets were collected and microsatellite genetic markers were analyzed. Significant genetic structure was observed in swamp rabbits; such structuring suggests swamp rabbits in the northernmost part of their range experience low habitat connectivity. Gene flow was negatively impacted by highway barriers, which may interrupt swamp rabbit dispersal due to their avoidance of roads or otherwise unsuitable habitat. We also used a PVA to estimate the probability of persistence of the swamp rabbit metapopulation in southern Illinois. The model suggested a 0% chance of quasi-extinction of swamp rabbits within 50 years. Changes in fecundity and the effects of catastrophic flooding had the greatest effect on extinction risk, and changes in no other parameter yielded any appreciable impact. Removing the largest patches from the population increased the risk of extinction to 4%, whereas any other habitat modifications did not change extinction risk. We suggest that managers focus on sustaining habitat quality, particularly roadless, upland habitats adjacent to occupied bottomland hardwood forests, to improve the likelihood of swamp rabbit persistence at the fringe of their range.

### 1502 Use of Constructed Burrows by New England Cottontail Rabbits

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The New England cottontail (NEC; *Sylvilagus transitionalis*) is a medium sized rabbit native to northeastern United States, and is threatened by large scale habitat changes. Conservation efforts are likely to have positive effects in the long-term, but near-term solutions to population declines are needed. Little is known about NEC use of burrows other than anecdotes of animals going to ground when pursued. Therefore, burrow availability might affect habitat quality. We constructed three burrows during 2013 in a Maine, USA, population to assess burrow use by NEC. Burrows were monitored with remote cameras to document NEC and predator approaches, enters, and exits. New England cottontails appeared to use burrows, but not for long durations. Rabbits entered all burrows

within two months of construction. Initial rates of predator approaches were decreased by further camouflaging burrows with brush. NEC interacted with burrows on average once per week (every  $7.23 \pm 1.24$  d) over 16 months. Interactions were over-dispersed in time, and were more frequent in fall ( $0.17 \pm 0.05$  /d) and winter months ( $0.15 \pm 0.04$ ) than in spring ( $0.10 \pm 0.03$ ) and summer months ( $0.04 \pm 0.02$ ). Sensors in two burrows revealed a 5°C temperature advantage to burrow use during winter. Rabbits entered or exited burrows 60 times, although detection was imperfect. Ten of fourteen events interpreted from images as burrow occupancy were < 10 min in duration (range: 1 min to 19 h). Ongoing work will more accurately estimate burrow occupancy, and will assess the population-level effects of burrow availability.

### **1503 The Influence of Invasive Species on Habitat Use and Dispersal of the New England Cottontail, an Imperiled Endemic Lagomorph in a Human-Dominated Landscape**

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Historically common throughout the northeastern United States, the New England cottontail (NEC, *Sylvilagus transitionalis*) has experienced range-wide declines. This decline has prompted the United States Fish and Wildlife Service to consider the NEC for listing under the Endangered Species Act. Programs throughout the northeast U.S. have been instated to restore early successional forest, with the goal of increasing NEC populations in the region. However, a better understanding of dispersal capabilities and seasonal habitat use is necessary to ensure restored habitat patches are successfully colonized by NEC. Using radio telemetry, dispersal, seasonal home range, and habitat composition were examined for adult and juvenile NEC in the lower Hudson Valley, New York in relation to the presence of non-native eastern cottontails (*Sylvilagus floridanus*) and invasive vegetation. The maximum observed dispersal distance of a NEC in our study was approximately 1 km. However, NEC more frequently dispersed small distances (<300 m) through suitable habitat, suggesting habitat restoration efforts should be conducted in close proximity to known NEC populations to be maximally effective. Home ranges of NEC included both native and invasive vegetation patches when present, and were largest in sites dominated by native vegetation. We also noted a seasonal shift in core home range from dense shrubland during winter to grassland and young shrubland during summer. These results suggest young shrubland and grassland might be important summer habitat components for NEC when in close proximity to suitable overwintering habitat, and NEC management strategies should be devised accordingly.

### **1504 The Effect of an Introduced Competitor and Non-Native Forage Plants on Parasites and Body Condition of the New England Cottontail in Fragmented Habitat**

**Sadie Ryan**<sup>1</sup>, Emily Gavard<sup>2</sup>, Jonathan Cohen<sup>2</sup>, Amanda Cheeseman<sup>3</sup>, Christopher Whipps<sup>3</sup>, <sup>1</sup>University of Florida, Gainesville, FL, <sup>2</sup>SUNY ESF, Syracuse, NY, <sup>3</sup>SUNY-ESF, Syracuse, NY, Contact: sjryan@epi.ufl.edu

Once common throughout its native range, the New England cottontail (NEC, *Sylvilagus transitionalis*) is a candidate for listing under the Endangered Species Act, and is thus a focus of conservation management in its native range. This management will largely be enacted via habitat restoration, to promote early successional forest, and thus population recovery of NEC. In New York,



non-native eastern cottontails (EC, *Sylvilagus floridanus*) often co-occur with NEC, and appear to be more abundant, suggesting they may out-compete NEC. Our research examines several mechanisms of potential population regulating aspects of rabbit physiology that may confer competitive advantages to EC. We are exploring GI parasite burden and diversity, ectoparasite burden, diet (using histological analyses to ascertain cottontail use of invasive species), nutritional plane (via urinalysis), body condition, and hematocrit. Using a stratified habitat sampling design, we are able to explore landscapes where the species have been reported to co-occur, and occur independently. In addition, we have near-stratification of invasive and native vegetation species. In this talk, we report our initial findings after one full season of data collection and analyses. Due to sparse reporting of NEC parameters in the literature, we report a baseline for NEC hematocrit [41.48% (SE=0.96, n=29)], and a first survey of NEC GI parasites. While our sample size is limited, NEC appear to have higher hematocrit than EC, and parasite diversity is higher in EC than NEC, but the abundances of 13 (putative identified) GI parasites are markedly different between the species, which we discuss in context.

### **1505 Space Use in a Seasonal Environment: Antelope Jackrabbits in the Sonoran Desert**

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Knowledge of the basic ecology of small game species is crucial to understanding how animals use the landscape during a period of rapid and extreme changes due to human development and climate change. The antelope jackrabbit (*Lepus alleni*) is a large hare found in southern Arizona, USA and Mexico. Despite its large size and conspicuous presence on the desert landscape, little is known about the antelope jackrabbit. For this study, we tracked antelope jackrabbits across the Buenos Aires National Wildlife Refuge in southern Arizona across multiple seasons and years. Using data obtained from radio telemetry locations, we determined home range size and tracked seasonal movements of male and female animals. We used GIS to plot animal locations and overlay habitat layers to determine whether animals change their locations seasonally, possibly indicating a shift in habitat based on food or cover availability. Our results show male antelope jackrabbit home range size is smaller than female home range size and have not detected any significant seasonal movements. This study is the first to document the large but stable home range of antelope jackrabbits. This information will allow managers to more accurately anticipate seasonal antelope jackrabbit space use patterns within a unique and fragile arid environment.

### **1506 Ancient Introgression and Phylogenetic Relationships among Eastern Asian Hares**

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Eastern Asia (including China, Far Eastern Russia, Korea, and Japan) is one of the most species-rich areas for hares (genus *Lepus*), with more than six recognized species. Those species show different habitat preferences, such as forest and grassland from subtropical to arctic climates. We examined

phylogenetic relationships among four hare species (*L. timidus*, *L. mandshuricus*, *L. coreanus*, and *L. brachyurus*) from Russia, Korea and Japan using sequences of eight nuclear gene loci (*Mgf*, *Tg*, *Tshb*, *Sptbn1*, *Mc1r*, *Asip*, *Phka2*, and *Sry*) and *Cytb* of mtDNA, with database sequences of other populations and neighboring species (*L. capensis* and *L. sinensis*) in China. Phylogenetic analyses showed multiple introgression of nuclear and mitochondrial genes among continental hare species, suggesting reticulate evolution. An extreme case of introgression is observed in the *L. mandshuricus* complex (*L. mandshuricus* and *L. coreanus*), which has lost the original mtDNA lineage due to replacement by introgressed lineages from the northern species *L. timidus* and the southern species *L. sinensis*. In addition, *L. timidus* is shown to have undergone at least two large expansion events in northeastern Asia since the late Middle Pleistocene, causing recurrent introgression with some neighboring species in the continent. In contrast, no evidence of introgression across genomes to *L. timidus* in Sakhalin and Hokkaido exists, or of the participation of *L. brachyurus* in Japan in the reticulate evolution. Climatic changes during the Pleistocene promote the reticulate evolution among eastern Asian hare species on the continent, but long-term isolation on the marginal islands after colonization.

#### **1507 Recent Condition of Amami Rabbit *Pentalagus furnessi* and its Conservation Problems**

**Fumio Yamada**<sup>1</sup>, Yui Ito<sup>2</sup>, Kazumi Shionosaki<sup>3</sup>, Harutaka Watanabe<sup>4</sup>, Mariko Kimura<sup>2</sup>, <sup>1</sup>Forestry and Forest Products Research Institute, Tsukuba, Japan; <sup>2</sup>Amami Wildlife Center of the Ministry of the Environment, Amami, Japan; <sup>3</sup>Kyoto University, Kyoto, Japan; <sup>4</sup>Amami Wildlife Center of the Ministry of the Environment, Amagi, Japan. Contact: fumio@ffpri.affrc.go.jp

The Amami rabbit *Pentalagus furnessi* is thought to be phylogenetically primitive and has evolved in an insular environment without native mammalian predators. It is endemic to Amami-Oshima Island (island size=712km<sup>2</sup>) and Tokuno-Shima Island (248 km<sup>2</sup>) in Japan. Population size of the rabbit was estimated as ca. 5,000 in Amami-Oshima Island (habitat size=370 km<sup>2</sup>) and ca. 200 in Tokuno-Shima Island (30 km<sup>2</sup>) in 2004. The IUCN and Japanese government designated the Amami rabbit as the endangered species in 1986 and 1998, respectively. To understand population change and negative impacts on the rabbit in both islands, fecal pellet count censuses of the rabbit was investigated after 2006 and feral cat scat was analyzed after 2007. In Amami-Oshima Island, the rabbit population has been increasing, especially in the area where populations of the invasive mongoose *Herpestes aurpunctatus* has been reduced by a recent eradication campaign. Successful breeding of the rabbit estimated by juvenile fecal pellets also has increased on Amami-Oshima Island. On the other hand, in Tokuno-Shima Island, the rabbit population has been decreasing, especially in the south. Only a small number of Juvenile fecal pellets were observed. From the analysis of feral cat *Felis catus* scats (n=176), the rabbit (frequency of scats=0-16%) was recognized as one of principal prey items as well as other prey items (2 endangered rodents 8-43% and 1 non-native rodent 14-40%). Therefore, urgent control of feral cats and management of house cats in both islands is necessary to avoid extinction of the Amami rabbit and other endangered species.

## Session 16: Biodiversity Conservation Using Blakiston's Fish Owl and Red-Crowned Crane as Umbrella Species

### 1601 Frontier of Field Research for Conservation of Blakiston's Fish Owl

**Takenaka Takeshi**, Fish Owl Institute, Sapporo, Japan. Contact: fishowl.takenaka@nifty.com

Due to their nocturnal ecology, population loss, and their endangered status, ecological research of the Blakiston's Fish Owl (*Ketupa blakistoni*) has been both difficult and limited. However, despite the success of conservation programs and population recovery, more ecological information is required for future conservation strategies. Nest camera surveys revealed a variety of food sources of which the main elements are fluvial fish and frogs. Some owl pairs living near the coast hunted marine fish and inland owl pairs primarily consume sculpin (*Cottus nozawae*). Each pair adapts to the food resources available in its habitat. GPS logging is a powerful tool in the understanding of the Fish Owl's nocturnal ecology. It has revealed not only the territory size and habitat usage but also aggressive activities such as intrusion into the territories of adjacent owls. DNA marker analysis has contributed to the identification of individuals and has revealed that frequent mate change occurs in high population density areas. These results suggest that dispersal stagnation and increased competition might occur as a result of habitat shortage and environmental barriers to dispersal of young owls. Habitat restoration and creation of physical connections between regional populations will be most important in future conservation efforts.

### 1602 Breeding Status of Red-Crowned Crane in Hokkaido: Comparison with the Russian Far East

**Masatomi Yoshiyuki**, Red-crowned Crane Conservancy, Kushiro, Japan. Contact: tome@sea.plala.or.jp

There are two isolated populations of *Grus japonensis* (Japanese or Red-crowned Cranes) in northeastern Asia : a Japanese resident population in Hokkaido, and a continental population migrating from the Amur River basin to the Korean Peninsula and the east coast of China. Although the Japanese population faced a crisis of extinction in the late 19th century due to hunting and habitat destruction, the number of cranes has increased to about 1,450 in 2014, primarily due to artificial feeding in winter. Along with this population growth, however, death by traffic accidents is recently increasing, and population sizes are approaching carrying capacities in both breeding and wintering habitats. Therefore, it is important to verify the species' breeding status for sustainable conservation of the population. In the spring of 2014, we performed aerial surveys on the breeding status of the species in Kushiro Marsh in Japan (KMJ) and the southeast marsh around Khanka Lake in Russia (KLR). As a result, 53 breeding pairs were found in KMJ, and 45 pairs in KLR. The area of KMJ was about 210km<sup>2</sup> and that of KLR was estimated at 590km<sup>2</sup>. Therefore, the density of breeding pairs in KMJ was more than triple to that in KLR. This difference in density is probably due to environmental factors such as vegetation, food availability and/or topography. Moreover, with the use of vegetation maps and data of nesting location of Red-crowned Crane, nesting habitat suitability in Hokkaido was estimated by geographical information system (GIS).

**1603 Historical Changes of Genetic Diversity in the Blakiston's Fish Owl and Red-Crowned Crane Populations on Hokkaido**

**Ryuichi Masuda**, Hokkaido University, Sapporo, Japan. Contact: masudary@mail.sci.hokudai.ac.jp

Quantifying the genetic variation in wild populations is essential to establish the conservation action plan. Two highly endangered birds, the Blakiston's fish owl (*Bubo blakistoni*) and red-crowned crane (*Grus japonensis*), have undergone remarkable population reduction on Hokkaido, Japan, during the last few decades mainly due to human activities. The conservation efforts have been resulting in gradual recovery of their populations, but the risk of extinction is considered to be still high because of the loss of adaptive genetic variation and the inbreeding depression. Our recent genetic studies using mitochondrial DNA sequences, microsatellite makers, and major histocompatibility complex (MHC) genes revealed contemporary and past status of genetic variation in the Hokkaido populations of the Blakiston's fish owl and red-crowned crane. In this presentation, I show our research results, and discuss how the past population reduction affected the genetic diversity and population genetic structure in the two bird species, and what should be done in the future conservation activities.

**1604 Assessing Blakiston's Fish Owl and Red-Crowned Crane as Biodiversity Surrogates Using Large-Scale Citizen Data**

**Koizumi Itsuro**<sup>1</sup>, Motoki Higa<sup>2</sup>, Yuichi Yamaura<sup>3</sup>, Masayuki Senzaki<sup>1</sup>, Yuki Yabuhara<sup>1</sup>, Satoru Ono<sup>4</sup>, Takeshi Takenaka<sup>5</sup>, Yoshiyuki Masatomi<sup>6</sup>, Kunikazu Momose<sup>6</sup>, <sup>1</sup>Hokkaido University, Sapporo, Japan; <sup>2</sup>Kochi University, Kochi, Japan; <sup>3</sup>Forestry and Forest Products Research Institute, Tsukuba, Japan; <sup>5</sup>Hokkaido Research Organization, Sapporo, Japan; <sup>5</sup>Fish owl Institute, Sapporo, Japan; <sup>6</sup>Red-crowned Crane Conservancy, Kushiro, Japan. Contact: itsuro@ees.hokudai.ac.jp

Charismatic megafauna have been used as icons and financial drivers of conservation efforts worldwide. If they can also function as useful surrogate species, conservation of both megafauna and biodiversity in general might be mutually enhanced. However, tests of this premise have been constrained by data limitation, especially at large scales. Here we overcome this problem by combining large-scale citizen-sourced data with intensive expert observations of two endangered charismatic species, Blakiston's fish owl (forest specialist) and the red-crowned crane (wetland specialist). Owl and crane breeding sites had higher forest and grassland/wetland bird species richness, respectively. However, this surrogacy was only valid at smaller scales (1-2-km resolutions), nearly equivalent to the charismatic species' home range sizes. We suggest that the agreement of surrogate species functional scale and broader biodiversity is essential to successful surrogacy, and that specialist charismatic species can contribute to biodiversity conservation.

## 1605 Possibility of Habitat Restoration Associated with Future Land-Use Change in Hokkaido

**Nakamura Futoshi**<sup>1</sup>, Junko Morimoto<sup>1</sup>, Hiroaki Kakizawa<sup>1</sup>, Hiroshi Higashiyama<sup>2</sup>, Masami Kaneko<sup>3</sup>, Motoki Higa<sup>4</sup>, Yoshiko Kobayashi<sup>1</sup>, Chiaki Yoshii<sup>1</sup>, Masatoshi Shibata<sup>1</sup>, <sup>1</sup>Hokkaido University, Sapporo, Japan; <sup>2</sup>Hokkaido University, Sapporo, Japan; <sup>3</sup>Rakuno Gakuen University, Ebetsu, Japan; <sup>4</sup>Kochi University, Kochi, Japan. Contact: nakaf@for.agr.hokudai.ac.jp

We predicted future habitat changes of Blakiston's fish owl (*Ketupa blakistoni blakistoni*) and red-crowned crane (*Grus japonensis*) associated with the abandonment of current land use activities. The land abandonment was regulated originally by the extent of agricultural area, slope of land, and soil productivity between 1976 and 1997, but thereafter density of human population became one of the main drivers that initiate land abandonment. We predicted how fish owls and cranes increase their populations and expand their territories together with land-abandonment. The results indicated that preservation and restoration of riparian forests are key activities to provide migration routes and nesting sites for fish owl. Moreover, breeding success rate of fish owls can be increased if food resources such as fishes and amphibians are abundant in streams and lakes. Rehabilitation of stream environment and modification of check dams may increase prey abundance and thereby breeding success. The restoration of wetlands after the agricultural land abandonment at a larger extent will be an important strategies to provide healthy habitat for cranes. These wetlands may provide various ecosystem functions such as flood control, improvement of water quality and provision of recreational opportunities. Furthermore, we propose alternative conservation plans for the two species, to ensure social acceptance by local communities.

## Session 18: Colonization History of Commensal Small Mammals (House Shrews, House Mice and Black Rats) and Human Impact on Their Distribution Expansion

### 1801 Beginning Speech

**Ohdachi Satoshi**, Hokkaido University, Sapporo, Japan. Contact: ohd@pop.lowtem.hokudai.ac.jp

Comparing to wild large mammals, less researchers pay their attentions to commensal small mammals. However, these commensal animals are important objects to investigate the relationship between animals and humans. In addition, commensal small mammals sometimes transmit serious diseases to humans. Thus, revealing natural history of the commensal mammals benefits study of human history and human society. The main purpose is to provide up-to-date information of the colonization history of three commensal small mammals, house shrews, house mice, and black rats, and discuss the relationship of their movement and human activities. We wish more researchers were interested in small commensal mammals after attending this symposium.

### 1802 General Introduction with a Special Reference to House Shrew Colonization

**Oda Sen-ichi**, former professor at Okayama University of Science and Nagoya University, Okayama, Japan. Contact: oda@zool.ous.ac.jp

Commensal small mammals such as the house shrew, house mouse, and black rat, colonized into a new region, accompanying with humans. The process of the colonization history of these animals fundamentally depends on human activities, such as trading, cultural transmission, human

movement, and even conquering other societies. In most cases, the commensal small mammals are unintentionally introduced by humans, although some rodents such as the Polynesian rats in several Pacific islands seems to be brought as foods, like large live stock animals. Therefore, usually the historical relationship between commensal small mammals and humans is not clarified, and thus it is difficult to infer the process of colonization of commensal animals. In such case, genetic and phylogenetic comparison of animals among regions could bring a deep insight to estimate the colonization history of the animals. Conventionally, we have used nucleotide sequence, karyological, and isozyme data to estimate the process of colonization and the period and route of the movement of animals. Now, genomic big data can be used for more precise estimation of colonization process of animals, but it has not generally used yet. Here, I demonstrate some example studies for colonization history of commensal animal, based on conventional genetic analyses in the house shrews.

### **1803 Realized and Fundamental Distribution of the Asian House Shrew; Examining the Historical Anthropogenic Effects**

**Murakami Masashi**, Chiba University, Chiba, Japan. Contact: muramasa@faculty.chiba-u.jp

Recently many organisms expand their distribution range by anthropogenic transfers both intentional and unintentional ways. These cause the problem of alien species all over the world. On the other hand, this phenomenon gives us a chance to examine how the organisms change their distribution by means of human activity in historical events. The Asian house shrew is a common mammal dwelling around human habitats. The original distribution area of this species is thought to be southern-eastern Asia, which expands from western-pacific islands to eastern-coast of Africa by the historical trade by human. In this study, the distribution range of this species was examined by the niche analysis with and without examining the history of human distribution and movements.

### **1804 Colonization History of the House Mouse *Mus musculus* in East Asia**

**Suzuki Hitoshi**, Hokkaido University, Sapporo, Japan. Contact: htsuzuki@ees.hokudai.ac.jp

Tracking the dispersal of the house mouse *Mus musculus* might give insight into the prehistoric movements of the humans that the mice accompanied. Construction of networks with the concatenate sequences of eight linked nuclear genes yielded three distinct clusters representing the three major subspecies groups: *M. m. castaneus* (CAS), *M. m. domesticus* (DOM), and *M. m. musculus* (MUS) and suggest the earlier onset of allopatric divergence in the predicted homeland (the Middle East and Indian subcontinent) and subsequent intermittent admixing via gene flow across CAS haplogroups and among the three subspecies groups. Both nuclear and mitochondrial sequences suggest that Southeast Asia and southern China are representative areas to which CAS expanded efficiently, associated with prehistoric human movement mediated. Population genetic analyses with available mitochondrial cytochrome *b* gene sequences suggest the past population expansion in MUS and CAS occur ca. 20,000 and 8,000 years ago, respectively. Notably, two areas of the continent, South China and the Korean Peninsula, are the possible primary source areas of Japanese wild mice, suggesting pre-historical introductions associated with certain historical agricultural developments in East Asia. Haplotype structuring analyses, surveying break points of recombination along a chromosome region focused, provides valuable temporal aspects of the secondary contact among different subspecies lineages dispersed. For example, in Japan the genetic

contact between CAS and MUS is estimated to have occurred ca. 1000 years ago. Although there are still many unresolved questions, it is time for us to cooperate for better understanding the evolutionary history of the East Asian mice.

#### **1805 Evolution of the Black Rat *Rattus rattus* Species Complex Based on Genomic Data**

**Aplin Ken**, United States National Museum, Smithsonian Institution, Washington D.C., DC, Contact: [aplin.ken@gmail.com](mailto:aplin.ken@gmail.com)

The 'Black Rat' (*Rattus rattus* sensu lato) is a notorious commensal pest, yet it also holds enormous promise for the study of speciation, hybrid interactions, and adaptation. Recent global sampling of mtDNA sequence diversity has revealed 12 major phyletic lineages (many with an associated, distinct Y-chromosome lineage), each seemingly native to a particular area within the broad region of South, Southeast and East Asia. Analysis of large numbers of nuclear gene loci for small numbers of representatives of major lineages supports the notion that the mtDNA lineages represent long-standing evolutionary units, either species or geographic isolates well on the way to speciation. Sampling at several contact zones within the inferred natural ranges, and in several areas where different mtDNA and Y lineages have been co-introduced historically, in each case revealed dissociated admixture of mtDNA and Y lineages, suggestive of introgression of these uniparental, non-recombining genomic elements. By contrast, microsatellite DNA profiling of the same populations failed to detect evidence of introgression. Instead, the microsat data suggest that the nuclear identity of each of the major Black Rat lineages is at least partly defended against introgression, presumably by post-zygotic incompatibilities. This possibility is being further investigated by several methods including RADseq analysis and gene capture methods of key populations, and full-genome sequencing of individuals drawn from across the native and introduced range of the Black Rat. The same datasets also offer genomic insights into the eco-physiological and behavioral adaptations that allowed black rats to colonize almost every part of the world.

#### **1806 General Comments towards Synthesis: Comparative Studies of Commensal Small Mammals**

**Stephen Donnellan**, South Australian Museum, Adelaide, Australia. Contact: [Steve.Donnellan@samuseum.sa.gov.au](mailto:Steve.Donnellan@samuseum.sa.gov.au)

The recent population, dispersal and genomic histories of three highly commensal small mammals - the House Mouse, the Black Rat, and the Asian House Shrew - can be scrutinized for answers to a series of key questions. Was it serendipity that saw each of these species enter the commensal niche or were they each somehow pre-adapted for this role? How has each species faced the challenge of maintaining ecological versatility/flexibility while undergoing repeated bottleneck events associated with long-range dispersal? What role has genetic admixture after multiple independent introductions played in maintaining genetic diversity and fitness? Satisfactory answers to these and other related questions are currently elusive but they should be forthcoming once large scale genomic datasets become available for each group. However, care will be needed to frame hypotheses in ways that allow for clear discrimination from alternatives, and to identify appropriate populations for critical testing of each hypothesis. Early consideration of these issues may help to

guide sample collection over coming years, and to ensure that opportunities to secure critical samples are not missed.

## Session 19: A Role of *Ex Situ* Conservation by Zoos and Aquariums: A Linking Bride with Public and Nature

### 1901 Polar Bear Conservation in Manitoba: Integration with Assiniboine Park Zoo

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Manitoba is home to one of the most accessible subpopulations of polar bears and as such the species is important to the Province in a number of ways (i.e., management, tourism, culture). The Western Hudson Bay subpopulation has also been extensively studied and the link between climate change and polar bear survival is well documented. These factors have led the Province to invest significant resources into the Assiniboine Park Zoo in order to leverage the educational and conservation possibilities that housing polar bears can provide. This investment has extended to making legislative changes relating to the management of wild polar bears, setting rigorous standards for the housing and husbandry of polar bears, and encouraging research on polar bears and zoo visitors. Legislative and regulatory changes have been made to allow for the rescue of polar bears that would normally die if not captured. At risk polar bears are primarily orphan cubs but can also include problem bears. Together the Province and the Zoo have built the International Polar Bear Conservation Centre (IPBCC) within a new Arctic themed exhibit (Journey to Churchill – J2C). The IPBCC houses research laboratories, educational space, and transition and quarantine areas. Rescued bears move from the IPBCC to J2C where the 4 hectare exhibit emotionally connects visitors to polar bears and then provides ways they can help reduce carbon emission – the cause of threats to polar bear habitat. The close collaboration between the Province and Assiniboine Park Zoo provides a novel and integrated approach to polar bear management and conservation.

### 1902 Importance of *Ex Situ* Conservation of Polar Bear and the Efforts of Japanese Zoos

Hiroki Ishibashi, Sapporo Maruyama Zoo, Sapporo, Japan. Contact: hiroki.ishibashi@city.sapporo.jp

It is known that population of wild polar bear has been declining because of decreasing the Arctic sea ice due to global climate change and marine pollution. Many researchers recognize the importance of *ex-situ* conservation supporting for *in-situ* conservation in their natural habitats. Zoos can play a key role in the management of threatened species that require the support of captive breeding for their survival. This presentation reviews the role of zoos and explains the efforts and what is required for contribution to polar bear conservation into the future. One of the roles of zoos for wildlife conservation is that many visitors can learn about them with strong impression moved by real animals alongside environmental education and research in their captive collections. Moreover, zoos have potential for recovery programs for endangered species including re-introduction based on the study of reproductive physiology and establishment of captive breeding techniques. However, how to keep animal collections becomes a big problem. For example, although breeding success rate of polar bears in Japanese zoos is improving in recent years, management of genetic sustainability of captive populations is still in severe. To play the potential role sustainably, it is necessary to keep the captive population with genetic diversity regionally as a part of global population.



It is vitally important for Japanese zoos to strengthen the cooperation with global zoo networks or foreign researchers and work together including animal exchange and establishment of captive breeding programs for contribution to worldwide conservation into the future.

### **1903 Ex Situ Conservation of Endangered Native Species**

**Hidemasa Hori**, Japanese Association of Zoos and Aquariums, Tokyo, Japan. Contact: hidemasa\_hori@tzps.or.jp

In Japan, traditional conservation planning and actions for the endangered native species have been mostly conducted in their wild habitats. Field researchers and wildlife managers monitor wild populations and develop conservation plans and actions to protect the species. However, the necessity of establishing the captive populations is recently increasing because they will play a role as the insurance to avoid complete extinction of the species. We, JAZA (Japanese Association of Zoos and Aquariums) and MOE (the Ministry Of Environment) have worked together to develop the captive management plan for Tsushima leopard cat (*Prionailurus bengalensis euptilurus*) and have intensively promoted their captive breeding since 2013. Meanwhile, we have developed the founders capture plan to establish captive population of Japanese rock ptarmigan (*Lagopus muta japonica*) with the cooperation of field researchers and zoo staffs. On May 22th, 2014 (UN the day of Biodiversity) we concluded the agreement on promoting the conservation of Biodiversity. Our activities based on the agreement will help bridging the gap between wild and captive population management.

### **1904 Conservation Activities for Japanese Giant Salamander by Hiroshima City Asa Zoological Park**

**Noriyuki Nonoue**, Yuki Taguchi, Hiroshima City Flora and Fauna Association, Hiroshima City, Japan. Contact: nonoue@asazoo.jp

Japanese giant salamander (*Andrias japonicus*, JGS) is one of the biggest amphibians in the world, and is protected by the Japanese government as a special natural monument. However, this species is threatened by habitat fragmentation and degradation due to construction of small agricultural dams and artificial concreting of riverbanks. Hiroshima City Asa Zoological Park (AZP) is located among the Chugoku Mountains which contains the main distribution of JGS. We have surveyed JGS 485 times in their habitat since AZP opened in 1971. Based on observed reproduction in the wild, AZP has continued to successfully captive breed JGS since 1979. The program has recorded oviposition 94 times and succeeded in the world's first production of captive F2 generation in 2007. Findings from captive breeding ex situ were effectively applied to in situ conservation. JGS have reproduced continuously in artificial nests in our study area after concrete riverbanks were established. Continuous research work also attracted the attention of local residents, which lead to collaborative JGS conservation activities. We also conducted educational activities for the future generation at a nursery school in the region. Thanks to a request from the community, the local government renovated a dam to enable JGS to move upstream. In addition, AZP has collaborated in 17 JGS research programs with universities and museums. These will play an important role in future conservation. We believe that field surveys and ex situ conservation allows for successful in situ conservation.

## Session 20: Ecology and Management of Carnivores

### 2001 The Application of Occupancy Modeling to Evaluate Intraguild Predation in a Model Carnivore System

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Intraguild predation (IGP) is an extreme form of competition that involves a dominant predator (IG predator), a subordinate predator that is also a superior exploitative competitor (IG prey), and their shared prey. We modeled the probabilities of detection and occupancy of the kit fox (*Vulpes macrotis*) and their IG predator, the coyote (*Canis latrans*), at White Sands National Monument, New Mexico, using species occurrence data obtained from randomly distributed remote cameras and a conditional two-species occupancy model. Kit foxes persisted in habitats of low resource abundance, which could not support coyotes. The odds of a coyote being present vs. absent in prey-rich habitats was 332:1 ( $\pm 0.006$ ) whereas the odds of their presence vs. absence in prey-poor habitats was 1:4 ( $\pm 0.11$ ); coyotes were much more likely to be present in prey-rich habitats. Kit foxes were more frequently photographed in prey-poor habitats avoided by coyotes. The odds of kit foxes being present vs. absent at a site where coyotes were absent was 7.9:1 ( $\pm 0.082$ ), which was greater than the odds of their presence vs. absence at a site where coyotes were present (2.2:1  $\pm 0.081$ ). These findings indicate that kit foxes avoid coyotes, but that their adaptations to arid conditions enable them to exploit habitats unsuitable for coyotes. Consequently, the primary driver of this spatial separation is the inability of coyotes to use prey-poor habitats, rather than kit fox avoidance of coyotes. Our results reveal the existence of concurrent IGP states within the same ecological community, a finding consistent with theoretical predictions.

### 2002 Historical Distribution and Conservation of the Indian Wolf in Uttar Pradesh, India

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The Indian Wolf (*Canis lupus pallipes*) is distributed mainly in grassland, shrubland, grassland-shrubland interfaces, which are highly fragmented. The species was once widely distributed in Uttar Pradesh but has now disappeared from most of its former range and presently survives in extremely low numbers in few districts in the state. Field surveys were conducted in the state from time to time during 1996-2008 to estimate wolf population. Questionnaire surveys, interviews with shepherds and farmers, indirect evidences such as tracks and signs of wolves were used while investigating their population status. Simulated wolf howling and playback of pre-recorded wolf howls were also used for response of wolves for their presence during surveys. Howling was performed at 5 minute intervals from prominent raised areas and wolf numbers were deduced by randomly interviewing people inhabiting the area. The total wolf population consists of approximately 100-120 individuals surviving in highly altered habitats within the state. The areas where wolves survive presently are densely populated by humans and represent a unique co-existence of wolves with humans despite high wolf-human conflicts. Wolves were commonly seen in several districts in the state until the 1920s to 1930s. Bounties were offered to eliminate them during this period. Special bounties were offered to wolf hunters in the areas wherever they endangered human life. The natural habitat as well as prey base of wolves has declined over years,

and they survive primarily on livestock and also by scavenging. Wolves have been attacking children in these areas from time to time leading to a rise in conflict. The conservation of the species under these circumstances is a major challenge to biologists that has been discussed in this paper.

### **2003 Distribution and Population Number of the Far Eastern Leopard in the Russian Far East**

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Distribution and number of the Far Eastern Leopard (*Panthera pardus orientalis*) is commonly researched in the Russian Far East every 5 years. The purpose of our study wasn't only to conduct a census, also to understand the population of the Far Eastern Leopards within their entire range. We also aimed to register their range as well as new types of habitats developed by leopards. Methods of our research implied tracking the routes, which were laid within the entire range including potential habitats. Researchers recorded leopards' tracks with GPS navigators, gauged leopards' pad tracks with scale ruler and registered print descriptions. Besides leopard tracks we registered tracks of other carnivores and ungulates. All registered tracks were mapped. The number of leopards was calculated, based on the size of leopard's area and its daily movements. Our research identified 47 leopards: 5 females and 5 cubs, 12 males and 25 individuals with unidentified sex and age. Additionally, we identified 27 tigers: 1 female with 2 cubs, 7 males and 17 individuals with unidentified sex and age. Moreover, leopards were recorded 20-30 km further south and north of what was previously believed to be their entire range. One female with a cub was found in the open woodlands, unusual habitat for leopards. Our research results showed real range expansion of the Far Eastern leopards. They were found in the non-typical leopard habitat. Total population number was estimated for 47 and is larger than in 2007.

### **2004 Mukundara Hills Tiger Reserve: Sustainability of Re-Introducing Tiger**

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Mukundara Hills Tiger Reserve (MHTR) lies between 24° 38' to 25° 7' N Latitude and 75°26' to 76°11' E Longitude. MHTR consists of 417.17 km<sup>2</sup> as core area and 342.82 sq km as buffer area with a total area of 759.99 sq km. The reserve forms a continuous tract of forest further connected to Bhainsaroghar Wildlife sanctuary in Chittorgarh district of Rajasthan and also Gandhisagar sanctuary in Madhya Pradesh. In a study in Darrah sanctuary by distance sampling as compared to the density of ungulates with other protected area (Tiger Reserve), the density of ungulate is very low except for Nilgai. The area of Darrah Wildlife sanctuary forms a major part of the recently declared Mukundara Hills Tiger Reserve in 2012. For future Tiger relocation, in the study area, mitigation measures should be taken up to improve the preferable prey and habitat of ungulates throughout the reserve. Historically, the tract has been the natural habitat of the flagship species- the tiger. Unfortunately, due to mining activities and ever increasing heavy biotic pressure, there was considerable loss of bio-diversity of this area; result being that by 1982 tiger population was totally wiped out. But the area still has sufficient population of panther, sloth bear, chinkara, sambar, chital, nilgai, wildboar, crocodile, gharial, scaly ant eater, otter, etc and sufficient scope of reintroducing tiger in the area. A

long term monitoring of prey species, habitat type and mitigation measures is proposed to take up for proper conservation and management plan.

## **2006 Relationship of Bears and Tigers in the Russian Far East**

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In the southern Russian Far East, brown bears (*Ursus arctos*) and Asiatic black bears (*U. thibetanus*) co-exist with Amur tigers (*Panthera tigris altaica*). In the Sikhote-Alin Reserve the relationships between these three species were studied in 1992-2013 during extensive telemetry and snow-tracking efforts. Bears often fed on Amur tiger kills. Of the 353 tiger kills we found during the non-denning period for bears (April-November) 62 kills (17.6%) were used by bears including 37 (60%) brown bear, 9 (14%) by Asiatic black bear and 16 (26%) of uncertain bear species. The proportion of tiger prey scavenged by bears is likely higher than what our data indicate, since utilization by scavengers was not always complete when we visited kills. Often bears fed on kills after tigers abandoned them. However, in at least in 8 cases (12.9%) bears displaced tigers from a kill, and in 7 cases (11.3%) both tigers and bears utilized a kill during the same period. Analysis of prey items revealed that bears represent 3.4% in the diet of tigers in the non-denning period (1.7% for each species of bears). In 44 recorded encounters between tigers and bears, the tiger initiated contact in 12 cases while the bear initiated contact in 8 cases, while in all other cases the individual initiating contact could not be determined.

## **2007 Autumn Habitat Selection by Asiatic Black Bears over Multiple Mast Producing Years**

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To understand the mechanism and adequately manage mass intrusion by Asiatic black bears (*Ursus thibetanus*), knowledge on habitat selection in multi-scales and -years for hard mast productivity is necessary. We analyzed autumn habitat selection by tracking bears using GPS collars in Ashio-Nikko Mountains of central Japan during a moderate (2007) and poor mast year (2006). Low resolution vegetation map was inadequate for evaluating important components of autumn habitat; therefore, we evaluated results of habitat selection from two vegetation maps, differing in resolution (low vs. high), comparing them with a field vegetation survey. During moderate mast year, bears selected hardwood forests of hard mast-producing trees as core area and home range; however, this area was not detected by coarse vegetation map (low resolution). In poor mast year, through a field vegetation survey, we confirmed that bears used the area dominated by hard mast-producing trees; however, this selectivity could not be detected by either vegetation maps. Bears responded to small patchy habitat during both moderate and poor mast years, which could not be detected by low-resolution vegetation map. Habitat validation by field vegetation survey revealed that only Japanese oak (*Quercus crispula*) composed the core area in moderate mast year, while in poor mast year, there were various hard masts producing tree species in core area. Bears showed flexibility in

selecting hard mast-producing trees, based on production of Japanese oak, a key resource component governing bear feeding behavior during autumn.

### **2008 Current Distribution of the Siberian Weasel in Fukui City, Fukui Prefecture**

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The Siberian weasel *Mustela sibirica* is an introduced species in Japan except for on Tsushima. The population in Honshu is thought to have originated from escaped individuals from fur farms in Hyogo Prefecture on the 1930s, and has expanded its range throughout western parts of the island. At the present time, the eastern fronts of its distribution are Fukui, Gifu and Aichi Prefectures. Along with its expansion, the distribution of the Japanese weasel *M. itatsi* might have been limited to mountainous areas. However, interspecific interactions between these two species have been poorly understood. As a first step to reveal their interactions where they are sympatric, we are investigating the fine scale distribution of the two species in Fukui City, Fukui Prefecture. In 2013 and 2014, we conducted the camera and trapping surveys. In these surveys, 3 and 1 individuals of *M. itatsi* and *M. sibirica*, respectively, were trapped at the riversides of Asuwa River. In Mt. Asuwa, an isolated forest surrounded by residential areas, *M. sibirica* was photographed 4 times and 1 individual of *M. itatsi* was trapped. On the other hand, only *M. sibirica* (1 individual) was trapped in the urbanized city area. These results suggest that *M. sibirica* has already established in Fukui City.

### **2009 Correlative Distribution Models for Marten and Fisher in the Northern Forest: Abiotic, Biotic, and Climate Change Drivers**

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Species distribution models (SDMs) are commonly used to predict species range limits and how they shift over time. However, most SDMs only consider abiotic variables to predict species suitability, and merely account for biotic effects implicitly. This approach can produce inaccurate models if the species distribution is constrained by interspecific interactions. We consider the distributions of two North American mustelids, the American marten (*Martes americana*), a species of conservation concern in much of the northeast U.S., and the fisher (*Martes pennanti*), a mostly sympatric and larger-bodied competitor that also preys upon the marten. Using this system, we will test three different approaches of incorporating biotic effects into abiotic SDMs: 1) post-hoc modification of abiotic models, 2) adding the interactor SDM as a predictor, 3) building a joint model that breaks co-occurrence into shared environmental preference and postulated biotic effects. Here, we present preliminary models with Maxent for the first approach. These abiotic models for both species indicate sharp gradients in suitability over elevational transitions, with marten suitability stronger in higher-elevation areas. Later, we will pursue the other two approaches and evaluate models via field validation. We will then select the best performing model and project it to contrasting climate

change scenarios. Finally, we will make conservation recommendations for marten based on the above results and corridor analyses of modeled suitability surfaces.

## Session 22: Seeking for Future Strategy to Control Ungulate Populations in East Asia

### 2201 Aborigine Hunting as an Alternative to Wildlife Management in Taiwan

**Ying Wang**, National Taiwan Normal University, Taipei, Taiwan. Contact: t43002@cc.ntnu.edu.tw

Unregulated hunting and habitat destruction during past several hundred years drove many games on the verge of extinction in Taiwan. Games such as Sika deer extinct in the field in 1969 and sambar became locally extinct in many areas. Between 1980 and 1990, Taiwan Government strode a serial effort to save the wildlife, including the enactment of the Wildlife Conservation Act, establishment of wildlife sanctuaries and national parks. After 2 decades of protection, today wildlife populations gradually recovered and also began to produce hazard problem such overgrazing natural vegetation, preventing forest regeneration and causing crop damage. During these protection decades hunting was banned except aborigine hunting for traditional rituals and life which was unofficially recognized and tolerated. As a consequence, hunting tradition was gradually disappearing due to this unclear status for aborigine hunting. Thus, a win-win situation is proposed if a clear status for aborigine hunting is granted, to strike a balance between recover of indigenous traditions and wildlife conservation. It is advantageous for aborigines to take part in wildlife management such as wildlife protection, monitoring and control for the following aspects. First, geographic advantage: access to target area or serve as a guardian for wildlife could be easily achieved by many aborigines who lived in mountain area close to wildlife habitat. Second, traditional advantage: tradition and lifestyle are closely related to wildlife management. Third, legal advantage: recently enacted Aboriginal Right Act provides aboriginal people the right to harvest wildlife resource. Fourth, inertia advantage: many aborigines still practice hunter's life.

### 2202 Key Issues on Managing Wild Ungulates in Terrestrial Ecosystems of China

**Kun Shi**, Beijing Forestry University, Beijing, China. Contact: heliusox@163.com

Wild ungulates play vital roles as a primary consumer in the process of energy flow within ecosystems. We consider the management of wild ungulates in terrestrial ecosystems throughout China, including desert plateau and tropical forest. We contrast integrative strategies that target ungulates along with their predators, vegetation and other habitat components with traditional approaches that varied levels of direct control, for example through hunting. Here we discuss the need for wild ungulate management strategies that address both controlling population numbers based on scientific assessments and monitoring ecosystems in the absence of top predators. The goal of these strategies is to maintain a sustainable population of ungulates within the ecosystem. Taking as an example the mountainous landscape of Qilianshan Nature Reserve in northwest China, results from our work suggest the importance of a variety of large carnivores, including the snow leopard (*Panthera uncia*), lynx (*Lynx lynx*), grey wolf (*Canis lupus*) and red fox (*Vulpes vulpes*), while it also emphasized the particular importance of prey through by bottom-up processes to snow leopard as top predator in the plateau ecosystem. On the other hand, in tropical forest ecosystem of Xishuangbanna Nature Reserve in southwest China, ungulates like wild boar (*Sus scrofa*), sambar

deer (*Rusa unicolor*) and muntjac (*Muntiacus*) damage rubber and crops in areas where there are few large carnivores. Here, the necessity of controlling ungulate population size in the absence of top-down pressure by large carnivores has to be balanced against the need to reduce human disturbance on the population and habitat.

### **2203 Wildlife Protection and Control System of Japan**

**Reiji Higashioka**, Ministry of the Environment, Government of Japan, Tokyo, Japan. Contact: reiji\_higashioka@env.go.jp

In Japan, recently, wild deer and boar population is increasing rapidly, and those habitats are also expanding. As a result, the impacts on forest eco-system and damage to the agriculture and forestry industry and human living environment are getting worse. Until now, the efforts of hunting and pest-control of wild deer and boar were being addressed, but those situations aren't being improved enough.

Reflecting those situations, the government decided to establish the immediate goal that is to halve wild deer and boar population by 2023. Moreover, Protection of Wild Birds and Mammals and Hunting Management Law was revised in 2014, and "control of birds and mammals" was added to the purpose of the law and the name of the law was changed " Protection and Control of Wild Birds and Mammals and Hunting Management Law ".

As one of the amendments of the law, culling wildlife of public work plans by prefectures are institutionalized. The government is planning to support culling of birds and mammals (currently focused on wild deer and bore) by prefectures financially from fiscal year 2015 when the revision law carries out. By this law revision, because there are nationwide damage and distribution, about the birds and mammals that it is necessary to carry out an intensive and wide-area management, the government supports it, and prefectures decide to build the system promoting management of the population of the birds and mammals positively.

### **2204 Challenges for South Korea's Cyclic Licence Hunting System**

**Arthur Miller**, Tokyo University of Agriculture and Technology, Fuchu, Tokyo, Japan. Contact: arthur.miller@hotmail.com

The aim of the presentation is to provide a historical and current overview of the intransparent cyclic hunting licence system in South Korea. Central problems on the ecological level such as low development of hunting areas, rising game damage, partly not refunded game damage compensation, mostly fragmented small area habitats, high numbers of off-season culling, the lack of data collection on runnable game animals represent major challenges for hunters, researchers and other user groups. The coordination, support and promotion of responsible government agencies remained insufficient for a long time, but during the last decade the political will and funding campaigns greatly increased to implement counter-measures on critical issues. Major legislative successes, such as the "Act on Protection of Wild Animals and Plants" (2004/11) and the "Act on Wildlife Conservation and Management" (2005) triggered institutional changes. Nevertheless, on the socio-cultural level, high numbers of illegal wildlife trade and poaching activities continue in a mainly uncontrolled and mildly sanctioned way, while the numbers of hunters who could safeguard the environment increase slowly. On the economic level, the marketing of shootings and pest control are given top priority by many hunting ground owners,

while the economic importance of venison marketing remains low. In summary, overuse- and development syndromes at the expense of nature and in the course of rapid industrialization and urbanization have created a “hunting system in early stages” in need of more intensified legislative reformation and institutional improvement to recover losses from failed or missing wildlife management in the past.

## **2205 The Norwegian System of Deer Harvest and Population Management**

**Duncan Halley**, Norwegian Institute for Nature Research, Trondheim, Norway. Contact: duncan.halley@nina.no

The Norwegian system of deer monitoring, management, and hunting of today is the result of development and refinement over many decades. The core of the system is a partnership of government, landowners (who own the hunting rights), and hunters, each with a defined role. This is backed by professional wildlife management skills, monitoring of harvests and populations to provide high quality data for future management, and binding harvest management plans. These regulate and maintain population levels of the national game resource in accordance with democratically accountable national, regional and local goals. This has included in some regions managed reductions in populations and targeted hunting in the interests of natural forest regeneration; road safety; and crop damage limitation. The government has been also keen to encourage a market for wild game meat. Food Safety Authority regulations for sale of meat on the open market by hunting rights owners, hunting teams, and/or individual hunters are simple and the system efficient. In this presentation, we outline how the system is organised and functions. The system has been effective in managing the resource at sustainable levels, which take into account wider environmental, social and economic interests. It enjoys broad public support. This has considerably expanded the market, to the benefit of hunting rights owners, hunters, and consumers. Social aspects are very important in developing a functioning management system, and we discuss the degree to which various aspects of the system in Norway may be transferable to East Asia.

## **2206 Training and Certification of Deer Stalkers in the United Kingdom**

**Nick Lane**, British Association of Shooting & Conservation, Wrexham, United Kingdom. Contact: nick.lane@basc.org.uk

The purpose of this talk is to look at training and certification of the recreational and professional stalkers in the United Kingdom. 1) Ideal roles of the recreational stalker in UK: review the role played by recreational stalkers vs professional deer. The numbers of deer and recreational stalkers are increasing, while human and deer conflicts occur. 2) The history of Deer Stalking Certificate: National Stalkers Competency Certificate started 1982 and Woodland Stalkers Competency Certificate started 1984, 1997 onwards - DSC 1 & DSC 2 and Trained Hunter Status. 3) The activities of Deer Management Qualifications: we develop and maintain a progressive approach to deer management standards and assessment, linked to the current National Occupational Standards (NOS). DMQ is supported by organisations from within the deer sector. Currently there are two awards Deer Stalkers Certificate 1 and Deer Stalkers Certificate 2. 4) Deer stalker training by BASC: Within BASC Sporting Services lies BASC Deer Assessment Centre, an approved DMQ Assessment Centre. BASC also undertakes a variety of training from beginners to experienced recreational and professional stalkers. Through training, BASC develops and maintains standards in all areas of deer management.



It works with government and other shooting organisations on standards within deer management and provides members with access to high quality training opportunities covering all aspects of stalking and deer management to help self-regulate shooting activities. BASC provide specialist advice on training, education, qualifications, health and safety, rifle shooting, and food hygiene.

**2207 Balancing Costs and Benefits of Deer as a Resource, and the Damaging Impacts Which Deer May Have on Other Land-Use Interests: Is Recreational Hunting the Driver or the Effector?**

**Rory Putman**, University of Glasgow, UK, Glasgow, United Kingdom. Contact: roryputman@btinternet.com

Almost all European countries rely on recreational hunting to manage populations of ungulates and other game species; in consequence there is, in many countries, a tension between pressure to maintain significant ungulate populations for hunting, and the need to control overabundant populations and their impacts (in damage to agriculture, forestry, natural habitats etc). In this presentation I will review the different administrative structures developed in a variety of different European countries in an attempt to reconcile the two needs: systems where ungulate populations are routinely maintained at levels below which significant damage might occur; systems where some level of damage is tolerated in the interest of maintaining adequate populations for hunting but alterations are made to methods of forestry or agricultural management to allow the crop to 'tolerate' higher densities of ungulates, and finally systems where compensation is paid for damage caused by ungulate populations which are maintained for sporting reasons at levels above which damage may occur. But the concept of basing management on recreational hunting is to some extent responsible for creating this same tension; we should examine whether dependence on recreational hunters is producing effective management or itself contributing to problems of overabundance and damage. In many countries numbers of ungulates are increasing, while at the same time numbers of recreational hunters are declining. This potentially a future mismatch between management need and management capacity if systems continue to be dependent on recreational hunting. Should we already be looking towards other models of management?

**Session 23: A World of Opportunities and Challenges: Graduate Students Seeking International Collaboration and Education in Wildlife Ecology and Conservation**

**2301 Why Are International Graduate Students Important to the Wildlife Profession?**

**Rick Baydack**, University of Manitoba, Winnipeg, MB, Canada. Contact: baydack@cc.umanitoba.ca

Wildlife resources are distributed on a global basis, yet their importance may vary from country to country depending upon factors such as historical trends, cultural values, government priorities, or other influences. But no matter the location, wildlife will exist, and opportunities for research and management on a wide range of species will be available. In most countries, aspiring biologists and managers seek to enhance their knowledge by completing University or College coursework in wildlife biology or management and increasingly, environmental science or studies. Although opportunities may exist in many developing countries for this type of advanced education, oftentimes students find it advantageous to move abroad to further their experiences. This flow of people brings with it a concomitant transfer of information that is multi-directional and beneficial in

a variety of ways. Students leaving their home countries to study elsewhere will obtain a level of education that is generally superior to what they could experience locally. These international students will enhance their skills and abilities in the wildlife field and can put them to good use when returning to their origins. Students returning from several different countries to their homes will bring with them a diverse array of educational experiences that can be shared, thus expanding the abilities of organizations to provide high quality strategies to benefit local wildlife resources. Knowledge will also flow from international students to faculty members and students at host institutions who will learn about different cultural and regional factors, thereby enhancing their knowledge of global wildlife.

### **2302 Science without Borders: Collaboration across Space and Time**

**John Koprowski**, University of Arizona, Tucson, AZ, Contact: squirrel@ag.arizona.edu

Science has been described as a way of knowing. Although collaboration in science has long occurred, often research was completed within a single lab group with results not shared with researchers elsewhere until publication. More recently, the model for conducting science has been increasingly collaborative. As a result, scientists are challenged to be skilled in technology and social media to exchange data as well as savvy in communication with other scientists. Collaboration across international boundaries to investigate long-term or large-scale phenomena is of increased frequency and importance. However, rarely do graduate students obtain training in international research and collaboration. In fact, the majority of collaboration often seems to occur among senior scientists that have well established careers. While the reasons for this are clear, finding ways to foster collaboration and facilitate international experiences in early career scientists likely will yield fruitful and long lasting relationships that can develop over 30-40 years or a scientist's career rather than 15-20 years in the case of a senior scientist. Programs to promote international collaboration among early career scientists will enhance professional growth, research opportunities and truly permit research to be accomplished across space and time.

### **2303 Introduction to International Collaborative Works in Asia**

**Tatsuo Oshida**, Obihiro University of Agriculture and Veterinary Medicine, Obihiro, Japan. Contact: oshidata@obihiro.ac.jp

International collaborative works can produce important results for mammalogy. Humans have defined national borders, but wild mammals never follow these political restrictions. In the Indochina Peninsula, for example, Asian elephants freely move among countries. To understand biological characteristics of Asian elephants, therefore, we need international corroborative research.

Throughout my career, I have collaborated with researchers throughout Asia (especially Taiwan, Vietnam, Korea, Thailand, India, Pakistan, and Myanmar) and Europe (especially Russia, Turkey, and Czech Republic). Fortunately, these collaborations have resulted in co-authorship and publication of several papers. I use my experience to identify the most important requirements for successful international corroborative research in Asia. Asia contains many countries and includes many different races, languages, religions, foods, goals, traditional costumes, and cultures. For good international collaboration, we should first understand and respect our differences. Second, the research purpose of collaborative work must be explicitly clear. Here, I introduce my experience in

international collaborative work with Taiwanese and Vietnamese researchers. In addition, I stress the importance of young researchers and graduate students joining international collaborative projects, even though these opportunities are not easy to find.

#### **2304 International Experience in Wildlife Ecology Fosters Global Connections and Conservation**

**Martha Desmond**, New Mexico State University, Las Cruces, NM, Contact: mdesmond@ad.nmsu.edu

International awareness and engagement in wildlife ecology are key components of a graduate student education. Students can engage in international opportunities directly through graduate research, global and cultural exchanges, and international field courses, or indirectly through diverse lab groups, interacting with international graduate students or through professional societies and organizations. These types of experiences are key to fostering a global perspective in wildlife ecology and conservation. I will discuss my experience as an international postdoctoral student in Mexico, conducting ecological research and promoting student exchanges across the US/Mexico border as a university faculty member, advising international graduate students, teaching classes where international students bring a new perspective, participating in professional societies, and working with students to find meaningful international research experiences.

#### **2305 Wildlife Conservation and Ecotourism: Opportunities for Educational Leadership**

**Walt Anderson**, Prescott College, Prescott, AZ, Contact: wanderson@prescott.edu

Ecotourism (environmentally and culturally sensitive, low impact, educational, of conservation value) is one of the fastest growing enterprises globally. Wildlife scientists and conservationists can be prominent leaders in this field. Academic institutions can foster collaborative international relationships and give students experiences and contacts to create career opportunities as effective ecotour leaders, outfitters, organizers, scientists, writers, or entrepreneurs. Conservation depends ultimately on building favorable constituencies to support local efforts. Wildlife students who see the big picture, who establish good working relationships, and who can communicate well, can serve as leaders from the country providing the tourists or as resident experts at the destination. Ecotourism assigns greater values for living wildlife than for wildlife products and provides images, stories, and financial support for both scientific studies and conservation. Creative partnerships encourage mutualistic sharing; education can focus on the skills needed for scientific interpretation and responsible stewardship of natural resources. "Voluntourism" (e.g., Earthwatch, Global Work & Travel) is one way for individuals to make a difference and gain field experiences and connections that have potential to lead to meaningful careers. Similarly, study abroad programs of colleges and universities provide relevant educational preparation for students seeking an alternative career niche or exploring potential subjects for graduate research. Clearly high standards are essential for programs to meet genuine ecotourism criteria, standards that distinguish this from less responsible "nature-based tourism." This presentation provides context for and examples of ways that ecotourism can contribute to wildlife conservation and can provide meaningful employment through international partnerships.

### **2306 Study Abroad: 10 Things I Wish I'd Known before Taking off**

**Hsiang Ling Chen**, University of Arizona, Tucson, AZ, Contact: [cherlene@email.arizona.edu](mailto:cherlene@email.arizona.edu)

Studying abroad is a life-changing experience, an excellent way to learn a foreign language, and provides great opportunities to establish an international professional network. The challenge is how to get on the graduate school plane, with limited seats, and arrive at your destination successfully - graduation. The number of international students in U.S. higher education grew dramatically from 110,000 in 2001 to 524,000 in 2012. Nevertheless, students majoring in natural resources are the minority, and it is therefore difficult to gather information about international education in wildlife ecology and conservation. After obtaining my Master's degree from an Ecology and Evolutionary Biology program in Taiwan, I won a three-year Study Abroad Fellowship from the Taiwanese government allowing me to accomplish one of my goals of gaining international experience in wildlife science. As a non-native English speaker who does not have close family members in the U.S., I survived through the PhD program and gradually learned to be personally and academically independent and actively participate in student clubs, professional societies, and scientific communication. I will share my experience and provide tips about applying to a PhD program, including a timeline for preparing application materials, funding opportunities, and contacting potential advisors. I will discuss strategies to deal with challenges of studying abroad such as cultural differences, homesickness, course work, fieldwork in unfamiliar environments, and language barriers. I will provide thoughts about the pros and cons of studying abroad as it relates to professional development in wildlife science and advancing career development after graduation.

### **2307 Japanese Cowboys: Collaborative Projects, Research Experience, and Education in the Southwestern USA**

**Masahiro Ohnishi**<sup>1</sup>, Tatsuki Shimamoto<sup>2,2</sup>, <sup>1</sup>Caesar Kleberg Wildlife Research Institute, Texas A&M - Kingsville, Kingsville, TX, <sup>2</sup>Iwate University, Morioka, Iwate, Japan. Contact: [mohn896@gmail.com](mailto:mohn896@gmail.com)

To facilitate collaboration, wildlife professionals need to be effective communicators, because wildlife problems and human-wildlife conflicts abound in both public and private sectors. Working with different communities, such as agencies, private landowners, and research institutes, is inevitable. Going abroad is one of the ways we can develop skills necessary for working with diverse groups of professionals. The objective of this presentation is to share information on developing collaborations in support of wildlife conservation based on experiences both inside and outside of academia. Masahiro, with his 8-years' experience in the US, will focus his talk on his affiliations. When he was working at the Chihuahuan Desert Research Institute, with funding from the U.S. Fish and Wildlife, he facilitated the restoration of habitat for grassland bird species by removing invading juniper. With some funding from Texas Parks and Wildlife Department, he also supported projects on pronghorn, mule deer, bighorn sheep, and other species. Masahiro became a member of Texas Master Naturalists, started hunting, spent many hours volunteering, and now is working on his doctoral research with a landowner and state agencies in Texas. Tatsuki will focus his talk on his experience at the University of Arizona, where he visited to meet professionals who share his passion for the study of flying squirrels. Attending The Wildlife Society Annual Conference in Pittsburgh was an opportunity for him to make new connections, and ultimately collaborations. Additionally, we will provide information on applying for scholarships and travel preparation for study and research abroad.

## Session 24: Evaluations of Multidiscipline Group of Wildlife Professionals in Wildlife Conservation and Management of Borneo

### **2401 International Cooperation by JICA: A Case Study from Sabah, Malaysia**

**Kazunobu Suzuki**, JICA-SDBEC, Kota Kinabalu, Malaysia. Contact: switzerland\_tca@yahoo.co.jp

Sustainable Development on Biodiversity and Ecosystems Conservation in Sabah (SDBEC) is a joint technical cooperation among the Sabah State Government, Malaysian Federal Government and Japan International Cooperation Agency (JICA) under Japan's Official Development Assistance (ODA), starting in July 2013 to June 2017 for a four-year cooperation project. SDBEC assists capacity development in respect to realising a society in harmony with nature, and the Sabah's experiences sharing nationally and internationally for biodiversity conservation and sustainable development. In detail, the project provides necessary technical support and capacity building opportunities through the pilot project of alternative livelihood activities in and around protected areas to seek co-existence between human living and nature. At the symposium, some results and on-going activities will be shared.

### **2402 Research and Outreach from a University Institute for the Biodiversity Conservation in Sabah, Malaysia**

**Charles Vairappan**, Universiti Malaysia Sabah, Kota Kinabalu, Malaysia. Contact: csv@ums.edu.my

Universiti Malaysia Sabah is the ninth public university in Malaysia. In addition to the 10 faculties, it has three Centres of Excellence, one of which being the Institute for Tropical Biology and Conservation (ITBC). Being a leading research institute in Sabah, it plays critical roles in biodiversity conservation in Borneo as well as in the world. The researchers at ITBC actively collaborate with other universities and/or research institutes nationally and internationally, in the field ranging from basic to applied science, and from student level to world-class professionals. ITBC also have a close partnership with the local government and JICA. For example, we have annual Third Country Training Programme (TCTP) on biodiversity and ecosystem management since 2009, through BBEC and SDBEC projects. Based on our experience of casting effective management practice over the rapid land-use change in the past, Sabah is now in the position to lead the movement for biodiversity conservation and sustainability. In addition, there are many education programs provided at ITBC for local and international young students, to learn to appreciate our natural environment. It is expected that the future generation develop their mind for research and conservation.

### **2403 Ongaeshi Project: Connecting Japan and Sabah to Save the Bornean Elephants**

**Gen Bando**, Asahiyama Zoo, Asahikawa, Japan. Contact: toukou202002@yahoo.co.jp

The tropical rainforest remaining along Kinabatangan River is highly fragmented and disconnected because of human settlement, deforestation and expansion of palm oil plantations. The Borneo Elephant Sanctuary (BES), officially launched in September 2013, was established by the joint effort from the Sabah Wildlife Department, Borneo Conservation Trust (BCT) and Borneo Conservation

Trust Japan (BCT Japan) as a refuge for the injured or orphaned Borneo elephants (*Elephas maximus borneensis*). BES is an endeavor to save the endangered elephants and their habitat. To support construction, Asahikawa City and Asahiyama Zoo, and a number of companies and individuals in Japan raised fund for Borneo elephants. It is a significant achievement that the citizens of Japan and Malaysia worked together for biodiversity conservation. Asahiyama Zoo is also active in environmental education at the schools around Asahiyama Zoo, to introduce the current situation of the rainforest in Borneo, its relationship with the life in Japan, and to let them realize that they can do something to reduce their impact on the environment. The process of constructing BES and examples of Asahiyama Zoo's activities will be introduced in this symposium.

#### **2404 Evaluations of Multidiscipline Group of Wildlife Professionals in Wildlife Conservation and Management of Borneo**

**Rosli Jukrana**, KOPEL Bhd, Sabah, Malaysia. Contact: kopelbhd@gmail.com

Batu Puteh Community Tourism Cooperative (KOPEL Bhd) started from the initiative to protect the forest by producing alternative income to palm oil plantations in the area. It began from the discussion among the villagers, to start homestay to accommodate foreign tourists, boat service, cultural performance group, and food catering service. With help from WWF, the government of Sabah and other donor agencies, KOPEL Bhd started habitat restoration projects, most notably tree planting and eradication of invasive waterweed in the lake. The fragmented forests around the village, home for Bornean orangutan (*Pongo pygmaeus*), Malayan sun bear (*Helarctos malayanus*) and Sunda clouded leopard (*Neofelis diardi*), are gradually recovering the vegetation cover. Nowadays many groups from overseas visit Batu Puteh village to enjoy wildlife watching cruise, jungle walk and homestay, as well as forest restoration program. From 2012, a project with Rakuno Gakuen University started to formulate database on local environment and utilize this information for conservation and education purposes. The local staff from the village put camera traps in the forests, tree planting sites as well as plantations, to see the distribution and seasonal trends of the wildlife. KOPEL Bhd serves as a platform for the foreign as well as local visitors to experience and contribute to biodiversity conservation and/or research activities.

#### **2405 Initiative on the Capacity Building and Education for the Mutual Benefit of Sabah and Japan**

**Chie Kosuga**, Rakuno Gakuen University, Ebetsu, Japan. Contact: kosuga@rakuno.ac.jp

Rakuno Gakuen University and KOPEL Bhd launched a community development project in Aug 2012 with financial assistance from JICA. The project involves the state government of Sabah, Universiti Malaysia Sabah, Conservation International Japan and Asahiyama Zoo, and increasingly wider sectors such as other community organizations and local politicians. Through the project, KOPEL Bhd is being transformed from tourism destination to the center for education on sustainable development (ESD). Within the year 2015, the whole district of Kinabatangan aims at establishing the Regional Centre of Expertise (RCE) on ESD, by acquiring approval from the United Nations University. Meanwhile, in Japan, there are growing interests from education institutes for study tours in South-East Asia to let the students learn about the biodiversity, environmental issues and conservation initiatives. Sabah has high potential to meet the needs, having visible examples to think about nature and human life, and sustainable consumption. The needs from both Japanese

institutes and the conservation fields in Sabah will be discussed, and some outcomes from such study tours will be presented.

## Session 25: For Better Conservation of Wild Ungulates and Utilization of Gobi-Steppe Ecosystem of Mongolia

### 2501 Takhi and Red Deer: Interspecific Relationship and Management in National Parks

**Seiki Takatsuki**, Ayano Ohtsu, Azabu University, Sagamihara, Japan. Contact: takatuki@azabu-u.ac.jp

Takhi or the Przewalski's horse (*Equus przewalskii*) was extinct in the 1960s in Mongolia, and a few population were returned to Hustai National Park from European zoos. The population has been recovering and more than 220 takhi lives in the park. This park is also inhabited by ca 200 red deer (*Cervus elaphus*). We studied the habitat use, food habits, and effects on vegetation of these two large ungulates in 2010 and 2011. Habitat uses were studied by dropping counts in the forest, at the forest edge, and in the steppe. Food habits were studied by microscopic fecal analysis. Death rates of standing trees and browsing of saplings were determined at a place inhabited by both takhi and red deer, and another where only takhi lived. Takhi preferred the steppe and fed on mainly graminoids while red deer stayed in the forest and fed on both graminoids and dicots (browse and forbs). Despite the ungulate density differences, tree mortality and browsing rates of samplings were quite high in both the places. Since tree mortality is high, it is possible that the forest will disappear in future. This would mean that the red deer would lose the habitat. Restoration of the takhi population is highly appreciated, but we think that park management including not only population increase of takhi but also forest condition will be more important for Hustai National Park.

### 2502 Habitat Management of Mongolian Saiga in Response to Overgrazing

**Buyanaa Chimeddorj**<sup>1</sup>, Takatsuki Seiki<sup>2</sup>, <sup>1</sup>WWF Mongolia Programme Office, Ulaanbaatar, Mongolia; <sup>2</sup>Azabu University, Sagamihara, Japan. Contact: chimeddorj@wwf.mn

Increasing number of livestock and out-of-season grazing are leading to unsustainable use of grassland and competition between livestock and wild ungulates. To establish a pastureland management option for endangered species, reliable data on habitat selection, food habits and interrelation between sympatric animals are necessary. To identify competition between the endangered Mongolian saiga (*Saiga tatarica mongolica*) and domestic sheep and goats, we collected their fresh pellets through the year in 2012 in Sharga Nature Reserve, Mongolia, and analyzed their food overlaps. Mongolian saigas have a preference for feeding on high quality plants such as onions (*Allium* spp.) and saltwort (*Anabasis brevifolia*). Further, the food habits of Mongolian saigas were similar to sheep and goats which indicating that competition for food resources between saigas and sympatric livestock during food-limited periods is potentially high. Thus, from the viewpoint of pasture management and conservation of the Mongolian saiga, grazing by goats and sheep should be avoided in key saiga areas. The establishment of 13 reserve pastures covers 434,380 ha of saiga distribution was approved by the county parliament based on this study finding. The reserve pastures are free of livestock and will be used only for limited number of livestock during harsh weather conditions. This is the first policy for sustainable use and protection of pastures approved

by all stakeholders. The methodology can be applied to other endangered species as the most of ungulates are in risk of becoming victims of overgrazing by burgeoning livestock.

### **2503 Population Estimates and Factors Influencing Spatial Distribution of Ungulates in Southern Gobi, Mongolia**

**Bayarbaatar Buuveibaatar**<sup>1</sup>, Samantha Strindberg<sup>2</sup>, Thomas Mueller<sup>3</sup>, Peter Leimgruber<sup>4</sup>, Buyanaa Chimeddorj<sup>5</sup>, Naranbaatar Galsandorj<sup>6</sup>, Amarsaikhan Saruul<sup>7</sup>, Dashnyam Batsuuri<sup>7</sup>, Purevsuren Tsolmonjav<sup>7</sup>, Petra Kaczensky<sup>8</sup>, Kina Murphy<sup>1</sup>, Dennis Hosack<sup>7</sup>, Todd Fuller<sup>9</sup>, <sup>1</sup>Wildlife Conservation Society, Ulaanbaatar, Mongolia; <sup>2</sup>Wildlife Conservation Society, New York, NY, <sup>3</sup>Senckenberg Gesellschaft für Naturforschung, Frankfurt, Germany; <sup>4</sup>Smithsonian Conservation Biology Institute, Front Royal, VA, <sup>5</sup>World Wide Fund for Nature, Ulaanbaatar, Mongolia; <sup>6</sup>Mongolian Academy of Sciences, Ulaanbaatar, Mongolia; <sup>7</sup>Oyu Tolgoi LLC, Ulaanbaatar, Mongolia; <sup>8</sup>University of Veterinary Medicine, Vienna, Vienna, Austria; <sup>9</sup>University of Massachusetts Amherst, Amherst, MA, Contact: buuveibaatar@wcs.org

Mongolia's Gobi ecosystem, a stronghold for substantial populations of Asiatic wild ass (khulan - in Mongolian; *Equus hemionus*) and goitered gazelle (*Gazelle subgutturosa*), currently faces conservation challenges due to a number of mining-related development and infrastructure projects (including the Oyu Tolgoi mine). During 2012-2014, we surveyed a 98,216-km<sup>2</sup> area to obtain abundance estimates and determine factors affecting the distribution of khulan and goitered gazelles in the Southern Gobi. We conducted distance sampling surveys on a total of 64 line transects systematically spaced 20 km apart, with a total of 3,464 km of survey effort. For the pooled data across 3 years, we observed 782 groups (2,897 individuals) of goitered gazelles and 579 groups (11,513 individuals) of khulan. Average densities were 0.55 and 0.60 individuals/km<sup>2</sup>, respectively, giving estimates of 54,248 goitered gazelles (CV = 14.7%) and 59,467 (CV = 22.2%) khulan. Distribution of khulan and goitered gazelles best explained by a Generalized Linear Mixed Model that included the factors of Normalized Difference Vegetation Index (NDVI - vegetation productivity), elevation, presence of household, and human disturbance (settlement, mining, and roads). Probability of ungulate presence decreased with increasing human disturbance and aggregations of households. NDVI and elevation emerged as significant factors with second-order polynomials, indicating the selection of intermediate values of these variables by these species. Our findings can be a critical component of Oyu Tolgoi's biodiversity offset planning for its mining development, to reduce impacts to these threatened nomadic species.

### **2504 Food Overlap between Wild Ungulates and Livestock in the Southern Mongolia Examined by Next-Generation Sequencing**

**Taro Sugimoto**<sup>1</sup>, Takehiko Y. Ito<sup>1</sup>, Takeshi Taniguchi<sup>1</sup>, Badamjav Lhagvasuren<sup>2</sup>, Tsendsuren Oyunsuren<sup>2</sup>, Yumi Sakamoto<sup>1</sup>, Norikazu Yamanaka<sup>1</sup>, <sup>1</sup>Tottori University, Tottori, Japan; <sup>2</sup>Mongolian Academy of Sciences, Ulaanbaatar, Mongolia. Contact: tasugi@ees.hokudai.ac.jp

The number of livestock such as sheep and goats has been growing in Mongolia during past 20 years. This increase causes reduction of vegetation cover and land degradation in many parts of Mongolia, which is referred to as "overgrazing". This habitat degradation is likely to pose negative effects toward sympatric wild ungulates such as Mongolian gazelle and Asiatic wild ass. Understanding of



the similarity and difference of the ecological characteristics between wild ungulates and livestock is necessary to infer the impact of the increasing livestock toward wild ungulates. Food habits analysis for ungulates has traditionally been conducted by identifying plant remains in feces under a microscope. However, it is difficult to discriminate plant fragments into the species level. This drawback hampers the accumulation of the accurate knowledge of food habits of ungulates. DNA barcoding has been known as one of the effective means for species identification. This method allows reliable and rapid species identification and has been applied in many research fields. The advent of next generation sequencer further improves the usefulness of DNA barcoding, because it can generate a large amount of sequence data from samples composed of a mixture of various species DNA (e.g. feces), allowing simultaneous multiple species identifications. In this study, we examined food overlap between two wild ungulates (Mongolian gazelle and Asiatic wild ass) and four livestock (sheep, goats, horses, and camels) in the dry region in southern Mongolia, using DNA barcoding approach via next generation sequencer.

### **2505 Effects of Interannual Variability of Environmental Conditions on Seasonal Ranges of Mongolian Gazelles**

**Takehiko Y. Ito**<sup>1</sup>, Badamjav Lhagvasuren<sup>2</sup>, Seiki Takatsuki<sup>3</sup>, Atsushi Tsunekawa<sup>1</sup>, Masato Shinoda<sup>4</sup>,  
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Environmental conditions, such as precipitation and snow cover, greatly fluctuate in arid lands including the Mongolia's Gobi-steppe ecosystem, and would affect on habitat use of wild and domestic animals. For long-distance movement ungulates represented by Mongolian gazelles (*Procapra gutturosa*) in the ecosystem, interannual variability of plant productivity and snow cover would be important factors for habitat selection of gazelles. To examine the relationship between interannual variability of environmental conditions and habitat use Mongolian gazelles, we analyzed the relationships between seasonal ranges of three satellite-tracked gazelles captured in central Mongolia and spatial distributions of vegetation index (NDVI) and snow-cover duration derived from satellite images from 2002 to 2005. Seasonal range locations of the same individual were different among years both in summer and winter. The differences were larger in winter than summer, and the longest distance between winter ranges of the same individual was more than 300 km. The gazelles are likely to avoid areas of low NDVI values and long snow-cover duration. These results suggest that interannual variability of environmental conditions change spatial distribution of suitable habitats for wild ungulates. Conservation strategies considering interannual variability of environmental conditions, therefore, are necessary for long-distance movement ungulates to retain accessibility to wide areas in their habitats.

## **2506 Genetic Structure in Mongolian Gazelles Based on Mitochondrial and Microsatellite Markers**

**Ayumi Okada**<sup>1</sup>, Takehiko Y. Ito<sup>2</sup>, Bayarbaatar Buuveibaatar<sup>3</sup>, Badamjav Lhagvasuren<sup>4</sup>, Atsushi Tsunekawa<sup>2</sup>, <sup>1</sup>Kitasato University, Aomori, Japan; <sup>2</sup>Tottori University, Tottori, Japan; <sup>3</sup>Wildlife Conservation Society, Ulaanbaatar, Mongolia; <sup>4</sup>Mongolian Academy of Sciences, Ulaanbaatar, Mongolia. Contact: okada@vmas.kitasato-u.ac.jp

Mongolian gazelles (*Procapra gutturosa*) are wide-ranging grassland ungulates in Mongolia. High mobility is the well-known characteristic of the species, but their movement pattern is still to be discussed. Additionally, even if nomadism is an intrinsic character of the species, the behavior might be prevented locally by several factors, including recent artificial alterations of the environment, such as cities and roads. We obtained tissue samples of more than a hundred Mongolian gazelles in 2005 along the international railroad from Ulaanbaatar to the Chinese border (> 500 km). We carried out a molecular study using mitochondrial control region sequences and microsatellite markers. Both markers had high genetic diversity. Maximum likelihood genealogies using control region sequences revealed two distinct genetic lineages as previous studies; however, they were unrelated to geographic location. Bayesian clustering with microsatellite data using ten loci did not indicate genetic structure either. Neither marker showed barrier effects, including isolation-by-distance. Our results support the results of field studies that the animals have high mobility, and suggest that the mobility of the animals has allowed sufficient gene flow to maintain a homogenous population. Though the field studies suggest the railroad is preventing the movement of the animals, the apparent barriers have not caused detectable genetic differentiation in the area.

## **2507 Habitat Suitability Analysis and Development Assessment for Mongolian Gazelles in Southern Mongolia**

**Yumi Sakamoto**<sup>1</sup>, Takehiko Y. Ito<sup>1</sup>, Badamjav Lhagvasuren<sup>2</sup>, Toshihiko Kinugasa<sup>1</sup>, Masato Shinoda<sup>3</sup>, <sup>1</sup>Tottori University, Tottori, Japan; <sup>2</sup>Mongolian Academy of Sciences, Ulaanbaatar, Mongolia; <sup>3</sup>Nagoya University, Nagoya, Japan. Contact: sakamoto@alrc.tottori-u.ac.jp

Negative impacts of mining developments with new roads and railroads construction on long-distance movement animals including the Mongolian gazelle (*Procapra gutturosa*) are concerned in southern Mongolia. To assess impacts of mining and railroad constructions, we tracked 8 Mongolian gazelles by satellite near the development area from September 2013 to September 2014, and evaluated habitat suitability and important environmental factors for the Mongolian gazelles in summer (Jun.-Sep.) and winter (Dec.-Feb.) by using Maxent software. Spatial distribution of areas with high habitat suitability and highly contributed environmental variables for habitat suitability varied with the season. The most contributed variable for habitat suitability was elevation in the both season, and its contribution was higher in winter than summer. The next important variables were distance to village and normalized difference vegetation index (NDVI) in summer, and snow-cover duration and distance to villages in winter, respectively. Because the areas used by all tracked gazelles for a year were apart about 100 km from the areas of the planned railroad, the new railroad construction may have only a slight influence on the population of Mongolian gazelles in this area. However, spatial distribution of habitat suitability for Mongolian gazelles would change interannually because snow cover and NDVI were important factors and fluctuate interannually in this area. Influences of the planned railroad, therefore, should be considered with long-term

variability of environmental conditions. Conservation strategy considering developments would be also needed because distance to village was one of the important factors for habitat suitability.

## **2508 Railroad Fence Management: Opening the Corridors for Migratory Species of Mongolian Gobi**

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Different type of fencing has been used in many countries of the world for variety of purposes. This includes protecting pasture from wildlife, preventing endangered species from hunting, or preventing wildlife collisions with different kind of transportation. Nevertheless, the fences are strong problem for migratory mammals. The railroad between Ulaanbaatar and Beijing was established in 1955 with parallel barbed-wire fences. This became a significant obstacle for steppe and Gobi ungulates, such as the Mongolian gazelle (*Procapra gutturosa*), khulan (Asiatic wild asses, *Equus hemionus*), and the argali sheep (*Ovis ammon*) in their movement to reach better pasture and calving grounds. In cooperation with Japanese colleagues, we tracked the movement of 24 Mongolian gazelles and 12 wild asses near the Ulaanbaatar-Beijing railroad from 2002 to 2012. Gazelles were captured on both sides of the railroad at the same time and no any individual crossed the railroad. Several times the findings of these studies were presented to the Mongolian Government and possibilities to reduce the effects of fencing as well as other alternative options were discussed. To learn the modern methodologies and to study existing successful practices, the study tour to US was organized involving representatives of mining companies, NGOs, media, scientists and the Mongolian government. The decision to develop the standard for creating under- and over passes along the Ulaanbaatar-Beijing railroad for crossing of migratory mammals was made. As well as the field trip to identify the problem places along the railroad to remove the fences was organized.

## **Session 26: Reintroduction of Wildlife in East Asia: Practices and Plans in Korea and Japan**

### **2601 Establishment Plan for the National Conservation Center for Endangered Species in Korea**

**Won Myung Kim**, National Conservation Center for Endangered Species, Ministry of Environment, Sejong-si, Republic of Korea. Contact: scrofakim@korea.kr

In Korea, many species are threatened with extinction, and this trend is expected to last in the future. The Ministry of Environment have designated 246 wildlife species as 'endangered' species for special management, as they are being threatened with drastic decrease in the number of individuals (Ministry of Environment, 2012). Among these species, the Ministry has especially selected 54 species for a nation-wide plan, that is "Endangered wildlife breeding restoration plan" (Ministry of Environment, 2006). In this paper, I would like to introduce establishment plan for the national conservation center for endangered species in Korea. The purpose of this plan is to create a foothold for further researches to expand/restore those biological resources native to Korea. The center will be constructed from 2013 to 2016 in Yeongyang-gun, Gyeongsangbuk-do, at a 2,112,419 m<sup>2</sup> area (building area: 53,513 m<sup>2</sup>). The center will play a control tower role on a national level,

synthesizing those functions performed by the current habitat preservation institutes and restoration centers for restoration/preservation of Korean wildlife.

### **2602 The Role of the National Ecosystem Survey in Grasping the Current Status of Endangered Species**

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The National Ecosystem Survey of Korea has been implemented to contribute to the conservation of natural environment in Korea by checking the status of physical environments and biological diversity of ecosystem in Korea. The National Ecosystem Survey has been conducted at five-year intervals across the country. As of 2014, 144 maps have been surveyed across nine categories (topography, vegetation, flora, terrestrial insects, benthic invertebrates, freshwater fish, amphibians, reptiles, birds and mammals) with 336 experts in total. The National Ecosystem Survey is the one and only survey project, which looks into categories of representative animal and plant species across Korea. The 2014 Survey confirmed the existence of 712 animal and 6,443 plant species in total; among them, endangered wildlife species include five Class I species and 24 Class II species. Endangered wild fauna and flora are very imperative to lay hold of the current status of these species, and in this regards, periodical surveys are mandatory. But the National Ecosystem Survey is currently focusing on the status of the entire biota, rather than endangered wild fauna and flora; thus it is difficult to grasp the accurate status of endangered wild fauna and flora. However, since the National Ecosystem Survey is the only survey available to understand the status of endangered wild fauna and flora in Korea at present, it is necessary to upgrade the survey method to grasp the current status more clearly.

### **2603 Restoration through Reintroduction Project for the Asiatic Black Bear (*Ursus thibetanus ussuricus*) in Korea**

**Kyounghee Jang**, Species Restoration Technology Institute of Korea National Park Service, Gurye-gun, Republic of Korea. Contact: animalconser@naver.com

The Korea Ministry of Environment and National Park Service started on the Asiatic black bear restoration project since 2004 for the purpose of preserving endangered species. The Asiatic black bear restoration project is based on the IUCN guidelines for reintroduction, and the subspecies have been introduced from Russia, North Korea, China and Seoul Grand Park. As of the current year of 2015, 35 bears are inhabiting in Mt. Jiri, among which 17 have been born from the ones that successfully adapted to the natural environment after 2009. The birth rate is increasing every year, shining light on the future of the restoration project. At first, the Asiatic black bears were managed by attaching a transmitter to each bear to track down the location, and the transmitter was changed every year by capturing the animal. However, now the method is being replaced by analyzing the genetic data through non invasive samples, and installing more cameras so that the restored species and humans have minimal contact. As a result, we were able to establish the pedigree data of 32 Asiatic black bears inhabiting in Mt. Jiri. Such information will be invaluable in selecting the individuals to be introduced hereafter and establishing an identification key for genetic management of the bear population. Moreover, by analyzing the location data, we can check the possibility of

bears encountering visitors at the national park. With scientific measures, we will seek for ways that human and bear can coexist on the same resources.

#### **2604 Restoration Efforts and Achievements of Endangered Deer Species Inhabited De-Militarized Zone Area in Korea**

**Young-Su Park**<sup>1</sup>, Goo Jang<sup>2</sup>, Jong-Taek Yoon<sup>3</sup>, Ho-Jun Lee<sup>3</sup>, Sang-Hwan Kim<sup>3</sup>, Chae-Woong Lim<sup>4</sup>, Bok-Sun Kweon<sup>5</sup>, <sup>1</sup>National Institute of Ecology, Seocheon-gun, Republic of Korea; <sup>2</sup>Seoul National University, Seoul, Republic of Korea; <sup>3</sup>Hankyong National University, Kyonggi-do, Republic of Korea; <sup>4</sup>Chonbuk National University, Jeollabuk-do, Republic of Korea; <sup>5</sup>Division of Environmental Hygienic, Jang-Su Province, Jang-Su, Republic of Korea. Contact: musk\_deer@hanmail.net

Sika (*Cervus nippon hortulorum*) and Musk deer (*Moschus moschiferus*) lived freely in mountain nation widely in Korea at least 100 years ago. Unfortunately, Sika deer was extinct and only a few musk deer lives in near DMZ in Korea. Ministry of Environment and local governments (Jangsu county) are interested in restoration of these animals. To restore Sika deer, nuclear transfer, one of assisted reproduction technologies, was chosen. For nuclear transfer, matured bovine, porcine, caprine and cervine oocytes were used. Oocytes were enucleated, microinjected by a Sika deer cell, fused by electrical stimulation, and activated. Activated cloned embryos were cultured for seven days and cloned blastocysts were observed in caprine, porcine and cervine oocytes. Viable cloned embryos were transferred into surrogate mothers (*Cervus nippon taiouanus*) and diagnosis of pregnancy has been waiting. We have several trials and errors of Sika deer restoration. Thus we decided on somatic cell cloning of Musk deer restoration. It's now under the study about somatic cell cloning embryo. Artiodactyl does not allow to be imported due to quarantine matter as original species into Korea from FMD outbreak country. In conclusion, we were performed on Sika and musk deer restoration from 2012 to present. Although several methods have applied to restore the native species, embryo transplantation and somatic cells cloning process is the alternative way for restoration of Sika and Musk deer in Korea.

#### **2605 Restoration Project for Goral (*Naemorhedus caudatus*) of Ecological Axis in Baekdudaegan, Korea**

**Cheun Cho**, Species Restoration Technology Institute of Korea National Park Service, Inje-gun, Republic of Korea. Contact: goral71@naver.com

Korea goral (*Naemorhedus caudatus*) as IUCN protecting I Vulnerable was on the list of National Endangered animal, endangered animal I and protected by national treasure 217 in Korea. It was recorded that goral had inhabited all over the peninsula by the early 1900s. However, the goral is facing imminent extinction, surviving barely as a species in limited regions. In Korea 700-800 gorals are currently inhabiting in regions such as seoraksan, DMZ, Yanggu-gun and Hwacheon-gun, and Uljin-Gun, Samcheok-gun. Goral restoration project for ecological axis recovery in Baekdudaegan was begun in Woraksan. Korea Forest Service released 6 gorals in Woraksan, bred from a pair rescued from an avalanche in 1978. However, the in-breeding between individuals from the same mother reduced genetic diversity, and eventually it was determined that maintenance of the number of the individuals is not viable in the long term. As a result, 22 individuals (10 in 2007 and 12 in 2012 to 2014) were moved and released into Yanggu-Hwacheon and Seoraksan region. The total

of 61 gorals inhabit including wild bred gorals. We introduced and released 4 gorals in 2014 because 26 gorals in a part of Odaesan area, one axis of Baekdudaegan, were found currently. Goral restoration project was in progress at Odaesan and Woraksan. The purpose of goral project was to recover Baekdudaegan with keeping the viability of gorals and habitat stabilization in Korean Peninsula through habitat recovery with species restoration.

#### **2606 Movement Patterns and Home Range of Captive-Bred Amur Ratsnake (*Elaphe schrenckii*) Juveniles in the Natural Habitat**

**Dae-In Kim**<sup>1</sup>, Min Ho Chang<sup>1</sup>, Hoan Jin Jang<sup>1</sup>, Daesik Park<sup>2</sup>, <sup>1</sup>National Institute of Ecology, Seocheon-gun, Republic of Korea; <sup>2</sup>Kanawon National University, Gangwon-do, Republic of Korea. Contact: dae2ni@nie.re.kr

To determine the movement patterns, home range, and use of structural features of captive-bred one- or two-year-old Amur ratsnake (*Elaphe schrenckii*) juveniles in the natural habitat, we radio-tracked a total of 11 juvenile snakes in a mountain valley in Chiaksan National Park, South Korea, between August 21 and September 20, 2010 and between June 13 and July 13, 2011. During the first week of the release, most juveniles moved short distances, daily, but they increased their distances after the first week. The body weight of the juveniles was negatively related with the movement rate (dividing the number of movements by the number of relocations), which was positively related with the mean daily distances moved and the size of both a kernel 50 % and 95 % home range. During the study period, the juveniles moved daily, approximately 17 m, and the size of the minimum convex polygon and the 50 % and 95 % kernel home ranges were 1.8 ha, 0.4 ha, and 3.0 ha, respectively. The released captive-bred juveniles were more frequently confirmed underground or on the ground rather than on rocks or on trees. Our results suggest that the body condition of released individuals, the seasonal time of the release, and the existence of available prey and shelters in the habitat should be carefully considered when releasing captive-bred Amur ratsnake juveniles for the rehabilitation of field populations.

#### **2607 Management of Reintroduced Population of Crested Ibis in Sado Island, Japan**

**Hisashi Nagata**<sup>1</sup>, Hiromu Nakatsu<sup>1</sup>, Norio Yamamura<sup>2</sup>, <sup>1</sup>Niigata University, Niigata, Japan; <sup>2</sup>Niigata University/ Doshisha University, Niigata/ Kyotanabe, Japan. Contact: hnagata@gs.niigata-u.ac.jp

The crested ibis *Nipponia nippon* used to be widespread in Japan, but the species was extinct in the wild. In order to re-establish a wild population, a re-introduction programme has been implemented on Sado Island since 2005. This programme aims to re-establish self-sustaining population on Sado Island, Japan. To date 10 ibis have been hard-released in 2008, and 166 have been soft-released between 2009 and 2014. In order to evaluate whether re-introduced population on Sado Island will persist for 100 years, population viability analysis (PVA) was conducted by using population parameters of wild population in China and captive ones in Japan. Re-introduced population will persist for 100 years if it has the same population variables as Chinese one exposed to less than 25% environmental fluctuation. Though some young have fledged in the wild since 2011, breeding success was still less than 30% of pairs for last three years, which is not enough to maintain population in the wild. After 2016, continuous releases of minimum number of individuals will be necessary to maintain re-introduced population on Sado Island until breeding success will be

improved. We conclude that it is necessary to improve breeding success and survival rate at first year in order to establish self-sustaining population of the ibis. We will discuss what are limiting factors of breeding success and how we can manage reintroduced population in the wild to improve it.

## Session 27: Integrated Approach for Resolving Human–Macaque Conflicts in Depopulating Society

### **2701 The Japan Syndrome and Expanding Human-Monkey Conflicts: Present Situation and Future Prospects**

**Hiroto Enari**, Yamagata University, Tsuruoka, Yamagata, Japan. Contact: enari@tds1.tr.yamagata-u.ac.jp

A natural decline in human population has recently been observed or predicted for several European and Asian countries. Among them, Japan has experienced a marked decline in population growth. According to a government-led demographic study, it is estimated that the current population in more than 60% of Japanese communities will decrease to half by 2050. This demographic transition has generated substantial impacts on the social system, a phenomenon known as the “Japan Syndrome.” Rapid population decrease has also caused disruptions in the existing initiatives in wildlife management. Expanding conflicts with Japanese macaques (*Macaca fuscata*) serve as a prime example of such disruptions. Although macaques were excessively hunted throughout Japan in the early 20th century, conservation initiatives in the postwar years allowed the populations to gradually recover. This recovery has further progressed through depopulating the rural areas since the 1980s, resulting in recovering populations to cause excessive damage on local farming and daily living. The reason why we cannot prevent the damage is not always the deficiency in the knowledge and techniques that are used to manage macaque population, which have increasingly accumulated, especially for effective damage control. The reason lies primarily in the rapidly declining human resources that could apply the sound knowledge and techniques in many communities. This presentation broadly discusses the common challenges of the human-wildlife conflict under depopulation conditions by addressing the current political issues related to macaque management through a nationwide questionnaire survey.

### **2702 Practical Examples of Community-Based Damage Management: Effect of Reducing the Food Resources Using Effective Fences**

**Katsuya Suzuki**, University of Hyogo, Tanba, Japan. Contact: katsuya0916@gmail.com

To alleviate crop-raiding by Japanese macaque (*Macaca fuscata*), community-based damage management approach has been gradually spreading in Japan, which entails the involvement of and positive action by local people, that is, guarding, chasing, fencing, and eliminating attractive foods in and around human settlements. On the other hand, it has become increasingly difficult to carry out all countermeasures by local people because the human population has recently been declining and aging in most mountainous areas. Therefore, setting apparent goals is required in order to promote damage management effectively. The most important principle for damage management is to reduce available food resources in the village. Especially, amount of crops is expected to have a large impact on macaque appearance there. In this study I examined the relationship between the

frequency of macaque appearance and available food resources in the village. Positive correlation was observed between macaque appearance and food resources in summer, harvest season, and it was confirmed that macaque tended to appear a lot frequently in the village which had a lot of available farmland, that was not effectively protected. Furthermore, as a result of social experiment to promote the installation of the effective electric fence for each farmland over several years, it was found that the frequency of macaque appearance was dramatically decreased in that village. Thus reduction of available food resources for macaque using effective fences could have an effect on not only protecting the individual crops, but also decreasing macaque appearance in the entire village.

### **2703 Practical Examples of Community-based Damage Management: Effect of Chasing away by Village**

**Naoto Yamabata**, Mie Prefecture Agricultural Research Institute, Matsusaka, Japan. Contact: yamabatanaoto@yahoo.co.jp

In Mie Prefecture, there are over 120 groups of Japanese macaques (*Macaca fuscata*) which are causing damage to crops in about 800 communities. In many communities of Mie prefecture, local people recognize Japanese macaques as more troublesome than any other wildlife, such as deer or wild boars. Japanese macaques are active during daytime, and they easily get used to people. So chasing macaque is one of the important community-based management. But there are few evidence that how to chase away macaques to reduce damage. So, in this research, we demonstrated that's effectiveness. In 2009, the experiment started in Shimoawa community in Iga city, Mie Prefecture. The experimented method of chasing macaques has six elements. (1) Whenever anyone noticed macaques. (2) Whoever noticed macacues has invaded, (3) must gather at the macaque's invaded point, (4) all of them should act together, (5) until all macaques moved out of community, (6) use multiple instruments. In 2010, after continual experiment, the appearance number of macaques in the community decreased dramatically. Also, the homerange of this macaques group changed, obviously avoiding Shimoawa and agricultural damage of Shimoawa decreased to about 1/8. There are unsolved problem, we must reduce food resources for macaques to get further effect of chasing. In case of large population groups, chasing doesn't work so effectively. So, we must control group's population appropriately.

### **2704 Practical Examples of Planned Population Control: Selective, Partial, and Complete Capture from a Troop**

**Hironori Seino**, Wildlife Management Office Inc., Kobe, Japan. Contact: seino@wmo.co.jp

In recent years, regardless of huge effort put into capturing over a million numbers of Japanese Monkey (*Macaca fuscata*), significant damage reduction has not been confirmed. Japanese Monkey is known to form social troops that uniquely differ by each troop, which makes it challenging to reduce damage effectively under the unorganized capture. Therefore, in order to effectively reduce the damage by capturing and maintain the local population at the same time, population control plan that are unique to each troop needs to be created. The priorities of target troops, number of target captures and optimal capture method are determined accordingly based on the number of individuals, distribution, habitat types and the level of harmfulness of each troop. Three methods of population control have been implemented, including "Complete capture" which captures an entire



troop, “Partial capture” which randomly captures individuals from a troop, and “Selective capture” which selectively captures individuals with high level of harmfulness in a troop. Despite the fact that the damages were reported to be reduced by all of these methods, it is important to note the possibilities of negatively affecting other local populations under Complete capture and inducing a troop fission and further the damages as a result of Partial capture still remain. Furthermore, expensive cost of Selective capture often becomes a financial obstacle. In order to properly promote the management of Japanese Monkey, building up well organized practical experiences plays an important role for establishing a better management plan and efficient capture methodology.

## **2705 Grand Design for Conservation and Management of ‘Snow Monkeys’ in the Tohoku Region**

**Takeharu Uno**, Tohoku Wildlife Management Center, Sendai, Japan. Contact: uno@four-m.jp

The Tohoku region consists of six prefectures - located in the northern part of Honshu. The northernmost population of Japanese macaques (*Macaca fuscata*), also known as the snow monkey, lives on the Shimokita Peninsula in Aomori prefecture. In the beginning of the Meiji Period (1868 - 1912), the local population of macaques in Tohoku decreased drastically because of high hunting pressure. It was easy to hunt for macaques in the winter during heavy snowfall since the traces were clearly left on the snow. Since the protection of macaques began in the 1947s, the number of the local population started increasing. Now, many troops of macaques live in continuous areas along water systems. The troops that inhabit the upper area of a river are called mountain-side troops and they eat leaves, fruits and seeds. The troops that inhabit the lower area of a stream are called village-side troops and they eat farm crops and garbage from villages. The latter causes serious social problems in the Tohoku.

All the troops in Miyagi prefecture have been researched, and the level of damage by each troop has been measured. Additionally, for their protection, mountain-side troops have been pushed to the forest by the upper stream. On the other hand, the number of village-side troops has decreased due to capture pressure.

The methods conducted in Miyagi to control the number of macaques have been quite effective. Therefore, a ground design for the entire Tohoku is also necessary in order to maintain the local population of macaques.

## **2706 Study on Conservation Unit of Japanese Macaques Using Genetic Information**

**Yoshiki Morimitsu**, University of Hyogo, Tanba, Japan. Contact: morimitsu@wmi-hyogo.jp

Wildlife management is often based on considering each local population as a unit. A local population comprising a small number of individuals isolated from continuous distribution is considered endangered. From the management standpoint, such populations should be subject to capture restraint. A large local population continuously spreading over an extensive region is considered to have a low extinction risk, and its number of individuals is reduced through capture to prevent harm to crops and humans. Local populations are mainly identified based on distribution information. In ecology, a population is defined as a group of conspecifics living in the same region and sharing a common gene pool. A group of individuals without genetic exchange is not considered a population even if they inhabit the same region. However, individuals inhabiting different regions may constitute a single population if they have been shown to exchange genes and further to share a common gene pool. Each local population is assumed to share a common gene pool and used as a

unit of management. A large local population should be considered as a group of local populations only if the individuals share a common gene pool. Conversely, a group of local populations may be regarded as a single local population only if the individuals share a common gene pool, as determined by frequent emigration/immigration of males and inter-population reproduction. Here we revise the concept of local population from the standpoint of genetic exchange and discuss a management unit pertaining to Japanese monkeys.

## **2707 Guideline for Management of Local Populations of Japanese Macaques**

**Masaaki Takiguchi**, Japan Wildlife Research Center, Tokyo, Japan. Contact: mtakiguchi@jwrc.or.jp

In Japan, prefectural governments can establish Specified Wildlife Management Plans to manage local populations of specific wildlife species which have been rapidly increasing or decreasing in number. However, in the case of Japanese macaques (*Macaca fuscata*), whose distribution has been expanding rapidly for the last thirty years, only about half of the prefectures where macaques inhabit developed this plan, and those plans are not necessarily effective enough. As a result, damages caused by Japanese macaques have not declined. To solve these problems, the Ministry of the Environment of Japan systematized the results of population management that had been practiced in various regions, and is currently making a new guideline. The characteristics of new guidelines are as follows.

1. Promotion of the comprehensive population management that includes both population and damage controls
2. Three options for the population control depending on the level of harmfulness of each troop. Those options are “Selective individual capture”, “Partial troop capture”, and “Complete troop capture”.

We should promote effective population management of Japanese macaques using this guideline, but there are further two problems. One is insufficient organization and human resources which carry out population management in most prefectures. The other problem is difficulties of clearly defining the conservation units.

## **Session 28: Spatial Population Structure as a Management Unit**

### **2801 How Are Wildlife Populations Spatially Organized?**

**Takashi Saitoh**, Hokkaido University, Sapporo, Japan. Contact: tsaitoh@fsc.hokudai.ac.jp

Populations are spatially structured by various factors including historical, geographical, landscape, and/or social factors. By recent advances in ecological and genetic techniques, cryptic spatial structures have been revealed in many wildlife populations. Although information about the spatial structure should be considered to define management units in wildlife populations, management units are still delineated following administrative boundaries in many cases. The inconsistency between biological spatial structure and management units can be a cause of the failure of management. I will review studies on spatial genetic structure and management units in wildlife populations and show practical management problems that the inconsistency between biological spatial structure and management units causes. I will also talk about a case study on a Sika deer population in Hokkaido, in which the stability of spatial structure and its related factors were examined.

### **2802 A Sika Deer Population Can Be Spatially Differentiated Even in a Small Habitat: A Case Study on the Yakushima Island**

**Chisato Terada**<sup>1</sup>, Tetsukazu Yahara<sup>2</sup>, Arika Kuroiwa<sup>2</sup>, Takashi Saitoh<sup>3</sup>, <sup>1</sup>Hokkaido University, Nayoro, Japan; <sup>2</sup>Kyushu University, Fukuoka, Japan; <sup>3</sup>Hokkaido University, Sapporo, Japan. Contact: cterada@fsc.hokudai.ac.jp

Governments often use administrative boundaries for delineating management units of wildlife populations without considering their spatial genetic structure. The inconsistency between a management unit and the spatial genetic structure may affect the success rate of a management goal. One of the reasons why governments do not care for the spatial genetic structure is a baseless assumption that a population of large mammals cannot have subpopulations in a limited area. In this presentation, we will report that a sika deer (*Cervus nippon*) population can be spatially structured on the Yakushima island of southern Japan, which is small (505 km<sup>2</sup>) and a natural World Heritage site. Spatial genetic structures were analyzed using microsatellite DNA (12 loci) and mitochondrial DNA (mtDNA: 998bp) by software GENELAND to identify a subpopulation structure. Three and seven subpopulations were identified by microsatellite DNA and mtDNA, respectively. The difference in the number of subpopulations between microsatellite DNA and mtDNA may be attributed to female philopatry and male-biased dispersal. This subpopulation structure is not consistent with management units defined by Kagoshima prefectural government based on administrative boundaries. We will discuss management problems derived from this inconsistency and provide a biological platform for the deer management on the natural World Heritage site.

### **2803 Spatio-Temporal Changes in the Population Size and Landscape Occupancy of Boreal Small Mammal Populations**

**Frauke Ecke**<sup>1</sup>, Magnus Magnusson<sup>2</sup>, Birger Hörnfeldt<sup>2</sup>, <sup>1</sup>Swedish University of Agricultural Sciences (SLU), Umeå, Sweden; <sup>2</sup>Swedish University of Agricultural Sciences, Umeå, Sweden. Contact: frauke.ecke@slu.se

In the last decade, long-term declines in the population size of voles have been reported from several European regions. Our knowledge on a) the spatial patterns of changes in small mammal populations and communities within regions and b) the further ecological implications of these changes is however limited. Here, we studied spatial and temporal changes in the landscape occupancy patterns of small mammal populations in 1971-2005. In total, we studied eight species (four shrew, three vole and one lemming species) in a lowland forest area (100×100 km) in northern Sweden. The studied 58 permanent 1-ha trapping plots were analyzed for spatial patterns of their occupancy, also considering autocorrelation. During the study period, the landscape occupancy decreased significantly for several species but seemed to recover recently in some cases. For example the grey-sided vole (*Myodes rufocanus*) decreased its occupancy from 81 % in the early 1970s to only 3 % in 2000. In contrast, the landscape occupancy of the bank vole (*M. glareolus*) fluctuated and even decreased during the study period, but was never lower than 89 %. We discuss the relevance of the observed changes in landscape occupancy of small mammal populations for transmission of zoonotic diseases.

## **2804 Evidence for Different Drivers behind Long-Term Decline and Depression of Density in Cyclic Voles**

**Magnus Magnusson**<sup>1</sup>, Birger Hornfeldt<sup>1</sup>, Frauke Ecke<sup>2,1</sup>, <sup>1</sup>Swedish University of Agricultural Sciences, Umeå, Sweden; <sup>2</sup>Swedish University of Agricultural Sciences, Uppsala, Sweden. Contact: magnus.magnusson@slu.se

Density decline and long-term depression of numbers of the grey-sided vole (*Myodes rufocanus*) and the field vole (*Microtus agrestis*) have occurred in managed forest landscapes of Sweden since the 1970s. Generally poor over-winter survival during a period with mild winters suggested a common climatic driver, but other explanations exist. Here we explore the response of the grey-sided vole, preferring forested habitats, and the field vole, preferring open habitats, to clear-cutting of old forest in Sweden. The cumulated impact from long-term clear-cutting explained local extinctions of the grey-sided vole. Maintained connectivity of old forest to stone fields was important for local population survival, since no such populations became extinct. For the grey-sided vole, we rule out climate as the dominating driver due to different timing of the decline in our study area. Instead, habitat fragmentation is concluded being the main cause of the density decline and depression of grey-sided vole numbers. The long-lasting depression of field vole numbers, despite favourable landscape changes, suggests action of another strong driver. A recent field vole recovery, essentially back to pre-decline densities and distribution, coincided with favourable winter/snow conditions, suggesting a climatic driver in this case.

## **Session 29: Endangered Owl Species Conservation in the USA and Japan: Contrasts and Strategies**

### **2901 Laws and Treaties Governing Protection of the Spotted Owl in the United States**

**Gutierrez Ralph**, University of Minnesota, St. Paul, MN, Contact: gutie012@umn.edu

A hierarchy of laws governs the conservation of the spotted owl, *Strix occidentalis*, in the United States. Underpinning wildlife conservation in the United States is the Public Ownership Doctrine -- wildlife is held in trust for the people by the state. This doctrine has resulted in robust wildlife management systems, engaged citizens, and guides the evolution of laws and conservation measures. The Constitution of the United States allows development of federal legislation such as CITES (global-scale treaty), the Migratory Bird Treaty Act (a multi-national treaty), and the Endangered Species Act (ESA; national-level law) that confers protection for species deemed threatened or endangered. The ESA is the enabling federal legislation for CITES in the USA and also guides conservation of endangered species such as the spotted owl. Other laws also confer protection to spotted owls such as state endangered species laws and regulations and laws guiding federal land management agencies such as the U. S. Forest Service (e.g., National Forest Management Act). Collectively, these laws should work synergistically (sometimes in the role of checks and balances) with the ESA being the most comprehensive and powerful law. However, political influence has the capacity to undermine legislation because these laws, particularly the Endangered Species Act, are sometimes viewed as threats to private interests. The conservation conflict surrounding the spotted owl, the threats to its viability, how laws are being invoked for its protection, and the current status of legal disputes over its conservation is discussed in this talk.

## **2902 Current Conservation Status and Issues of Blakiston's Fish Owl in Japan**

**Yuko Hayashi**, Sapporo University, Sapporo, Japan. Contact: hayashiy@sapporo-u.ac.jp

Although Blakiston's fish owls *Ketupa blakistoni* were formerly widespread throughout Hokkaido, it now occurs in very restricted areas of eastern and central Hokkaido. The main causes of population decline in Japan are thought to be the loss of suitable habitat, comprising extensive riparian forests and streams that remain partially unfrozen throughout the winter and support plentiful fish. Conservation programs for Blakiston's fish owls in Japan have been conducted since 1984 by a group of professionals organized by the government. The principal activities of conservation programs are: to supplement food in some habitats, to provide nest boxes to compensate for lack of natural nest cavities, and to ring fledglings to facilitate individual identification for population estimation. As a result of this 30-year undertaking, the population of Blakiston's fish owl in Japan has been slightly increasing although habitat restoration has not progressed satisfactorily. On the other hand, disturbance of owls by birdwatchers is of conservation concern in some accessible habitats. The government has kept habitat information and location of owls secret strictly to prevent human disturbance, however, many intruders to some habitats have increased drastically because of their desire to see and photograph this species. Moreover, some private lodges feed owls to let visitors take photographs. In the age of internet, it is impossible to keep habitat information secret. Here, I suggest it will be necessary to modify conservation measures to penalize those who disturb owls, and to make use of field camcorders to reduce intruders.

## **2903 Legal Measures Against Harassment of Endangered Wildlife Species**

**Mitsuhiko Takahashi**, University of Toyama, Toyama, Japan. Contact: mitsu@edu.u-toyama.ac.jp

Endangered wildlife species are often sensitive to human activities and may bear negative impact by human disturbances. There are sets of laws to protect endangered species; however, most of them regulate direct takings—hunting etc.—and habitat conservation only. Human activities, such as wildlife viewing and photographing (WVP) are often out of the scope of regulatory measures, even though they pose certain risks to wildlife behavior.

U.S. Endangered Species Act (ESA), which some consider to be the strongest environmental law, is also progressive on this subject. The ESA defines “harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect any threatened or endangered species” as “take” and prohibits such actions. Thus, WVP may be regulated when it may cause “harassment” to the listed species. To the contrary, equivalent law in Japan does not have such provisions. We believe such regulation would be beneficial to protect iconic endangered species such as the Blakiston's fish owl.

Then, should such regulations be applied to wildlife in general?

Firstly, scientific data cannot justify strict regulation of WVP in general. Secondly, it is often unrealistic to strictly regulate all human activities and it may be unfair to single out WVP. Moreover, WVP has broad benefits to recreation, tourism and education.

As a conclusion, WVP of sensitive species (eg. endangered species) or WVP at sensitive places (eg. sanctuaries) should require legal supervision; however, balancing risks and benefits are indispensable for legal regulation. Desirable legal measures will be discussed in line with actual cases.

## **2904 Comparing Endangered Species Protection Laws between United States and Japan**

**Takemichi Hatakeyama**, Waseda Law School, Waseda University, Tokyo, Japan. Contact: hatake@aoni.waseda.jp

The Blakiston's fish owl *Ketupa blakistoni* is listed as protected species by the Act on Conservation of Endangered Species of Wild Fauna and Flora, Japanese version of the American Endangered Species Act, and recovery plan has also being issued by the Act. However, the protection which the Blakiston's fish owl enjoys is basically limited to supplementary feeding and nest box installation. Habitat conservation, which is the most important conservation measure, is not adequately addressed by Japan's ESA. Conservation status of endangered owls between Japan and United State will be discussed with emphasis on law as well as the difference in social backgrounds, role of the judiciary, participation of NPO's and experts. The discussion will hopefully reveal the future of community-based wildlife conservation.

**Tuesday, July 28, 2015**

# Plenary

## Session 30: Invasive Species Management

### **3001 A Tour de Force by Hawai'i's Invasive Mammals: Establishment, Takeover, and Ecosystem Restoration through Eradication**

**Steven C. Hess**, U.S. Geological Survey Pacific Island Ecosystems Research Center, Hawaii National Park, HI, Contact: shess@usgs.gov

Invasive mammals, large and small, have irreversibly altered Hawai'i's ecosystems in numerous cases through unnatural herbivory, predation, and the transmission of zoonotic diseases, thereby causing the disproportionate extinction of flora and fauna that occur nowhere else on Earth. The control and eradication of invasive mammals is the single most expensive management activity necessary for restoring ecological integrity to many natural areas of Hawai'i and other Pacific Islands, and has already advanced the restoration of native biota. Science applications supporting management efforts have been shaped by longstanding collaborative federal research programs over the past four decades. Consequently, feral goats (*Capra hircus*) have been removed from >690 km<sup>2</sup> in National Parks, and feral pigs (*Sus scrofa*) have been removed from >367 km<sup>2</sup> of federal lands of Hawai'i, bringing about the gradual recovery of forest ecosystems. The exclusion of other non-native ungulates and invasive mammals is now being undertaken with more sophisticated control techniques and fences. New fence designs are now capable of excluding feral cats (*Felis catus*) from large areas to protect endangered native waterfowl and nesting seabirds. Rodenticides which have been tested and registered for hand and aerial broadcast in Hawai'i have been used to eradicate rats from small offshore islands to protect nesting seabirds and are now being applied to montane environment of larger islands to protect forest birds. Forward-looking infrared radar (FLIR) is also being applied to locate cryptic wild ungulates which were more recently introduced to some islands. All invasive mammals have been eradicated from some smaller islands, resulting in the restoration of some ecosystem processes such as natural forest regeneration, but changes in other processes such as fire regimes and nutrient cycling remain more difficult to reverse at larger landscape scales. It may soon be possible to manage areas on larger islands to be free of invasive mammals at least during seasonally important periods for native species, but at the same time, new mammal introductions continue to occur.

### **3002 Using Adaptive Management Strategies to Improve Management of Mink Populations on Offshore Islands in Scotland and Adapting These to Differing Scenarios in the Region**

**Sugoto Roy**, IUNC, Gland, Switzerland. Contact: Sugoto.Roy@iucn.org

Phase One of the Hebridean Mink Project (HMP) ran from 2001-2006 at a cost of £ 1.6 million. Its aims were to eradicate invasive mink (*Neovison vison*) from 1100 Km<sup>2</sup> of the Uists, the southern islands of the Outer Hebrides. The area included the interconnected islands of North Uist, Benbecula and South Uist and a suite of smaller offshore islands. Mink were also heavily controlled in Northern areas outside of the project focus, to prevent reinvasion and also as part of a number of research

projects designed to understand how mink populations responded to control. A total of 532 mink were removed, with no further animals being caught or recorded in the eradication area in the last full year of the project. Due to the challenging nature of the environment, coupled with limited time and resources, the programme used an adaptive management approach in order to maximize outputs. A strategy was formulated from data gathered from the project itself as it proceeded. This was based on continuously evaluating and refining the effectiveness of the operational procedures of the project, adapting the project to the changing population biology of the mink population in the eradication area, and adding new techniques based on the behavioural ecology of the species. These different aspects were combined using simple population models which were used to inform decision making as the work was carried out. The benefits of mink eradication are described, including the impacts on ground nesting bird populations and fish farms. The project is now in its second phase and is continuing to remove mink from the remainder of the Outer Hebrides using lessons learned from the original eradication. A broader range of techniques and strategies learned and developed from this project have since been applied to a range of scenarios exploring the feasibility of mink control in the region. These include areas where eradication is currently prohibitively expensive or unfeasible, to situations where eradication is not possible due to uncontrolled source populations repopulating control areas. The presentation briefly describes the challenges faced by the region in preventing the deliberate and unintentional movement of species between the islands.



# Symposia and Contributed Papers

## Session 31: Open Dialog towards Science Based Governance of Invasive Species Management

### 3101 Patterns and Trends of Biological Invasions: Prioritizing Pathways and Species to Improve Prevention and Enhance Effective Mitigation of Impacts

**Genovesi Piero**, Head Wildlife Service, Rome, Italy. Contact: [piero.genovesi@isprambiente.it](mailto:piero.genovesi@isprambiente.it)

Biological invasions are growing at an unprecedented pace, causing increasing impacts on global biodiversity, as well as on our economy and health. It is globally acknowledged that for responding to this threat it is crucial to prioritize action, focusing prevention on the most relevant vectors of movement of invasive species, and concentrating control efforts on the most harmful species and in the most vulnerable sites. Based on these assumptions, several studies have improved our understanding on the role of the different pathways of invasive species introduction. A standard categorization of pathways, acknowledged by the Parties to the Convention on Biological Diversity (CBD), has been developed and preliminary analyses of global data permit to highlight the most relevant vectors of invasive species' movement. Furthermore, IUCN is developing a method to rank invasive species based on their impact on biodiversity, using explicit semi-quantitative scenarios to describe increasing levels of impact on native ecosystems. A remaining gap indeed remains the development of science-based methods to prioritize areas where to concentrate response efforts. The recent advances in the understanding of the patterns of introduction of invasive species, and of the mechanisms and magnitude of impacts may indeed significantly improve our ability to prevent and mitigate the effects of biological invasions, as required by the Strategic Plan 2020 of the CBD. For this aim it is crucial to have access to data on pathways and invasiveness; this constraint is being addressed by the Global Invasive Alien Species Information Partnership, launched by the CBD.

### 3102 Addressing Invasive Alien Species in Japan: Its Progress and Challenges

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National Institute for Environment Studies have conducted invasive alien species (IAS) risk assessment and research in development of eradication methods for 15 years and supporting Invasive Alien Species ACT in Japan. Targeted species included mongoose (Herpestidae), common raccoon (*Procyon lotor*), large moth bass (*Micropterus salmoides*), various non-native pet species such as stag beetles, reptiles and amphibians to assess their ecological impacts. In the case of risks of pollinator species, *Bombus terrestris*, a confinement method for appropriate agricultural use and management the risk on biodiversity in the field. Further studies on Argentina ants (*Linepithema humile*) and other alien parasites associated with pet species elucidated their introduction pathways and effective border control methods have been developed. To improve public awareness on IAS, 'Database of Invasive Alien Species in Japan' has been published on the Internet. Community based dialogs and other media based campaign have resulted in effective cooperation on the ground. Challenge exists in costly control of already widely spread IAS such as red ear slider (*Trachemys scripta* subsp. *elegans*). International trade with free trade agreements is suspected provide additional pressure of IAS entries. The border controls on IAS could be challenged by exporter

countries and, in fact, Japan's revised Plant Protection ACT has lifted some of potential agricultural pest species, under the framework of the WTO-SPS Agreement. To facilitate the process of authorization / legislation scientists should make the data on ecological impacts available by publishing it on international journals, as well as other media to raise awareness of decision makers.

### **3103 Towards Achievement of Aichi Biodiversity Target 9: Measures to Address Invasive Alien Species in Japan**

**Kazuo Somiya**, Ministry of the Environment, Government of Japan, Tokyo, Japan. Contact: KAZUO\_SOMIYA@env.go.jp

Invasive Alien Species Act was enacted in Japan in 2005, in which international obligations under the Convention on Biological Diversity and other agreements were carefully considered to be legally consistent and to be implemented in a mutually supportive manner. The Act regulates import and transfer of selected animals, plants and other lower taxa under the category of invasive alien species (IAS) of Japan's concern. The list of IAS was compiled by the expert working groups followed by the review and commenting process of the public. The regulated species are annexed to the Act and informed to the World Trade Organization. Despite the Act was effective on the regulated species, importing of alien species of which risks are uncertain on biodiversity or agricultural production has continued to increase. More awareness raising on the invasion risks and effective eradication methods for the already established IAS are urged. To address the needs information on the experiences of management of IAS have been collected to further develop "the Invasive Alien Species Control Action Plan" and "Invasive Alien Species List of Japan". Experts and NGOs together with Office of the Ministry of the Environment have also worked on eradication of invasive alien species to protect the endangered species in important biodiversity areas, such as the world heritage site in Ogasawara islands. Japan wishes to continue the activities on eradication on the islands and effective prevention of new entries of invasive alien species.

### **3104 International Regulatory Framework on Invasive Alien Species, Pests and Diseases**

**Junko Shimura**, UNEP Secretariat of the CBD, Montreal, QC, Canada. Contact: junko.shimura@cbd.int

Under the CBD the Guiding Principles (1) and a new Guidance on introduction of pets etc.(2) assist the States to manage risks of invasive alien species as an integral part of conservation, including socio- economic development. Various hazard control mechanisms also provide international guidance to their members, e.g. Animal Health codes and their manuals of the World Organization for Animal Health, International Standards for Phytosanitary Measures of the International Plant Protection Convention, guidelines for management of ballast waters and bio-fouling of the International Maritime Organization) are expected to be implemented to reduce the risks of biological invasion, globally. The CBD Strategic Plan for Biodiversity with Aichi Biodiversity Targets provides an important overarching framework relevant to United Nations systems, other international organizations and their members to enable the governments and stakeholders from all other sectors in the full implementation and achieving the Targets. Aichi Biodiversity Target 9 is set to prioritize management measures to prevent the introduction and establishment of invasive alien species. Decision making in invasive species' management and its effective implementation require

sound results of risk assessments. Sharing scientifically credible information, development of cost effective measures and raising awareness of the public should be further promoted. Participation and informed decisions by all relevant sectors and stakeholder will ensure collaborative actions on the ground. Moreover, a success of one country reduces the risks of invasions in neighboring countries and trade partner countries. A combined implementation of these measures will permit to progress in the achievement of Aichi Target 9.

(1)<http://www.cbd.int/decision/cop/default.shtml?id=7197>

(2)<http://www.cbd.int/doc/decisions/cop-12/cop-12-dec-16-en.pdf>

## Session 32: Managing Competing Values of Beavers (*Castor* spp.) Despite Uncertainty

### 3201 Managing for Competing Values of Beavers in the Western United States

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In the western United States, beaver (*Castor canadensis*) populations are generally considered healthy and are classified by state agencies in a variety of ways from furbearers to predators. Management for beavers now ranges from lethal removal of individuals to relocation of individuals for wetland restoration and to increase wildlife and habitat diversity. My research team and I used radio-telemetry to monitor beaver populations in two distinct areas where managers desired more beaver dams to provide in-stream habitat for anadromous fishes. In an arid rangeland watershed, we monitored vital rates of 43 beavers, 2011-2012, and determined that the beaver population in this watershed was at biological carrying capacity. Thus, we recommended that no beavers be relocated into the system. In a temperate forested coastal watershed, we evaluated beaver relocation as a tool to increase in-stream habitat for coho salmon (*Oncorhynchus kisutch*). From September-December 2011, we trapped and transported 38 individuals to nine release sites where dams constructed by beavers would benefit coho productivity. Beavers moved an average of  $3.3 \pm 0.2$  (SE) stream km from release sites. Survival rate 16 weeks post-release was 0.47 and predation by mountain lion (*Puma concolor*) was the leading cause of mortality. Of the 38 beavers relocated, only five individuals contributed to construction of nine dams. All dams were destroyed by high flows within two months and relocation was ultimately not effective in providing in-stream habitat. Other ongoing interests in using beavers to restore wetlands and adapt to changing climate will be discussed.

### 3202 A Penny Saved? A Cost-Benefit Analysis of Alternative Mitigations for Human-Beaver Conflict

**Glynnis A. Hood**, Varghese Manaloor, Brendan Dzioba, University of Alberta, Camrose, AB, Canada. Contact: [ghood@ualberta.ca](mailto:ghood@ualberta.ca)

With the loss of approximately 70% of non-boreal wetlands in the Prairies of western Canada, there has been an associated decline of waterfowl and fish habitat. Although regulatory measures exist to prevent further loss of wetlands, draining of wetlands maintained or created by beavers is rarely quantified or enforced, despite several studies that indicate that these wetlands provide critical habitat to fish, waterfowl, and other aquatic species and are more resilient to drought. Our research

combines aspects of environmental management and economic decision-making to address wetland loss and disruption of recreational uses of popular trails. Using a cost-benefit analysis and cost-effectiveness analysis, we assessed management actions regarding current and potential beaver-human conflicts. The goal of our study was to quantify the efficacy of “traditional” beaver management approaches and “emerging” methods to compare their benefits and costs. “Traditional” approaches often include dam and/or colony removal, while “emerging” approaches include use of pond levellers, custom fencing, and commercial products. By combining historic and current management costs from managers, “willingness to pay” contingent valuation data from park users, and costs of new approaches, we determined the most cost-effective means for beaver management in the Cooking Lake / Blackfoot Provincial Recreation Area in east-central Alberta, Canada. Almost all devices installed in 2011, have required little to no maintenance, and an additional nine pond levellers installed since reveal similar results. Cost savings for management agencies are significant. Our study informs best management practices to help address a common human-wildlife conflict without compromising wetland function.

### **3203 Spatial Ecology of American Beavers in the Southeastern United States: Spatial Resource Selection, Movement and Ecological Connectivity**

**Guiming Wang**<sup>1</sup>, Jimmy Taylor<sup>2</sup>, Lance McClintic<sup>1</sup>, Jeanne Jones<sup>1</sup>, Eric Dibble<sup>1</sup>, <sup>1</sup>Mississippi State University, Mississippi State, MS, <sup>2</sup>USDA APHIS Wildlife Service, Corvallis, OR, Contact: guiming.wang@msstate.edu

Semiaquatic mammals require both aquatic and terrestrial habitat, particularly interface between the two habitats. As wetland ecosystem engineers, American beavers (*Castor canadensis*) are also sensitive to spatiotemporal changes in habitats and landscapes. We used Bayesian spatial resource selection models to study the effects of landscape structure on habitat selection by American beavers to account for both spatial and temporal autocorrelations in telemetry data. We also tested the resource heterogeneity hypothesis that seasonal variation in food resource availability would reduce American beaver home range sizes at Redstone Arsenal in north central Alabama, USA using radio telemetry. American beavers selected bottomland and upland hardwood forest edges but avoided crop fields. Utilization intensities and movement speed increased with increasing distance from water bodies. Home range sizes of American beaver were inversely related to seasonal coefficient of variation in within-home range normalized difference vegetation index (NDVI), consistent with the resource heterogeneity hypothesis. Additionally, home range sizes increased with increasing within-home range land cover diversity, supporting the resource dispersion hypothesis that habitat fragmentation and resource dispersion would increase movements and home ranges of American beavers. Ecological connectivity analysis based on niche modeling and circuit theory generated the maps of movement currents among 11 wetlands, delineating possible dispersal corridors that had high current values or probabilities of moving through. Ecological connectivity between wetlands provides insight into conserving critical habitat to maintain gene flow of American beavers or managing dispersal habitats to control American beaver abundance.

### **3204 Biology of Unexploited Beavers in Midwestern North America**

**Clayton Neilsen**, Southern Illinois University, Carbondale, IL, Contact: kezo92@siu.edu

Beavers (*Castor canadensis*) are important in ecosystems and to humans. Although beavers are increasingly protected from harvest, relatively few studies of unexploited beaver populations have been reported. Furthermore, few radiotelemetry studies exist for beavers because no practical method of attaching a radiotransmitter to beavers was available until recently. My research team and I used radiotelemetry, remote videography, and trapping data to quantify survival, dispersal, and natality of unexploited beavers in southern Illinois, USA, during 2004 to 2006. We monitored 62 beavers for survival; all mortalities ( $n = 15$ ) occurred during the fall and winter seasons. The pooled annual survival rate for adult and juvenile females was  $0.76 \pm 0.05$ . Annual survival rates for adult and juvenile males were  $0.87 \pm 0.04$  and  $0.55 \pm 0.07$ , respectively. Seasonal survival only differed among sex classes and age classes during the fall. Dispersal rates for juvenile beavers ranged from  $0.38 \pm 0.13$  to  $0.59 \pm 0.13$  and did not vary by sex or age. To quantify natality and recruitment, we captured and euthanized 79 beavers adjacent to our live-capture area; we found a low pregnancy rate of adult females (36%), and no juveniles were bred. Natality of bred females was 3.6 offspring per adult female, and 0.36 kits were recruited per adult female. Apparent kit survival was 28%. Our research provides information to wildlife managers about beaver demographics for a high-density and unexploited population, based on relatively large sample sizes and novel research techniques for the species.

### **3205 Life after Rehab: Can Beavers Survive Bitumen Contamination?**

**Glynnis Hood**, University of Alberta, Camrose, AB, Canada. Contact: ghood@ualberta.ca

Oil and gas exploration and development can result in unexpected releases of petrochemicals into natural habitats of terrestrial and aquatic species. The current trend in Alberta, Canada tends toward the euthanization of adversely affected wildlife. In July, 2013, a Canadian Natural Resources Ltd. bitumen spill at the Primrose site in Cold Lake, Alberta resulted in an estimated release of 1.1 million litres of bitumen. Rather than euthanizing all wildlife that came in contact with the bitumen, the Alberta Government requested that two juvenile and one adult beaver oiled in the spill be rehabilitated by the Wildlife Rehabilitation Society of Edmonton. The beavers were subsequently relocated to a waterbody on private land west of Bowden, Alberta. My research team and I then studied their post-release survival over a 14-month period to assess their overall health, and behavioural ecology. Our research determined that beavers can survive bitumen-contamination for more than a year post-rehabilitation. We also observed that without an adult beaver to aid their behavioural development, the juvenile beavers (< 1.5 years old) would have failed to adequately prepare for winter. Finally, we found that observational studies can reveal unanticipated surprises from even the more commonly-studied species. Our study results could aid policy-development for oil spills involving wildlife specifically, and wildlife rehabilitation guidelines in general.

### **3206 Eurasian Beaver Reintroduction and Genetic Management in Scotland**

**Rob Ogden**<sup>1</sup>, Roisin Campbell-Palmer<sup>2</sup>, <sup>1</sup>Kyoto University, Kyoto, Japan; <sup>2</sup>Royal Zoological Society of Scotland, Edinburgh, United Kingdom. Contact: ROgden@rzss.org.uk

The recovery of the Eurasian beaver, *Castor fiber*, through translocation and natural recolonization is widely recognised as a conservation success story throughout continental Europe. Their total extirpation from the British Isles around 400 years ago has prevented recolonization, leading to a series of official and unofficial attempts to reintroduce the species. Most of these efforts have focussed on Scotland, where a five year scientific trial reintroduction of Norwegian beavers has recently been completed on the west coast, while beavers have simultaneously been released without permission on the east coast's River Tay and Earn catchments. In line with the latest IUCN reintroduction guidelines, the west coast trial reintroduction and the ongoing management of both populations has paid close attention to the selection of source populations and individual beavers in terms of their evolutionary history, genetic diversity and veterinary health. The use of novel genetic analysis methods and veterinary diagnostic screening procedures has allowed a wealth of data to be generated that continues to inform the management of beavers in Scotland and plans for future reintroductions throughout Britain. This paper will present highlights of how cutting edge veterinary and genetic science has been developed and applied to many aspects of Eurasian beaver reintroduction to Scotland, providing resources for similar activities in other areas. The work serves as an example of how best scientific practice can often, but not always, be implemented within a wider socio-economic framework.

### **3207 The Past, Present and Future of Beavers in Europe: Population, Distribution and Management**

**Duncan Halley**, Norwegian Institute for Nature Research, Trondheim, Norway. Contact: Duncan.Halley@nina.no

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## Session 33: Managing Wildlife Populations in the Face of Uncertainty: Seeking Common Practices through a Sharing of Real-World Experiences

### 3301 Disease-Induced Decline of an Apex Predator Drives Invasive Dominated States and Threatens Biodiversity

Tracey Hollings<sup>1</sup>, Menna Jones<sup>2</sup>, Nick Mooney<sup>3</sup>, Hamish McCallum<sup>4</sup>, <sup>1</sup>University of Melbourne, Melbourne, Australia; <sup>2</sup>University of Tasmania, Hobart, Australia; <sup>3</sup>Independent Consultant, Hobart, Australia; <sup>4</sup>Griffith University, Brisbane, Australia. Contact: tracey.hollings@unimelb.edu.au

Apex predators play an important functional role in protecting and preserving biodiversity. Their extensive, worldwide decline has been linked with competitive release of invasive mesopredators and species extinctions. The Tasmanian devil (*Sarcophilus harrisi*) is the largest extant marsupial carnivore and is threatened with extinction in the wild from a transmissible cancer, devil facial tumour disease (DFTD). The disease has been responsible for population declines in excess of 95% in long-term diseased areas and has spread to more than 80% of the devil's current range. We conducted a rapid snapshot survey across the spatial extent of the devil's progressive population decline to assess the response of terrestrial mammalian fauna to devil decline. We assessed whether species composition and degree of homogeneity of mammal communities varied with devil decline using nonmetric multidimensional scaling (nMDS) with the Bray-Curtis dissimilarity matrix and a permutational multivariate analysis of variance. We also utilised generalized linear mixed models (GLMMs) to model: 1) invasive species community composition; 2) mesopredator activity and; 3) the relative abundance of mesopredator prey. We found increased activity of alien invasive species (feral cats, black rats), and reduced small and medium-sized native prey species in response to the timing of the devil decline. In areas of long-term devil decline invasive species comprised a significantly larger proportion of the community. The results provide evidence that the devil plays a keystone role in Tasmania's ecosystem with their decline linked to a shift towards an invasive state and biodiversity loss in Australia's most intact faunal community.

### 3302 Minimizing Impacts to a Population of Endangered Giant Kangaroo Rats during the Development of a Utility-Scale Solar Photovoltaic Energy Facility

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The giant kangaroo rat (*Dipodomys ingens*) is a small, primarily nocturnal, fossorial rodent that forms colonies of burrows called precincts. They are a keystone species in grasslands and shrub communities in California, USA. Currently, the species occupies less than 5% of its historic range. Predicting impacts to this species during multi-year development projects can be difficult because of its life history, including the capacity for rapid population increases in response to favorable climatic conditions. We completed two years of surveys across 2163 hectares to estimate the population size and distribution of giant kangaroo rats on a proposed solar energy site, and used these data to extensively redesign the project to maximize avoidance of occupied habitat. Additionally, avoidance of precincts was accomplished during the construction phase, as each precinct occurring within construction disturbance limits was evaluated on a case-by-case basis to identify precincts that could be avoided. A novel relocation method was used to successfully relocate kangaroo rats, which could

not be avoided through project redesign, to artificial burrows constructed within permanent conservation lands. To estimate the number requiring relocation and establish a permit threshold, we assumed a 10% colonization rate and population growth of 50% each year. We estimated up to 304 giant kangaroo rats would be relocated. The rate of population increase during construction exceeded our estimates, but only 225 individuals (74% of permitted limit) were relocated due to original redesign and commitment during construction to further redesign project elements when feasible to avoid the need to relocate animals.

### **3303 The Importance of Utilization of Multiple Data Sources for Estimating Deer Population Dynamics**

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Large measurement errors are inevitable in the monitoring of wildlife abundance. Then, monitoring must be conducted by multiple indices. However, classical statistical method could not treat multiple indices in a single model and distinguish measurement error and process error (stochasticity in population dynamics). In this study, I developed a Bayesian state-space model to estimate deer abundance by utilizing multiple deer abundance indices. As the deer abundance indices in 5 x 5 km mesh unit, seen deer per unit effort (SPUE), pellet group density, and deer density by block count (BC) surveys were conducted from 2005 in Yamanashi prefecture, central Japan. Latent deer abundance increase by intrinsic population growth rate, decrease by hunting and culling, and fluctuate by process error in process model. Intrinsic population growth rate in each mesh was estimated from the area percentages of forest, evergreen forests, and artificial grasslands (GA). Latent deer abundance linearly correlated to deer abundance indices with measurement errors in observation model. My model revealed that deer abundance in each year and each mesh. The estimation could be conducted only when both of SPUE and BC were available. Intrinsic population growth rate significantly increased with the increase of GA. More than 30 % of deer should be hunted and culled to reduce deer abundance, but the hunting and culling intensity was not accomplished especially in high deer abundance mesh.

### **3304 How to Manage the Mesopredator Release Effect Induced by Multiple Invaders**

**Shota Nishijima**, Yokohama National University, Yokohama, Japan. Contact: [nishijimash@ynu.ac.jp](mailto:nishijimash@ynu.ac.jp)

Removal of invasive apex predators can cause dramatic increases of smaller alien predators and ensuing collapses of their native prey. However, recent empirical evidence finds that the disappearance of apex predators does not reduce, but can increase, prey populations. This poses a great challenge in managing species interactions involving alien mesopredator release. Here we analyze a mathematical model to explain variable consequences of apex predator loss and to develop management guidelines for prey conservation. The model formulates an intraguild predation system (apex predators, mesopredators, and their shared prey) with mesopredators supplied with additional alternative prey. We show that apex predator loss causes only negative effects on shared prey without alternative prey, but has either negative or positive effects with alternative prey. Moreover, when alternative prey is highly abundant, apex predator loss causes strong mesopredator release and reduces shared prey greatly. Lastly, the model suggests that a viable management strategy to restore shared prey under much uncertainty about a target system is



to allocate a limited control effort not only to both invasive predators but also to alternative prey. Alternative prey for alien mesopredators may be a crucial ingredient that controls the cascading dynamics of intraguild predation systems, and should be considered as an important management target.

### **3305 Deer Population Management: A Proposed Zone-Based Management Approach for the Yakushima Island Population**

**Aomi Fujimaki**<sup>1</sup>, Katsunori Shioya<sup>2</sup>, Satoshi Tagawa<sup>3</sup>, Hiroyuki Matsuda<sup>4</sup>, <sup>1</sup>Yokohama National University, Yokohama, Japan; <sup>2</sup>Kagoshima Environmental Research and Service, Kagoshima, Japan; <sup>3</sup>Ministry of the Environment, Kagoshima, Japan; <sup>4</sup>Yokohama National University, Yokohama, Japan. Contact: fujimaki-aomi-nf@ynu.jp

The biological values of Yakushima Island are currently being compromised by an overabundant population of sika deer. Many studies have applied population models to investigate the deer population in Japan (Kaji et al. 2010 *Popul Ecol* 52:373; Matsuda et al. 1999 *Popul Ecol* 41:139; 2002 *Wildl Soc Bull* 30:1160). In this study, we used a matrix population model and took account for actual zones and goal in the Specified Wildlife Conservation and Management Plan for sika deer on Yakushima Island. We determined that the deer population on the island would continue to increase if population control efforts were less than three-fold as many as the 2012 levels. We considered possible management responses to address this issue. Under the current management with no dispersal, the median of the island population size will increase after temporarily decreasing. In all zones, the probability of achieving target deer densities under the current management with dispersal is lower than those under the management with no dispersal. The Priority Scenario prioritizes some zones where more threatened species exist than other zones. Simulations of population dynamics under this scenario with no dispersal indicated that if management efforts were concentrated on the Central zone, the median of the island population size decreased. In some zones, the probabilities of achieving target densities under Priority scenario with dispersal were higher than those without dispersal. In these zones, the ratios of the catch size needed to achieve target to the current catch size were higher than those in other zones.

### **3306 The Role of Population Models in Wildlife Management: Seeking Feasibility, Cost-Effectiveness and Consensus Building**

**Hiroyuki Matsuda**, Yokohama National University, Yokohama, Japan. Contact: matsuda@ynu.ac.jp

I introduce case studies, (1) cormorant management in Shiga and (2) bird strike risk of Awara Windfarm. (1) Cormorant, *Phalacrocorax carbo*, has once been threatened but recently are overabundant, resulting in damage on fisheries and forests in Lake Biwa. The forestry sector chased away them from their colony because the colony is a good forest. The fisheries sector shot cormorant in the colony because sharp shooting using air guns in the colony is effective for nuisance control. A population model was useful for consensus building. These sectors agreed with sharp shooting as an effective way of population control. After the cormorant population significantly decreases, they may prefer different way. (2) Awara windfarm was established between Lake Katanokamoike and a geese, *Anser albifrons*, feeding habitat. Several thousand geese fly near the windfarm every morning and evening in winter season. We estimate the collision risk of geese and the allowable number of bird strikes that guarantees the persistence of the local geese population in

Katanokamoike. We also showed some mitigation measures that reduce the bird strike risk. The windfarm has been established. Three years after the windfarm was established, the environmental group agreed that the mitigation measures are not necessary because the bird strike risk is low. As lessons learned from these experiences, a socio-economic approach is needed for the wildlife management. An extensive effort of population control probably pays in the long run, even though it is difficult for agreement of the government and tax payers.

## Session 34: Road Ecology in Asia: Current State of the Science of Impacts and Mitigation

### 3401 The Current State of Wildlife-Vehicle Collisions in Hokkaido

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Collisions between vehicles and wildlife, particularly large ungulates are a serious problem in many countries around the world. The damage from such collisions, including injuries and fatalities of humans and animals, tends to be serious. The number of sika deer (*Cervus nippon yesoensis*) on Hokkaido, the northernmost island of Japan, is steadily increasing, as are deer-vehicle collisions.

This study identifies tendencies of wildlife-vehicle collisions, especially those of sika deer, in Hokkaido. The data that are used for the analyses in this study have been offered by the Hokkaido Regional Development Bureau and the Hokkaido Prefectural Police. The results show that sika deer was the wildlife which most frequently collides with vehicles in Hokkaido, followed by red fox (*Vulpes vulpes schrencki*) and raccoon dog (*Nyctereutes procyonoides albus*). The collision accidents number of sika deer was chronologically increasing and the spatial distribution of the accidents almost coincides with that of sika deer population. It has also been identified that deer-vehicle collision accidents occur more frequently in spring and fall. However, the period of high deer vehicle accident slightly differs by area.

We found that deer vehicle-collisions increased in sunset time all year round, likely due to increased activity of deer and reduced driver's visibility. Our monitoring data also show that the features of wildlife-vehicle collisions were affected by the spatial distribution and ecology of wildlife. Thus considering the differences in wildlife ecology would be important to seek the solution of the collision accidents.

### 3402 Compliance Evaluation and Effectiveness of Wildlife Passages in South Korea

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Korean transport infrastructure development has increased significantly since 1990s. Habitat fragmentation due to transport infrastructure is recognized as one of the main causes of local wildlife extinction. Wildlife passages can reduce rate of road mortality and preserve biodiversity by connecting fragmented habitats.

The Korean government is dedicated to promote construction of wildlife passages to reduce effects of habitat fragmentation. Ministry of Environment established guidelines for design and management of wildlife crossing structures in 2003. Over the last 20 years, 415 wildlife passages, 200 overpasses and 215 wildlife underpasses have been constructed on the existing roads. However, the uses and effectiveness of passages have not been evaluated or proved.

The objective of this study is to analyze the compliance with the guidelines and effectiveness of wildlife passages. We conducted camera trapping, compliance evaluation and field survey on 95 passages on highways, national roads and local roads. Mean compliance rate with the guidelines was 33% and 22% for overpasses and underpasses respectively. We documented uses of wildlife passage by 8 mammalian species. Mean use rate of passage was 1.1 times/day. The use rate of passage and linkage patch size were positively correlated ( $r = 0.71$ ). Overall, mammals were more likely to use wildlife overpasses that  $>7$  m wide. Small-medium carnivores ( $< 10$  kg) used all underpasses regardless of length, width and openness, on the other hand, large herbivores selected passages with  $>0.7$  openness ratio (height  $\times$  width /length).

### **3403 Social Media as Citizen Science Platforms for Monitoring Road-Kills of Wildlife in Taiwan**

**Te-En Lin**<sup>1</sup>, Shih-Wei Chang<sup>1</sup>, Chih-Yun Chen<sup>1</sup>, Yu-Kai Chen<sup>1</sup>, Tyng-Ruey Chuang<sup>2</sup>, Dong-Po Deng<sup>2</sup>, Cheng-Hsin Hsu<sup>2</sup>, Jheng-Jhang Li<sup>3</sup>, Da-Li Lin<sup>1</sup>, Lucien C. H. Lin<sup>2</sup>, Guan-Shuo Mai<sup>2</sup>, Kwang-Tsao Shao<sup>2</sup>, Cheng-Te Yao<sup>1</sup>, <sup>1</sup>Taiwan Endemic Species Research Institute, Nantou County, Taiwan; <sup>2</sup>Academia Sinica, Taipei, Taiwan; <sup>3</sup>National Museum of Marine Biology and Aquarium, Pingtung County, Taiwan. Contact: dnlin@tesri.gov.tw

Rapid development of road systems represents a serious threat to wildlife worldwide. However, general public are not aware of ecological impacts of roads, and large-scale surveys of road-kills have not been conducted in Taiwan. To increase public participation in scientific research of road ecology and understand the severity of road-kills, we launched a Facebook group "Reptile Road Mortality" as a citizen science platform in 2011. We encouraged public to record road-kills and upload the information including photo, date and location to the Facebook group, and help our institute to collect bodies of road-kill victims. Through the platform, we successfully increased public attention to road impacts on animal populations. Group members increased 9 times from 800 people in the first year, to ~7000 people within 3 years. In the past 3 years, 1,526 contributors upload 20,828 records of road kills for terrestrial wildlife, mainly located at suburban areas with elevation  $<1,000$  m. Total 373 species were identified, and the majority (52%) were reptiles, followed by birds (19%), with a few species of mammals (11%), amphibians (9%), and land crabs (9%). The platform has contributed tremendous amount of data of road kills that produced the largest database for native reptiles in Taiwan (9,573 records), and provided an alternative source of specimens for research and monitor of rabies and pesticide residue. We suggest that, with systematic methods and appropriate analyses, social media such as Facebook pose a great opportunity to incorporate citizen science in road ecology research.

### **3404 Logging Road Can Be a Quantitative Criteria of Biodiversity Safeguard in Malaysian Production Forests**

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Quantitative criterion for biodiversity safeguard are urgently needed to measure the attainment of the biodiversity conservation. To provide a quantitative criteria for safeguarding of biodiversity in tropical production forests in Malaysia, we conducted researches in a production forest in Temengor Forest Reserve, Perak, Malaysia with paying special attention to the effects of road networks such as

skid trails, logging roads, and log yards on biodiversity of dung beetles and small mammals. Species assemblages of dung beetles as well as small mammal along and adjacent to road networks were largely different from those in forest interiors, suggesting that the road networks deteriorate diversity of forest fauna. Our field experiments on dung removal by dung beetles showed dung decomposition and secondary seed dispersal by dung beetles were less active along road networks than in forest interiors. This suggested that ecological functions provided by biodiversity were impaired along road sides. Our study strongly suggests that minimizing the road network density will contribute to biodiversity protection in a production forest. Therefore, we may be able to use road network density as a quantitative criteria for safeguarding biodiversity in Malaysian production forests. What is better, a road network is detectable by remote sensing techniques and thereby we can easily measure and verify a road network density in a production forest, which enables us to check the implementation of the criteria.

### **3405 The Effects of Major Roads on Bats in Singapore**

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Roads and vehicular traffic pose many challenges to the conservation of wildlife, which includes habitat loss, road-kills, and severing of commuting routes in natural areas. A growing number of studies have examined the effects of roads on different species in recent years but the majority was conducted in temperate regions. This study based in tropical Singapore used bats as an indicator taxon to ask two questions: 1) Are bat activity and diversity correlated with distance from major roads? 2) Do bats use mitigation structures, such as green bridges, to cross a major road? We investigated the effects of three major roads on bat activity and diversity in Singapore. During September 2013 to February 2014, bio-acoustic surveys of bats using a portable full-spectrum bat detector were conducted in both forest and urban environments along 800-metre transects perpendicular to the major roads. We recorded bat activity at ten recording points along each transect at a standardised duration post sunset. We examined the influences of environmental variables (e.g. light levels, noise, micro-climate) on activity and density of bats and compared the results with those in temperate regions. Finally, we assessed the role of a wildlife overpass in mitigating the barrier effects of the Bukit Timah Expressway in relation to bats.

### **3406 The Roadkills and Mitigation Efforts on Freeways and Forest Roads in Taiwan**

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As an environmental consulting company and one of the pioneers in road ecology in Taiwan, we have been cooperated with the Taiwan Area National Freeway Bureau, the Forestry Bureau, the Directorate General of Highways and local governments to monitor vehicle-induced mortality and design mitigation measures for wildlife-vehicle collisions, including warning signs, fences, underpasses and overpasses. We evaluated risk of road mortality and identified hotspots of road kills along freeways and forest roads in Taiwan. We designed the protocols for highway cleaners to conduct daily road-kill surveys along freeway shoulders and surveyed 4 forest roads with high risk of road mortality among 80 forest roads. Substantial number of road kills for vertebrates were recorded: >46,000 individuals in 5 years along freeways, and > 2,500 individuals in 1 year on forest

roads. Birds (73%), dogs and cats (19%) were the most common groups of road kills on freeways whereas amphibians (72%) and reptiles (23%) represented 95% of road mortality on forest roads. *Canis lupus familiaris*, *Columba livia*, *Passer montanus*, *Streptopelia chinensis*, *Streptopelia tranquebarica*, and *Felis catus* were the most impacted by road mortality on freeways, and *Rana sauteri*, *Bufo bankorensis*, *Buergeria robusta* and *Sphenomorphus indicus* were the most common species on the forest roads. To reduce rate of road kills while maintaining animal movement across roads, fences and wildlife overpasses and underpasses that modified from the existing bridges and tunnels were installed over 5km sections of freeways and two underpasses and fences were built for *Rana sauteri* on a forest road.

### **3407 Road-Crossing Structures for Arboreal Small-Mammals and Bats in Hokkaido, Japan**

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Roads cause habitat fragmentation and restrict animal movement, and therefore pose a great threat to wildlife conservation. In Hokkaido, Japan, We monitored wooden bridged and gliding poles to restore movement path of red squirrel (*Sciurus vulgaris*) and Siberian flying squirrel (*Pteromys volans*) and modified the existing culverts for bats to mitigate barrier effects of roads. We observed the uses of road crossing structures by red squirrels from May to November 1997. Red squirrels used the bridge several times during seven months without walking on the road. From May 2003 to April 2005, we used night-vision cameras with video system and an infrared sensor to monitor the uses of wooden bridges inside a culvert and gliding poles erected on both sides of a roads by Siberian flying squirrels,. The use of poles was not observed, but its feasibility was confirmed in a trial by capture-recapture method. Wooden bridge was used by Siberian flying squirrels throughout the year, although there was seasonal change such as decrease in midwinter. The number of use increased in the second year compared to in first year. We recorded the uses of the culvert by six species of bats and documented reproductive activity and temperature changes from 2007 to 2008 with a night-vision video system.

### **3408 The Influences of Body Size and Road Width on Barrier Effects of Roads in Mammals: A Meta-Analysis**

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Anthropogenic habitat fragmentation and destruction caused by development of infrastructure are recognized as major threats to biodiversity. Behavioral responses such as road avoidance and life history traits of species are critical in assessment of effects of linear development on species persistence. We conducted a meta-analysis with data from 35 studies that quantified road crossings by at least 1 species of mammals to determine influences of body size and road width on barrier effects of roads. A total of 117 records of road crossings by 44 species were extracted and small mammals with body mass <100 g represented 84% of species. Overall, roads are barriers, although a taxonomic bias toward small species was evident and studies show insignificant barrier effects of roads were underrepresented. The barrier effects of roads estimated by different methods vary considerably. Capture-recapture methods detected lower rate of road crossings compared to tracking methods. Small mammals (<150 g) were more likely to cross roads after translocation and

the probability of crossing was not affected by road width and body mass. For data collected by observation, body mass and road width explained 41.02% of heterogeneity among data. Effect size decreased as species body mass increased, and was positively affected by increasing road width. We demonstrated that interspecies variation in barrier effects of roads can be explained by road width and body size for mammals and suggest the species-specific magnitude of barrier effects of roads may be anticipated with basic information of life history traits and road characteristics.

## Session 35: Ecology and Conservation of Tibetan Antelopes

### 3501 Mystery of Seasonal Migration of Tibetan Antelopes

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Ungulates often migrate seasonally for long distances. Many kinds of temperate deer, for example, red deer (*Cervus elaphus*) and mule deer (*Odocoileus hemionus*), regularly migrate between their summer habitats and wintering areas. The maximum round-trip distances sometimes reach several hundred kilometers. On the other hand, ungulates in African savannas circuitously migrate for more than one thousand kilometers with large herds of multiple species, including wildebeest (*Connochetes taurinus*), zebra (*Equus burchelli*), and Tomson's gazelle (*Eudorcas thomsonii*). These migrations vary in length and route from year to year. In the polar region, caribou (*Rangifer tarandus*) migrate between their calving and winter-feeding areas for several hundred kilometers. Migration behavior evolved as a way to optimize food availability, which is change annually, depending on several environments inside of habitats. Tibetan antelopes (or chiru, *Pantholops hodgsoni*), endemic and endangered species in the Tibetan plateau, also migrate for long distances between their calving grounds and wintering areas. Most of pregnant females migrate from their wintering areas in May and June, calve and return their wintering area by late July or early August, while most of barren females either do not migrate or move only short distances. By contrast, most males travel only relatively short distances in distinct migration routes differ from those of females. Food quality, insect harassment, predation, and snow might have an influence on their movements. Solution of migration patterns of Tibetan antelopes will contribute to their conservation.

### 3502 Vanishing Wildness: Livestock Grazing and Wild Ungulates Conservation in Chang Tang, Tibetan Plateau

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Chang Tang in northern Tibet is the highest and largest protected wilderness area in the world. Pastoralists settled into the northern portion of Chang Tang in 1970s. Since then, pastoralists and livestock occupied habitat that had been exclusively utilized by wild ungulates. Repeated surveys on wild ungulates and livestock in two Chang Tang basins were conducted from 2003 to 2010. Significant differences in density of ungulates were detected between Garco-Cuoqiang basin and Ejiu basin. The Garco-Cuoqiang basin had higher densities of kiang, but lower densities of chiru than Ejiu basin. No differences in gazelle nor wild yak were detected. Meanwhile, Ejiu basin harbored higher densities of livestock. As for biomass, kiang accounted for 64.5% of the total biomass of wild ungulates, followed by chiru (32.9%), wild yak (2.1%) and Tibetan gazelle (0.5%) in Garco-Cuoqiang basin. In Ejiu basin kiang accounted for 99.2% of the total wild ungulate biomass and Tibetan gazelle

accounted for the remaining 0.8%. Based upon population estimates of wild and domestic ungulates, wild ungulates account for nearly 26% of all ungulate biomass in kg at Gacuo-Cuoqiang and about 25% at Ejiu. The results indicated that livestock grazing and associated human activities may be responsible for the local extirpation of chiru and wild yak in the Ejiu basin. Since the 1970s, humans and livestock have increased steadily in Chang Tang. Infrastructure improved rapidly during the last decade. To conserve the unique wild ungulate guild and this unique area of the Tibetan Plateau, ecologically-sensitive development will be required.

### **3503 Migration Patterns and Habitat Use of the Tibetan Antelope (*Pantholops hodgsonii*) Based on Argos Tracking in Qinghai-Tibetan Plateau, China**

**Buho Hoshino**, Rakuno Gakuen University, Ebetsu, Japan. Contact: aosier@rakuno.ac.jp

This study aims to identify the ecological drivers of the Tibetan antelope migration in terms of geographical characteristics, topographical variables of their ranges and the factors affecting the habitat selection within the seasons, the Argos transmitter satellite monitoring of the Tibetan antelope was performed. The analysis included the LoCoH Hull method for the home range estimation and the Maximum Entropy analysis for the habitat selection modelling, used for the first time on this species. The analysis of the Argos system accuracy in given conditions revealed less accuracy and fewer signals during the winter season. Location errors were concentrated distribution in the latitudinal direction, 67.52% of locations were accurate. The main pastures of the studied females were divided in three groups by their locations. The calving ground continued to be stable while wintering places changed easily. The Tibetan antelope used to start the migration in the middle of May and came back in the middle of August. The annual habitation area varied from 2024 to 2908 km<sup>2</sup>, and the wintering place located in a valley with the average home range of 441 km<sup>2</sup>. The home ranges located near the artificial barriers (railway and a highway) had the shape, dependent on the linear construction and the migration corridor was wider in that area. The Maximum Entropy analysis showed the area, estimated as suitable for habitation, however, almost half of the most suitable area was out of the identified home ranges.

### **3504 The Research Status of Tibetan Antelope in Xinjiag, China**

**Halik Mahmut**, Xinjiang University, Urumqi, China. Contact: reddeer512@sina.com

The Tibetan antelope (*Pantholops hodgsonii*), endemic to the Tibetan Plateau, mainly distributed high mountainous and desert grasslands in Qinghai, Xinjiang, China. Tibet and Sichuan et al province and regions, altitude is 3700~5500 m from sea level. In recent decades, because of habitat destruction and illegal poaching, the populations of the species have been threatened. Habitat fragmentation and sharp drop of population quantity of Tibetan antelope draw close attentions of the world and listed as endangered species. Kunlun-Altun mountain located contiguous area of Qinghai, Xinjiang and Tibet, northern latitude 36°42'-38° 30' and East diameter 88°50'-90°40'. In recent years, the population quantity of Tibetan antelope in Altun Mountain National Nature Reserve, Xinjiang was surveyed, meanwhile the study of genetic diversity, gene flow, population evolutionary history and habitat environment evaluation was carried out. Here, the paper mainly summarizes research situation of Tibetan antelope in Altun Mountain National Nature Reserve. It was supported by National Nature Science Fund project (Issue: 31360266); Xinjing University Regional Key Discipline-Zoology Discipline Fond.

## Session 37: Non-Visual Observation of Marine Mammals Using Innovative Technology

### 3701 Non-Visual Observation of the Predator-Prey Interactions of Marine Mammals

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To study the behavior and physiology of marine mammals that swim far from shore and dive deep beneath the waves, we use biotelemetry instruments to “virtually” dive along with them. I will describe methods we’ve used to study endangered Steller sea lions, their potential competitors, including human fisheries and northern fur seals, and their main predator, killer whales. Our research on the diet overlap between Steller sea lions and northern fur seals includes standard methods such as analysis of scats and stable isotopes, but also underwater seal and sea lion “head cam” video and simpler measures of prey ingestion including head-striking acceleration and stomach temperature telemetry. Although we have succeeded in attaching relatively large but streamlined instrumentation packages to these pinnipeds, their predator, the killer whale, as well as many other cetaceans, remain an enigma because of the difficulties of attaching devices to animals that don’t come ashore and don’t have fur to glue to. We’ve developed attachment techniques for whales, facilitating focal follows of mammal-eating killer whales, but also opening up research possibilities for many other cetaceans that were previously difficult to study. I will discuss how we have optimized tag design (using computer simulation and physical models) and the attachment techniques for remotely projecting very small satellite transmitters through the air, and how we are now working towards delivering, keeping attached, and retrieving data from larger, more complex instrument packages for cetaceans, while also measuring and minimizing the impact of these devices on the instrumented animals.

### 3702 Acoustic Remote Sensing of Small Odontocetes: Movement, Distribution and Density

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Cetaceans are the key species in the ocean eco system. Traditionally they have been observed visually at surfacing for respiration. However in these couple of decades, passive acoustic monitoring (PAM) is getting popular for cetacean census. Cetaceans produce distinctive and species/family specific sounds, which can be used to monitor presence of animals. PAM is quite strong to provide evidence of presence if the target sounds are produced frequently but weak to support evidence of absence during the animals keep silence. PAM has not been well developed to monitor population or group size, which is the most important information for the wildlife management. To fill this gap, we have developed to count the number of small odontocetes using a stereo event recording system (A-tag, Marine Micro Technology, Saitama, Japan) to count the number of echolocating small odontocetes. Independent sound source bearing angles was used as the proxy of number of existing animals. Stationed A-tag recorded local movements of phonating odontocetes, which was related with the tidal current and time of a day or a year. Towed A-tag revealed highly concentrated area of porpoises and seasonal change of distributions on transect lines of thousands kilometers. Extended mark recapture method using visual-acoustic or acoustic-acoustic means solved absence-or-silence issue. Recapture was defined by detections within a time window recorded by independent



monitoring means. This method provides estimation of detection probability of odontocetes that allows calculation of existing density of animals in the focal area including silent individuals.

### **3703 Underwater Observation of Harbor Seal Behavior in a Set Net Using an Underwater Camera and Acoustic Sonar**

**Yasuzumi Fujimori**<sup>1</sup>, Yousuke Ochi<sup>2</sup>, Shintaro Yamasaki<sup>2</sup>, Kaoru Fujita<sup>2</sup>, Ryohei Ito<sup>3</sup>, Yuhei Kawamoto<sup>3</sup>, Yumi Kobayashi<sup>3</sup>, Yasunori Sakurai<sup>3</sup>, <sup>1</sup>Hokkaido University, Hakodate, Japan; <sup>2</sup>Fisheries Research Agency, Kamisu, Japan; <sup>3</sup>Hokkaido University, Hakodate, Japan. Contact: fujimori@fish.hokudai.ac.jp

The interaction between harbor seals and salmon in a set-net fishery has markedly increased in this decade along the east coast of Hokkaido, Japan. This interaction causes damage to catch and sometimes to the fishing gear, risking the lives of harbor seals. To reduce such an interaction, modifying the fishing operation and gear is necessary. Therefore, we have observed salmon and seals in a set-net fishery for gaining knowledge regarding their behavior. Two types of devices, TrawlCamera (JT Electric) and dual-frequency identification sonar (DIDSON; Sound Metrics), were employed in this study. TrawlCamera is an optical camera that can be used under a low light condition. Further, DIDSON is an underwater imaging device, which provides near-video-quality images for identifying objects. TrawlCamera was set in the chamber end to film the entrance of the bag net at the end of the set net, and DIDSON was set outside the bag net to observe inside the bag net. Both devices confirmed that salmon would enter the set net, irrespective of the time. Meanwhile, as observed using DIDSON, seals frequently appeared in the bag net from dusk to night, suggesting that seals predate salmon during this period. These results reflect that damage to catch would be decreased by changing the time of net hauling that is conducted around noon to late afternoon, approaching dusk.

### **3704 Coupled Thermal and Photographic Surveys for Abundance and Distribution of Ice-Associated Seals in the Bering and Okhotsk Seas**

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U.S. and Russian Federation scientists collaborated to conduct comprehensive aerial surveys of ice-associated seals (bearded, spotted, ribbon, and ringed seals) in the Bering and Okhotsk seas in spring, 2012 and 2013. U.S. survey flights covered the pack-ice zone of the eastern Bering Sea, and Russian Federation flights covered the pack-ice of the western Bering Sea and Sea of Okhotsk. Three aircraft flew more than 87,000 km during 117 survey flights, and collected more than 2.2 million digital photos and 5.4 terabytes of thermal images. This program incorporated two significant innovations that differentiated it from previous efforts to estimate seal abundance and distribution in the regions. First, the detection of seals was conducted by instruments rather than human observers; the surveys relied upon thermal imagers to detect the warm bodies of seals against the background of the cold sea ice, and high-resolution digital photographs to identify the seals to species. Second, the analytical approach was based upon a statistical model, rather than a survey design. A Bayesian hierarchical model provides an effective means of incorporating both spatial and temporal variation due to environmental factors. This modeling approach also accounts for incomplete detection, and errors in species identification. Initial estimates from a small portion of the U.S. survey data indicate that even after accounting for more sources of variability than has been done in previous surveys,

the final abundance estimates will be substantially more precise and reliable than previous estimates.

### **3705 The Size Structure of Hauled-Out Seals Using an Unmanned Helicopter (UAV)**

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Cape Erimo is the largest hauled-out site for Kuril harbor seals (*Phoca vitulina stejnegeri*) which inhabit Hokkaido. In the 1970s, there were only about 150 seals, but in 2007, more than 600 were counted, and their population has been increasing in recent years. Accordingly, it is reported that the landing areas used by this species have been increasingly located further offshore. An understanding of the change in how they use the landing reefs is significant from the viewpoints of both population dynamics research and landing behavioral studies.

In this study, using an unmanned helicopter (Aryon Labe Sky Ranger) (hereafter, UAV), we photographed the landing reefs used by the seals from above, corrected position data from these images to create one tiff image, and measured the body length of seals that landed on each reef. By analyzing the body lengths from the UAV pictures using QZIS (cross-platform open source software), and measuring the body length 3 times for each seal, we calculated the average-value and standard deviation. It was found that there was almost no measurement error. Moreover, it was clear that there was a significant difference in the body length of seals depending on the reefs, suggesting that reefs further offshore were used more by bigger seals.

### **3706 Using High-Resolution Time-Laps Photo Cameras for Long-Term Surveillance of the Steller Sea Lion Rookeries and Haulouts**

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The Steller sea lion (SSL) has strong site fidelity to its rookeries and haulouts. Once established, these sites can persist for dozen or even hundreds years. This allows the use of automated time-lapse cameras (TLC) for long-term surveillance of SSL sites to collect information on presence/absence on land, diurnal and seasonal abundance changes, age and sex composition, events of disturbance and mortality, and monitoring of branded individuals and their activity, breeding performance, and first months of pup survival. In spring and summer of 2012, a total of 30 TLC sets were tested on 10 SSL rookeries in western Alaska and Russia (2-6 sets per site). Each TLC was custom built, containing a high resolution DSLR camera (Canon T3 or Sony A390), zoom lens (18-300 mm), timer, power adapter, light sensor, all placed into a waterproof Pelican case with a small window and weather hood. Power was provided by a charge regulated solar panel. Each TLC was completely autonomous and automatically took pictures of a portion of the rookery from dusk to dawn at preset time intervals. By July 2013, cameras were present on rookeries 330±16.7 days, of which 289±19.3 days they collected photographs. A total 431,102 images were collected and archived. Analysis of images yielded a comparable amount of SSL brand resight information as observers at field camps. The test demonstrate the high potential of TLCs for long-term monitoring of SSL rookeries and haulouts.

## Session 38: Genetics on Isolated Populations

### **3801 Founder Effects on the Japanese Populations of the Masked Palm Civet *Paguma larvata*, Revealed by Molecular Phylogeny and Population Genetics**

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Among the mammalogists in Japan, it has been long argued whether the masked palm civet (*Paguma larvata*) is an endemic or an artificially introduced species to the Japanese islands. To unveil this question, our group investigated molecular phylogeography and population genetics on the Japanese populations of the masked palm civet, compared with populations native in Taiwan and Southeast Asia. As a result, some of mitochondrial DNA (mtDNA) haplotypes identified from Japan were found also in the population of Taiwan, but not in those of Southeast Asia: mtDNA types from eastern Japan were found in western Taiwan and those from western Japan were in eastern Taiwan. One phylogenetically missing mtDNA type in Japan was at last found in Taiwan. These results show that one of origins for the Japanese populations is Taiwan, and that the central area (Gunma Prefecture) on the Honshu Island is a contact zone between eastern and western migration of the populations. Population genetic analyses using newly developed microsatellite markers supported mtDNA phylogenetic data, and indicated that the population of the Shikoku Island is genetically different from those on Honshu. It suggests occurrence of at least three lineages of founders in eastern Honshu, western Honshu, and Shikoku, respectively. These genetic features are thought to be evidence for founder effects in the masked palm civets in Japan. Further genetic studies provide more insight to understanding whether some founders from other origins are involved in the introduction to Japan and how the migration is expanding on the Japanese islands.

### **3802 Population Genetics of the Red Fox on Mt. Hakodate, Hokkaido, Revealed by Non-Invasive DNA Analysis**

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The red fox (*Vulpes vulpes*) is widely distributed in the northern hemisphere, and has a high ability to adapt themselves to various environments including forests, deserts, tundra and urban areas. This species lives on Mt. Hakodate (334 m; 3.26 sq km), Hokkaido, Japan, which is surrounded by the sea and an urban area, and then geographically isolated from the Hokkaido mainland. To examine the genetic structure of this isolated red fox population, in the present study, we non-invasively collected 150 feces on Mt. Hakodate from 2009 and 2011, and analyzed the genotypes at eight microsatellite loci using the DNA extracted from the fecal samples. The population genetic analyses of the obtained genotypes showed that the fox population of Mt. Hakodate was remarkably differentiated from those of the mainland of Hokkaido. It indicates that the urban area of Hakodate is a geographic barrier to the fox migration between the mountain and the mainland. In addition, the population of Mt. Hakodate had the lower genetic diversity than other populations in Hokkaido and an extremely high population density (about 14 foxes per sq km) estimated. The results suggest that the red fox has adapted to the isolated environment on Mt. Hakodate, utilizing an abundance of food resources in the mountain and the nearby urban area.

### **3803 Fragmentation of the Endangered Blakiston's Fish Owl (*Bubo blakistoni*) Population on Hokkaido Revealed by Genetic Analyses on Museum Samples**

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The Blakiston's fish owl (*Bubo blakistoni*) was previously widespread on Hokkaido Island, Japan, but their habitats have been fragmented and currently distributed in limited forest areas. To reveal the temporal and spatial changes in population structure and genetic diversity, we analyzed samples of the owl including old museum specimens collected for the last 100 years. The results showed that most mitochondrial DNA haplotypes were distributed over wide areas on Hokkaido, and that the local populations had been isolated since the late 20th century. The microsatellite analyses and field observations implied the smallest population size on Hokkaido in around 1980s when forest and river environments were destroyed by human activities. It indicates that the Blakiston's fish owl population on Hokkaido has recently been decreased and fragmented due to loss and division of habitats. For the last 30 years, the genetic diversity has been decreased due to genetic drift and/or inbreeding in the tiny local populations. In addition, the results suggest that recent dispersal of a few individuals occurred among local areas, and that movement of a small number of individuals can recover the genetic diversity. Promoting movements among local populations could be effective against decreasing of genetic diversity of the species. It is necessary both to monitor changes in genetic diversity and study the movement of individual owls in the field for long-term conservation activities of the Blakiston's fish owls on Hokkaido.

### **3804 Potential Habitats and Potential Source Populations for Otter Reintroduction to Hokkaido, Japan**

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The otter (*Lutra lutra*) in Hokkaido, Japan, was extinct in the late 20th century. Intensive trapping and habitat deterioration are two major causes of the extinction. The Shari Town Office in eastern Hokkaido is currently trying to recover the forest ecosystem including local extinct species, such as the otter. In order to evaluate the feasibility of the otter reintroduction, it is important to further understand the habitat potential and biological characteristics. Firstly, we conducted field surveys in Sakhalin, Primorsky region, and Khabarovsk region, and recorded locations of detected otter feces and footprints. Secondly, we calculated the river slope, distance from the coast, and river shapes around the otter track locations by GIS analysis based on Shuttle Radar Topography Mission (SRTM-3) data. Thirdly, we estimated potential otter habitats in Hokkaido by GIS analysis based on the SRTM-3 data and geographical conditions of the otter track locations in Russia. The result showed that the otter used various habitat types, including small streams, large rivers and coasts. It suggests the otter's adaptation to wide range of environments. In addition, based on records of archaeological remains and fur trades in Hokkaido, it was revealed that the otter was distributed through entire Hokkaido before the extinction. To more characterize this animal, ancient DNA on otter remains from Hokkaido was analyzed, and compared with those of the continental otters.

### 3805 Genetic Polymorphism and Characteristics of the Formosan Sambar

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Taiwan, a tropic island, has been connected to the Asian continent via land-bridges and isolated during different glacial and interglacial periods. Possessing over 100 mountains with altitude higher than 3,000 meters above sea level, different climate zones and ecosystems were created in Taiwan, which makes it an ideal place to study the genetics of isolated populations. The population of Formosan sambar (*Rusa Unicorn swinhoii*), which inhabits Taiwan, is distributed in the most east region of sambar in the world. In the present study, 120 mitochondrial DNA D-loop sequences obtained throughout mountain ranges of Taiwan were applied to investigate the polymorphism and characteristics of the Formosan sambar. Bayesian and Maximum likelihood phylogenetic trees showed two major clades with high bootstrap values. The distributions of two major clades were precisely concordant with their geographical distribution. High haplotype diversity ( $h > 0.5$ ) and low nucleotide diversity ( $\pi = 0.001$ ) was shown in both clades, indicating that the populations might have experienced population bottleneck followed by rapid population growth and accumulation of mutations. Considering the genetic characteristics and geographical distribution, it is urgent to explore the potential environmental factors that cause the genetic differentiation between two major clades of the Formosan sambar.

## Session 39: Consecutive Monitoring of Japanese Black and Brown Bear Population Trends: Practicable Methods and Implementation Systems

### 3901 The Status of Brown Bear Population Monitoring in Europe

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The public and wildlife management agencies usually require reliable estimates of the numbers and trends of brown bears (*Ursus arctos*), because this is a species of management concern wherever it is found. Here we will present an overview over the methods used to monitor brown bear populations in Europe. Although all countries in Europe have some form of population estimation and monitoring, their scientific quality varies considerably. Here, we define scientific quality in terms of providing a method that has been tested and verified independently and providing a quantitative measure of confidence in the accuracy of the estimate. Of course, the requirements for scientific quality vary based on the needs of management, which are affected by the level of the conflict, the conservation status and size of the population, whether it is hunted or not, and the society's financial resources. Many countries use collected DNA (from scats or hairs) to estimate population size (Norway, Sweden, Italy, Austria, Spain, France, Greece, Slovenia) and others use genetic methods to compliment or confirm data obtain by other methods, such as counts at feeding sites, snow tracking, and telemetry (Croatia, Poland, Slovakia). In other countries, estimates often are based on reported observations and/or expert opinion. In hunted populations, harvest data is used to identify population trends. We will also discuss the problem of estimating the size of transboundary populations, which may lead to overestimates of population size.

### **3902 Monitoring American Black Bear Populations and Trends: Matching Methods to Needs**

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During 3 centuries of European settlement of North America and displacement of native Americans, populations of American black bears (*Ursus americanus*) experienced prolonged decline and steady range compression across the continent. Changes in dominant cultural attitudes about wildlife during the 20th century, however, gave birth to the field of wildlife management and placed responsibility for wildlife conservation firmly in the purview of state, provincial, and federal agencies. This history encouraged the development of multiple approaches among the many separate North American agencies to monitoring black bear populations, managing bear mortality, and dealing with bear-human conflict. In this presentation, I broadly review a collection of methods currently in use to determine American black bear population size and/or trend, including bait and scent-post surveys, modeling of hunter harvest data, and methods of mark-recapture population estimation, including trapping, camera trapping, tetracycline marking, and sampling for genetic material (e.g. hair). Specifically, I discuss methods used in Minnesota, USA, during the past 35 years. These examples highlight strengths and limitations of each method and illustrate, in particular, the risks entailed in relying too heavily on only one or two indicators of population numbers and/or trends. Maintaining multiple working hypotheses, multiple lines of inquiry, and long-term data sets are extremely valuable in preventing misinterpretation of data from both annual and less-frequent population monitoring efforts, particularly where bears are hunted and/or mortality varies significantly from year to year. Sometimes simple and inexpensive surveys can provide indirect, but key, additional information for correctly interpreting population data.

### **3903 Data Gathering and the Analysis of Nuisance Killed Bears for Their Better Management in Gunma Prefecture, Japan**

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The Gunma Prefecture had decided to make the Specified Wildlife Conservation and Management Plan for bears in 1996 following the guideline of Ministry of the Environment due to increasing conflicts between humans and bears. In order to monitor the trends of bears, data and the specimens of nuisance killed bears were collected to analyze their age, diet, and reproductive status from 1997. The rate of collection of the specimens varied from 29% to 58% from 1997 to 2007, but became relatively stable after 2009. The analysis was first outsourced to a research center outside the prefecture; however, it was difficult to gain the understanding from the local governments, who actually are in charge, about the purpose of collecting the specimens. We had decided to take on the analysis from 2009, and at the same time tried to explain in many occasions the purpose of collecting data/specimens and how they were used, and also return the analyzed data of an individual bears to the local governments as soon as possible. We had intensified the data/specimen collecting system after the Fukushima Dai-ichi nuclear power plant accident in March, 2011. We send written request to the local governments asking to collect the specimens from all of nuisance killed bear specimens at the beginning of every fiscal year. The analyzed data are used in the Wildlife Conservation and Management Plan, but in many occasions, the scientific data are overturned by the movement of encouraging the capture of bears appearing in the human habitat.

### **3904 Potential Issues in Brown Bear Population Monitoring in Japan: What Information Is Needed to Explain the Population Trend?**

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The number of brown bear population in Hokkaido, Japan is deemed to be increasing. According to the government report, the current estimated population is 2,200-6,500, which is almost double what was reported in 2000. However, the estimation has been based on the questionnaire surveys to local hunters. Few studies have assessed relationships among trends of the estimated population and ecological data although a few regional ecological researches (e.g., a sign survey) have been conducted to reveal trends in brown bear population. In this symposium, I will introduce trends of the number of captured/hunted bears, the number of bear sightings, multi-stakeholders' perceptions of the bear population and findings from ecological researches, referring to the trends in bear populations reported by the government. It is beneficial to explore relationships among those trends to establish effective brown bear population monitoring systems. An example of the eastern Hokkaido considered as a region having the largest brown bear population showed that the numbers of captured/hunted bears and bear sightings had increased, and more than a half of residents considered that brown bear population had increased since last five years. These findings could support the government reports. Some ecological findings, however, reported that a few bears repeatedly appeared in towns. Also, town authorities and wildlife managers considered that these human-habituated bears had raised the number of bear sightings and affected the residents' perception. These views indicate that the trend in brown bear population in Hokkaido is still controversial and highlight the necessity of appropriate monitoring systems.

## **Session 41: Invasive *Callosciurus* Squirrels: From Asia to the World**

### **4101 Biological Characteristics of *Callosciurus* Squirrels**

**Tatsuo Oshida**, Obihiro University of Agriculture and Veterinary Medicine, Obihiro, Japan. Contact: oshidata@obihiro.ac.jp

*Callosciurus* squirrels are widely distributed in Southeast Asia, eastern parts of South Asia, and southern parts of East Asia. These squirrels are arboreal, feeding mainly on seeds, fruits, other vegetable matters, and sometimes animal materials. At present, this genus has 15 species (*C. adamsi*, *C. albescens*, *C. baluensis*, *C. caniceps*, *C. erythraeus*, *C. finlaysonii*, *C. inornatus*, *C. melanogaster*, *C. nigrovittatus*, *C. notatus*, *C. orestes*, *C. phayrei*, *C. prevostii*, *C. pygerythrus*, and *C. quinquestriatus*). Each species has enough many geographical forms (variations) to make classification of *Callosciurus* complicated. Based on morphological, molecular, and cytogenetic data, I briefly explain the present taxonomic status and phylogenetic relationships of *Callosciurus* squirrels. In addition, I introduce a few studies of *Callosciurus* squirrel phylogeography occurring in Southeast Asia, and discuss the geographical barriers important for their complicated speciation and geographical variations. Since *C. erythraeus* may be a bio-indicator of chemical pollution from semiconductor industry in Taiwan, I briefly introduce its physiological phenomena. Although this much content is difficult to address within my talk's time limit, my goal is to summarize the current fundamental biological information of *Callosciurus* species.

**4102 Ecology, Morphology and Management of Two Introduced Populations of the Red-Bellied Tree Squirrel (*Callosciurus erythraeus*) on Lyudao and Kinmen Islands of Taiwan**

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Red-bellied tree squirrels (*Callosciurus erythraeus*) were introduced to Lyudao and Kinmen islands in the 1990s. Squirrels increased to more than 2000-4000 individuals in two islands in 2014, and caused damage to crops. First purpose of this study is to figure out their origination. Introduced population is usually small and often experiences bottleneck when it comes to expanding population size. Founder effect and the following genetic drift enlarge within the small population, resulting in decline in genetic diversity and increase in inbreeding. Second purpose is to detect genetic diversity of *C. erythraeus* in Lyudao. Bottleneck, inbreeding, and decline in genetic diversity cause developmental instability to introduced population, and are reflected in morphological asymmetry, known as fluctuating asymmetry (FA). Third purpose is to clear whether Lyudao squirrels show FA in skulls under environmental pressure and/or genetic effect. To clear the origination of Lyudao squirrels, mitochondrial DNA control region sequences were analyzed. To evaluate the FA between Lyudao and Taiwan populations, 8 skull measurements were examined. The results show that Lyudao squirrels were introduced from northern and eastern Taiwan. Previously, 43 haplotypes are found in Taiwan population; the haplotype and nucleotide diversities are  $0.984 \pm 0.005$  and  $0.0200 \pm 0.0006$ , respectively. In this study, there are 2 haplotypes in Lyudao population; the haplotype and nucleotide diversities are  $0.469 \pm 0.001$  and  $0.0117 \pm 0.0009$ , respectively. There is weak FA in all measurements in Taiwan population, but Lyudao population shows significantly greater FA, and the values in mandible are greater than those of cranium.

**4103 How to Eradicate an Alien Squirrel Population with Thousands of Individuals: A Case Study in Kumamoto, Japan**

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An alien squirrel, the Pallas's squirrel *Callosciurus erythraeus*, was introduced to the western part of the Uto Peninsula, Kumamoto, southwestern Japan in 1993. The distribution area in March 2010 was estimated about 25 km<sup>2</sup>, accounted for 28% of the total area of the peninsula (90 km<sup>2</sup>). The primary industry, fruit production, is a major factor in the area. Although the squirrels have damaged citrus and other fruits since 2004, researchers recognized it in 2008. Local governments started a population control action near agricultural lands under the Wildlife Protection and Proper Hunting Act in June 2009 and then launched an eradication program under the Invasive Alien Species Act in April 2010. I have been involved in these activities as a scientific adviser since 2009. On the fiscal year basis (April-March), the number of squirrels trapped by cage-traps from 2009 to 2014 changed as 141, 3112, 1527, 751, 258, and 68 (in 10 months) animals, respectively. This suggests that the squirrel density decreased successively. In the first phase (2010-2011), an incentive (800 yen per animal) strongly promoted the trapping activity by local hunters. In the second phase (2011-2014), a year-round employment of trapping specialists by local governments promoted the trapping activity in mountain areas as the population source. The campaigns using local newspapers and televisions contributed to reduce the resistance against the eradication activity. In order to eradicate the alien squirrel from this area successfully, a new trapping method applicable to the populations at low densities should be developed.



#### **4104 From Management to Prevention: A New Strategy to Avoid the Introduction of Squirrels in Europe**

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The development of an effective approach to invasive alien species management is based on a priority emphasis on prevention. This requires to assess the key pathways of species introduction necessary to prevent new unwanted arrivals. In Europe, prevention of squirrel introductions failed and there are now four established species, including *Callosciurus erythraeus*, present in Belgium, France, Italy, and The Netherlands, and *C. finlaysonii* with two populations in Italy. Belgium, Italy, and The Netherlands have started the control and eradication of *C. erythraeus*; France is on the way to start. These management actions are reactive to the establishment and spread of species. However, the continuous trade of captive squirrels exposes to risks of the establishment of new populations through accidental escape or deliberate release. A regulation of the pet trade should be considered to avoid a further proliferation of new species and populations. A new Regulation adopted in 2014 by the European Union will introduce a more stringent provision for species non-native to Europe, including a ban of import, trade, possession, breeding, and release. To be included in the developing black list, species should be identified as invasive through a detailed risk assessment. Therefore, steps are underway to prepare risk assessments for squirrel species that should be banned from Europe.

#### **4105 Non-Native Squirrels: Biological Invaders, Adopted Citizens or Important Synanthropes?**

**John L. Koprowski**, University of Arizona, Tucson, AZ, Contact: squirrel@ag.arizona.edu

Biological invasions are considered to be one of the greatest threats to biodiversity ranking just behind habitat loss for most taxa. Invasions can result from accidental or purposeful introduction. Squirrels (Sciuridae: Mammalia) are an oft introduced group due to their perceived value as a synanthrope and have occupied locations on all continents except Antarctica following intentional introductions. Introductions have caused a myriad of conservation challenges that include increased damage, indirect spread of disease and direct competition with native and sometimes imperiled species. However, especially in urban areas, non-native squirrels are often valued by human residents who act to increase populations through supplemental feeding, nest creation, care of young, creation of crossing structures, resistance to removal and tolerance of damage. Effectively the synanthropic biological invaders have been granted citizenship by humans that have accepted the non-natives into the urban ecosystem. The impact of invasive species and challenges of managing non-natives will be considered in the context of biological invasions and synanthropes that have been granted citizenship.

## Session 42: Conservation of Breeding Seabirds on Islands: Control of Predators and Social Attraction

### 4201 Status and Threats on Seabirds Breeding in Japan

**Yutaka Watanuki**<sup>1</sup>, Fumio Sato<sup>2</sup>, Naoki Tomita<sup>2</sup>, Noboru Nakamura<sup>2</sup>, Kiyooki Ozaki<sup>2</sup>, <sup>1</sup>Hokkaido University, Hakodate, Japan; <sup>2</sup>Yamashina Institute for Ornithology, Abiko, Japan. Contact: ywata@fish.hokudai.ac.jp

Thirty-eight species of seabirds breed at ~160 sites along Japanese archipelago. Among these, 20 species, including little known Bryan's Shearwaters and Matsudaira's Storm Petrels, have been categorized as threatened. Basing on the colony database and data from MONITORING 10000 program by Ministry of the Environment Japan, the present status and the trends of seabird populations and the potential threats on them, were analyzed. Most abundant species were Streaked Shearwaters (>100x10<sup>4</sup> nests), Leach's Storm Petrels (70x10<sup>4</sup> nests), Black-tailed Gulls (13x10<sup>4</sup> nests), and Rhinoceros Auklets (55x10<sup>4</sup> nests). The numbers of three species of albatrosses (+3~+5% per year), Rhinoceros Auklets (+3~+7%, especially in the recent 20 years), and Japanese Cormorants (+2~+5%) have been increased in 1960-2010. The numbers of Red-faced Cormorants (-4~ -6%), Common Murres (-6 ~-10%) and Spectacled Guillemots (-4~ -7%) had decreased in 1960-1990, but after 1995 those of the later two species increased slowly (<1%, 3%). The number of Slaty-backed Gulls had increased in 1960-1990 (+3~+5%) but decreased after that (-2~ -4%), while the trends of Black-tailed Gulls varied between colonies: decreased at Teuri (-3%) but increased at Rishiri (+4%). Among 79 monitoring islands, cats, Norwegian rats, and black rats were recognized as potential threats on 6, 10 and 8 islands, respectively, while the relationships between the presence of these threats and the population trends were not so apparent. Seabird restoration programs including predator control and social attraction have been implemented at some sites in Japan. Prioritization and evaluation of these programs have to be made by monitoring the status of seabirds.

### 4202 Conservation Value of Active Seabird Colony Restoration Following Rat Eradication on Islands

**Dan Roby**<sup>1</sup>, Stephen Kress<sup>2</sup>, Donald Lyons<sup>3</sup>, Shuihua Chen<sup>4</sup>, Simba Chan<sup>5</sup>, Yasuko Suzuki<sup>3</sup>, Timothy Lawes<sup>3</sup>, <sup>1</sup>U.S. Geological Survey-Oregon Cooperative Fish and Wildlife Research Unit, Corvallis, OR, <sup>2</sup>National Audubon Society, Ithaca, NY, <sup>3</sup>Oregon State University, Corvallis, OR, <sup>4</sup>Zhejiang Museum of Natural History, Hangzhou, China; <sup>5</sup>BirdLife International, Tokyo, Japan. Contact: daniel.robby@oregonstate.edu

Humans have introduced terrestrial mammals, intentionally or unintentionally, to most islands globally, and in many cases these introductions have extirpated breeding populations of colonial seabirds. Introduced rats (*Rattus* spp.) have been particularly destructive and widespread exterminators of seabird breeding colonies. On islands where introduced invasive predators have been eradicated to restore native ecosystems, the philopatric and neophobic tendencies of most seabirds present a major obstacle to recolonization. Active restoration of seabird colonies can dramatically hasten recovery of extirpated seabird populations following predator eradication by exploiting the site fidelity and social facilitation that characterize most seabirds. The most broadly applied active restoration technique is the attraction of breeding age adults using acoustic

vocalization playbacks and decoys. For seabird species lacking post-fledging parental care, this approach can be augmented by translocating nestlings and rearing them to fledging. As a case study, we review outcomes of attempts to establish breeding colonies of Caspian Terns (*Hydroprogne caspia*) on 14 newly-constructed islands in western North America using a 4-step social attraction program developed by S.W.K. for terns (*Sterna* spp.) and puffins (*Fratercula arctica*) in eastern North America. We also review how this approach has been used to successfully restore a mixed colony of Greater Crested Terns (*Thalasseus bergii*) and critically endangered Chinese Crested Terns (*T. bernsteini*) in the East China Sea. Used in concert with increasingly sophisticated programs to eradicate introduced predators, active seabird restoration has been demonstrated to be a highly effective method for global seabird conservation since the first pioneering efforts in 1973.

#### **4203 Social Attraction and Control of Avian Predators for Restoration of Common Murres**

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The Teuri Island is the only single breeding colony of Common Murres *Uria aalge* in Japan and the southern edge of the breeding range of this species in the western side of northern North Pacific. The number of the murres on Teuri was c 8,000 in 1963 and decreased to be 129 in 1980's and 17 in 1990's. To restore the murres, the social attraction program (decoys) was carried out since 1990. However, the murres disappeared from the breeding sites at open ledges in 1994 and also from those in caves in 2005. With low fledging rate (27%, mean across 2006-2010) the population was expected to be extinct at 66% probability in 50 years. Thus, a sound system broadcasting the murre calls was installed since 2005. The open ledge were temporarily re-occupied in 2006 but abandoned again in 2010 with no fledglings, while a single breeding site in cave has been re-occupied since 2007. Nevertheless, during 2008-2010 the proportion of chicks fledged per egg at this cave was 33% possibly because of the predation by Slaty-backed Gulls *Larus schistisagus* and Jungle Crows *Corvus macrorhynchos*. Since 2011 the gulls visiting this breeding site were shot. Then, fledging success was improved to be 77% that was as high as that in other healthy colonies. To restore deteriorated murre populations which are not able to sustain against the moderate level of predation, we conclude that social attraction should be carried out with the control of avian predators.

#### **4204 Seabird Recovery by Habitat Restoration through Removal of Introduced Rats from Islands**

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Islands represent 5% of the earth's surface yet support a disproportionately higher amount of the world's biodiversity. Most extinctions have occurred on islands, and today, islands support ~ 40% of threatened species, including many of the 98 globally threatened seabird species. Commensal rodents, introduced on >80% of the world's islands represent one of the greatest threats to seabirds, capable of preying on eggs, chicks and adults. Increasing efforts to remove introduced rodents have been successfully implemented on over 500 islands worldwide using a "one time" application of a rodenticide, mainly the anticoagulants (>70% brodifacoum) delivered into every potential rodent territory using bait stations laid out on a grid pattern, or broadcast by hand or aircraft. However, the use of anticoagulant rodenticides presents an inherent paradox - how to balance efficacy needs

(100%) with a desire for no impact to native species. Most measures include reducing exposure to high risk species such as, seasonal timing of the operation when migratory species are absent, or live capture and temporary captive holding until the risk window passes. Many projects have documented impact to native species, but, in most cases the impact is of relatively short duration and populations have recovered to pre-eradication or higher levels. The recovery of seabirds on North American islands after rat eradication is unequivocal with increases in breeding success, and growing breeding populations. Removal of invasive rodents from islands is a growing strategy to recover and protect seabirds, with increasing coordination and collaboration between governments and conservationists in North America.

#### **4205 Control of Invasive Rodents for Seabird Conservation: Trials and Errors in Japan**

**Takuma Hashimoto**, Japan Wildlife Research Center, Tokyo, Japan. Contact: thashimoto@jwrc.or.jp

Three invasive rodents, *Rattus rattus*, *R. norvegicus*, and *Mus musculus* widely inhabit Japan. On the mainland Japan, these invasive rodents mostly occur in and around residences in urban and rural areas. On the other hand, invasive rodents inhabit natural forests and glassy areas on some remote islands. On some islands where no native mammals existed historically, the density of invasive rodents is higher, and has significant impacts on native ecosystems. In some case, damage to breeding seabirds are severe enough to cause significant negative impacts to their populations. Examples of areas with significant impacts by invasive species include predation of Bulwer's Petrels *Bulweria bulwerii* and Sooty Storm-Petrels *Oceanodroma tristrami* on the Ogasawara Islands (Tokyo Met.), and Leach's Storm-Petrels *Oceanodroma leucorhoa* on Yururi Island (Hokkaido Pref.). Because of declining seabird populations on these islands, attempts to eradicate rats have been carried out since 2007. Second generation rodenticides (i.e. anticoagulants like brodifacoum) have been used for rat eradication projects in NZ and USA. However, only 1st generation anticoagulants (i.e. diphacinone) are allowed in Japan. Diphacinone is relatively safer to non-target species and environments than 2nd generation anticoagulants, but the toxicity is generally ineffective on rats. Due to its mild acute toxicity, it is necessary for rats to intake the poison over multiple days to reach a lethal dose. As a result, the success rate of eradication in Japan is lower than the other countries'. Our next step is to adopt test 2nd generation rodenticides, while we carefully evaluate their environmental impacts and promote social consensus.

### **Session 43: Wildlife and Traffic: Infra-Eco Network and Road Safety**

#### **4301 Planning and Designing Effective Wildlife Overpass Structures for Highways in British Columbia, Canada**

**Leonard Sielecki**, University of Victoria, Victoria, BC, Canada. Contact: mailto:lsieleck@uvic.ca

Since 1987, federal and provincial governments in Canada have been constructing wildlife overpasses to reduce the number of wildlife-vehicle collisions occurring on highways. Wildlife overpasses are designed to provide wildlife safe movement corridors across highways and ensure long-term wildlife habitat connectivity. The structures have been primarily designed for large ungulates, such as deer, elk, moose and mountain sheep, and large carnivores, such as black bears and grizzly bears, which are considered to pose the greatest potential safety hazard for drivers. The structures are integrated into extensive wildlife exclusion systems usually constructed on higher

speed, limited and controlled access highways. The planning and design of effective wildlife overpasses require extensive pre-construction environmental assessments of ecosystems, wildlife populations and wildlife migration patterns. The mountainous terrain in remote regions of western Canada poses severe geotechnical and engineering challenges to the design and location of wildlife overpasses. The challenges were overcome with relatively narrow, simple structures using conventional engineering techniques and materials. Ongoing monitoring has proven these structures are effective for maintaining habitat connectivity for many larger species of wildlife. Ungulates, in particular white-tailed deer (*Odocoileus virginianus*), mule deer (*Odocoileus hemionus*) and bighorn sheep (*Ovis canadensis*), appear to adapt quickly to wildlife overpasses. These species are followed by their major predators, cougars (*Puma concolor*) and wolves (*Canis lupus*). Black bears (*Ursus americanus*), coyotes (*Canis latrans*) and Canada lynx (*Lynx canadensis*) also use the structures. All observed species of wildlife appear to traverse narrower wildlife overpasses as expeditiously as possible, exhibiting similar crossing behaviours.

#### **4302 Defragmentation in Germany I: Political Frame, Planning Tools and Guidelines**

**Marita Böttcher**<sup>1</sup>, Heinrich Reck<sup>2</sup>, Kersten Hänel<sup>3</sup>, Martin Strein<sup>4</sup>, <sup>1</sup>Federal Agency for Nature Conservation, Leipzig, Germany; <sup>2</sup>University of Kiel, Kiel, Germany; <sup>3</sup>University of Kassel, Kassel, Germany; <sup>4</sup>Forstliche Versuchsanstalt Freiburg, Freiburg, Germany. Contact: Marita.Boettcher@BfN.de

The first presentation gives an overview (1) about fragmentation due to the German road network and the respective high traffic density by  $\approx 190$  cars/km<sup>2</sup>, (2) the German federal defragmentation program and (3) the planning system to reconnect habitats across and along the road network. The most important sites for overcoming road related fragmentation are identified by the comparison of the relevance of potentially functional habitat systems (size of habitat networks and supra local habitat corridors) and the traffic density at sites where ecological corridors are dissected by traffic infrastructure.

<http://www.bfn.de/fileadmin/MDB/documents/themen/eingriffsregelung/Nationalwide%20Priorities%20for%20Re-Linking%20Ecosystems.pdf>). To build adequate overpasses or underpasses at such sites existing rules and guidelines are revised or newly developed with special respect to all affected species (insects or snails on par with reptiles or mammals etc.) and ecological functions as well. Thereby different criteria are offered to assess the effectiveness of defragmentation measures which depend on the quality of fauna passages in the same way as on the corridor quality in the surrounding area and hinterland.

#### **4303 Defragmentation in Germany II: Practical Reconnection of Habitats on Regional Scale in a Highly Fragmented Cultural Landscape**

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The testing and development project “Holsteiner Lebensraumkorridore” (Holstein habitat corridors, [www.lebensraumkorridore.de](http://www.lebensraumkorridore.de)) is a beacon project of the Federal Government within the framework of the National Strategy on Biological Diversity. Today the project’s landscape is dissected by the

motorways A21 and A7 and by the planned Hamburg northern bypass A20. The project aims at the restoration and preservation of an east-west habitat network north of the metropolitan region of Hamburg. This demands a close cooperation between nature conservation, hunting, forestry, highway and road departments and various local authorities. Thanks to this cooperation various successful actions have been implemented since 2010, thus biodiversity in the wider surroundings of one of the passages is reconnected and largely safeguarded. In 2013 the next steps were started to secure the survival of animal and plant species in the wider surroundings of at least three more crossing aids and within the cultural landscape inbetween in an area of approximately 400 square kilometers.

#### **4304 Examples of Wildlife Crossing Structures in Japan**

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Road-crossing structures for wildlife are taken into consideration from place to place in recent years. These devices are installed for mammals and other creatures. Various efforts are made in order to avoid collisions between animals and vehicles and to maintain wildlife habitat. Some typical examples in Japan are cited as follows. Measures for Japanese squirrels or Japanese dormouses in Yamanashi prefecture. Measures for Japanese serows in Miyagi prefecture, in Akita prefecture or in Wakayama prefecture. Measures for wild boars, foxes or raccoon dogs in Shimane prefecture. Measures for bats in Hokkaido prefecture. Many more examples other than those mentioned above are certainly found in the country. Those are sometimes prepared for a specific species and sometimes for several species which share habitat. Preliminary surveys are indispensable for ensuring wildlife habitat. When considering location of road-crossing structures in the planning stage, habitat of wildlife and animal trails should be taken into account. However, control of wildlife population, such as wild boar or deer, is sometimes a complicated issue. In the designing stage, types and standards of road-crossing structures are materialized according to the characteristic of the species. Equipment use status and damage should be examined in the monitoring stage. Information of each stage provides opportunities of feedback and fundamental data for the other projects in the future.

#### **4305 The Effectiveness of Mitigation Measures for Reducing Wildlife Vehicle Collisions and Providing Connectivity**

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In the first study of our work, we reviewed recent studies of road-kill, barrier effect and mitigation techniques on wild animals. It also surveyed road-crossing structures (WCSs) used in Japan. The road-studies in Japan were mostly studies of the road-kill of Sika deer, *Cervus nippon yezoensis*, and Raccoon dog, *Nyctereutes procyonoides*. There were fewer Japanese studies on roadkill and barrier effect examining species, taxa, and landscapes than international studies. Moreover, we investigated the availability of various WCSs ,box culvert, pipe culvert, underpass, overpass, eco-bridge, drift fence, planting, for focal species of conservation on 86 national highways. Target species of WCSs and their different proportion by regions. Most of the road-crossing structures were underpasses,

box-culverts, and pipe-culverts targeting large and mid-sized mammals. There were fewer eco-bridges targeting arboreal mammals and amphibian tunnels targeting herptiles in Japan. In the second study of our work, we selected 2 roads (Higashifuji-Goko Road and Toyotomi Bypass) from these 86 and set up infrared sensor cameras to investigate WCS use by species of wild mammals. Camera trap results show that large mammals such as deer, boar (*Sus scrofa leucomystax*), and several other species preferred the underpass WCS. Box culverts were used frequently by foxes and masked palm civets (*Paguma larvata*). Pipe culverts in Hokkaido were favored by sable (*Martes zibellina*) and rodents *Apodemus* spp (*Apodemus speciosus*, *Apodemus argenteus*). In summer, box culverts in Hokkaido were used by cave-dwelling bats. Preference of WCSs are attributed to biological×physical factors.

#### **4306 Measures to Prevent Wildlife-Vehicle Collisions on National Highways in Hokkaido, Japan**

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The number of sika deer, which widely inhabit in Hokkaido, Japan, was about 200,000 in the 1990s. In 2013, however, it was estimated to be about 560,000. With the increase in deer population, deer-vehicle collisions have increased, the number of which reached more than 1,800 in 2013. Road administrators are being required to take further measures against deer-vehicle collision accidents. The Hokkaido Regional Development Bureau has implemented accident-prevention measures such as deer-proof fences and one-way gates, as well as warned drivers against the collision accidents by placing road signs at accident prone spots or provided them with information which would be useful to avoid the accidents to reduce collisions on national highways. As one of those measures, we employed grooved pavement on a trial basis on Route 238 in 2009. The pavement grooves generate sound similar to deer's alert calls when vehicles pass over the grooves. The purpose of this trial was to clarify whether the sound would be effective to prevent sika deer from crossings the road in front of driving vehicles. We monitored the behavior of sika deer approaching the grooved pavement and analyzed the monitoring records to identify the effects of the grooves. The analysis results showed that the behaviors of sika deer were categorized into 6 patterns, all of which indicated that sika deer hesitated to cross the road, which proves the grooved pavement may be effective to reduce deer-vehicle collisions.

#### **4307 Application of Infrared Thermography to Sika Deer Population Surveys: Larger Areas Surveyed More Efficiently**

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Traffic accidents involving sika deer (*Cervus nippon yesoensis*) are becoming a major social problem in Hokkaido. Therefore, countermeasures are urgently needed. Several measures have been implemented by road administrators. Those measures cannot be effective unless ecological infrastructure, such as over-bridges and wildlife fences, is installed where needed after we fully understand the behavior of deer. Therefore, it is important to survey the roadside population of deer. Deer population surveys are often conducted by spotlight census. However, the eyes of deer that are not facing the research staff do not reflect the light. As a result, the census numbers may underrepresent the actual numbers. I conducted an infrared thermographic population survey of

deer to address this situation. More accurate surveys were found to be possible with the use of infrared thermography in combination with spotlights. If infrared thermographic equipment is mounted on UAVs and automobiles, it will become possible to survey larger areas in less time. In the future, the development of image analysis software to extract deer from the image data will be needed for the survey to become more efficient.

#### **4308 Development of a Video Image Analysis Method for Streamlining Surveys of Wildlife Behavior**

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When developing wildlife passages, crossings or other traffic infrastructure for wildlife, video recordings have been analyzed to study the road crossing behaviors of wildlife. Such analysis is also used for measuring the effectiveness of planned countermeasures. Video analysis has the advantages of ease of long-time recording and confirmation of road crossing by animals but the disadvantages of requiring electric power for the installed devices and requiring labor-intensive recording analysis. To overcome such drawbacks, we developed a system that automatically records a wild animal when it appears on the road and we verified the accuracy of the system. The system is configured with an infrared-sensor-equipped CCD camera, a video recorder and a tablet terminal (Windows 8). Specially developed animal detection software is installed on the system. System accuracy was verified by comparing the system's outputs to the visual observation results of recording. The detection rate of sika deer for the system was nearly the same as that for visual observation; however, the time taken was halved. The detection rate of birds for the system was low, about one-third that of visual observation. The software was able to detect animals that were not detected by visual observation, although such instances were not many. We have been continuing to improve the system, because software modification is expected to improve the detection accuracy and thus to contribute to savings in the labor needed to analyze the recordings and eventually to improve the efficiency and effectiveness of road infrastructure development for wildlife.

## **Session 44: Conservation and Management of Wild Pigs (*Sus scrofa*) in Asia and North America**

#### **4401 Wild Boar History and Management in Japan**

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After wild boar arrived on the Japanese Islands during the Middle-Late Pleistocene, their distribution had spread nationwide except for the island of Hokkaido. Afterwards in the later half of 19th century, their distribution had shrunk to the western part of Japan due to changes in the socio-economic structure of Japan. However, the energy revolution and the economic growth of Japan in 1960's led to the distribution recovery of wild boar and to an increase in agricultural damage by the species. Now the damage caused by wild boar amounts to over 5 billion yen per year in recent years. To resolve wild boar impacts to agriculture, 34 prefectural governments, as of 2012, have planned the Specified Wildlife Conservation and Management Plan involving a feedback system. But few plans adopt ecological investigations and fulfill its feedback system function. As a result, agricultural



damage by wild boar has not been decreasing. From the perspective of population management, the Japanese government has proposed that the control of population size or density is the most important objective for management. In 2013, the government estimated wild boar population to be 880,000 individuals and set itself the task of reducing of wild boar population by half within 10 years. But it is difficult to estimate available population size (or density) of wild boar due to their unique ecological characteristics such as multiple pregnancies, high initial mortality, and variable anestrus period. So we need to develop new management technique not only to depend on population size. Furthermore, the nuclear plant accident made the issue all the more complicated

#### **4402 The Genetic Diversity and Gene Flow of Formosan Wild Pigs**

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Wild boar (*Sus scrofa*) originated from Island Southeast Asia and spread throughout Eurasia continent. Formosan wild boar (*Sus scrofa taiwanus*) is an endemic subspecies of Taiwan which is located at the center of the western Pacific's island arcs region. Studying the phylogeny of Formosan wild boar in this critical geographic location assists in understanding the genetic linkage among Formosan wild boar (FWB), Chinese wild boar (CWB), Japanese wild boar (JWB), and Ryukyu wild boar (RWB). More than 200 Formosan wild boars' D-loop sequences were obtained. The values of haplotype diversity and nucleotide diversity of total FWB were 0.951 and 0.00356, respectively. Partial control region sequences (652 bp) of wild boar from FWB, CWB, RWB, and JWB have been integrated in this study to investigate the phylogenetic relationships and divergence times. Formosan wild boar clustered with Japanese wild boar, and Chinese wild boar formed the general east Asian wild boar (GEAWB). RWB diverged from GEAWB to form one unique clade. Furthermore, based on molecular clock analysis, RWB split early from FWB, JWB, and CWB at approximately 69,700 year before present (YBP). FWB and JWB diverged at approximately 41,800 YBP. These data provide the hypothesis of independent migration waves of wild boar among Taiwan and Ryukyu.

#### **4403 Challenges and Opportunities of Managing Wild Pigs in the United States**

**Mark Smith**, Stephen Ditchkoff, Auburn University, Auburn, AL, Contact: mds0007@auburn.edu

Wild pigs (*Sus scrofa*) are one of the greatest wildlife management challenges facing North American natural resource professionals in the 21st century. Wild pigs are a non-native, invasive species and their populations and distributions have increased dramatically in North America over the past 20 years due to illegal live-trapping, transport and release by private individuals to increase sport hunting opportunities. With wild free-ranging populations in >40 states, wild pigs cause an estimated \$1.5 billion/year (USD) in agricultural damage with many natural resource experts speculating their impacts on floral and fauna communities, ecosystem function, and environmental quality far exceeding agricultural impacts. Additionally, wild pigs carry diseases that affect livestock and humans and have potential to serve as agents for bioterrorism. However, despite these negative impacts, the reduction of wild pig populations in North American remains to some extent mired in politics and policy, lack of available financial resources to conduct removal efforts at levels necessary to elicit population level impacts, and a lack of a consistent message regarding wild pig management. For example, the legal status of wild pigs varies across states from a game species in some states, nuisance animals with very few restrictions regarding removal in most other states, and considered

as livestock that can be sold at markets once reduced to possession in two states. This presentation will provide an overview of the current challenges to managing wild pigs in North America and identify and explore opportunities and future directions toward resolving wild pig damage issues.

#### **4404 Attitudes and Financial Impact of Wild Pigs in the United States**

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There have been several studies in the US examining the financial impact of wild pigs. This presentation will present comparisons of financial damage across states and also examine attitudes about wild pigs and control activities undertaken by the public. This presentation will include economic damage estimates from several recent surveys. Nationwide estimates suggest damage from wild pigs may exceed \$1.5 billion USD/year and our research in Georgia estimated damages over \$84 million USD/year in 2011. Estimates include damage to crops, livestock, and other property. Though rarely quantified, ecological damage such as reduced water quality is known to be locally significant. Research suggests that the public has divergent approaches to wild pig control, lacks sound information about control strategies, undertakes a range of legal and non-legal activities, and suffers significant financial losses from wild pigs. Not all producers experience similar amounts of damage and therefore, attitudes regarding the significance of the wild pig problem in Georgia differ widely among citizens. Respondents from the 2011 Georgia wild pig survey felt most control measures were ineffective and that state and federal agencies should provide more assistance. Many survey respondents perceived a decline in some native game species. Collectively, our surveys indicate high levels of damage from wild pigs, frustration with control methods often perceived as ineffective, and a general understanding of the negative financial and ecological impacts of wild pigs.

#### **4405 Landowner Preferences for Wild Pig Management in Illinois**

**Craig Miller**<sup>1</sup>, Erin E. Harper<sup>2</sup>, Michael Mengak<sup>3</sup>, Jerry J. Vaske<sup>4</sup>, <sup>1</sup>University of Illinois, Champaign, IL, <sup>2</sup>USDA National Wildlife Research Center, Fort Collins, CO, <sup>3</sup>Warnell School of Forestry and Natural Resources, University of Georgia, Athens, GA, <sup>4</sup>arnner School of Natural Resources, Colorado State University, Fort Collins, CO, Contact: craigm@illinois.edu

Wild pigs are an invasive species across North America, causing widespread ecological damage. Wild pigs are present in the state of Illinois, USA, but populations are lower than those in most other states. These lower levels are due in part to aggressive management actions and the later arrival of pigs in the state compared to, for example, those from the Southeastern portions of the USA. We surveyed 5,320 landowners owning  $\geq 1$  acre (0.4 ha) to determine their attitudes toward wild pigs and preferences for management actions on their lands and in the counties in which they live. We received 3,035 (58%) useable responses. Few (2.7%) of respondents observed wild pigs on their land, yet a majority (84.1%) agreed that wild pigs should be eliminated whenever possible. When presented with 4 different management options (removal using dogs, targeted shooting over bait, trap and remove, aerial shooting) in the county where they lived and on their land, respondents favored targeted shooting over bait. Acceptance of all management options decreased when asked about their own lands compared to the county in which they lived. We will discuss our findings relative to management efforts by Illinois Department of Natural Resources and efforts in other states in the USA.

#### **4406 A Cooperative Education Approach to Gaining Public Support for Wild Pig (*Sus scrofa*) Management**

**Jessica L. Tegt**, Bronson Strickland, Bill Hamrick, Mississippi State University, Mississippi State, MS, Contact: [jtegt@cfr.msstate.edu](mailto:jtegt@cfr.msstate.edu)

Public support and political approval is critical for successful state, regional, and national wild pig management. Since 2008, Mississippi State University Extension Service has partnered with state and federal agencies to provide educational and informational tools to a wide variety of audiences regarding wild pigs - how they arrived here, the damage they create, their effects on wildlife, their threat to human health, and the legitimate rather than perceived impacts of current management. Cooperative Extension is an ideal outlet to provide such science-based information as this nation-wide educational network provides the critical link between current research and public education. Mississippi State University's Extension public education approach to wild pig management is unique and effective because it uses a variety of methods and media. Over 1,500 people have attended face to face on-site training events where trapping and control methods are demonstrated. In addition, over 106,000 educational technical guides have been distributed, 152,000 individual downloads of our educational DVD *A Pickup Load of Pigs: The Feral Swine Pandemic* has been documented, and 200,000 individual visits to our website: [www.wildpiginfo.com](http://www.wildpiginfo.com) has been validated. In 2013, Mississippi State University conducted a Legislative Wild Pig Summit to brief state lawmakers on the seriousness of the wild pig issue in preparation for the 2014 legislative session. Attendees were provided with key information about wild pig issues. Most recently our cooperative efforts extended to conduct landowner and public knowledge/attitude surveys to quantify ecological and economic impacts of wild pig damage in Mississippi.

#### **4407 Effective Wild Pig Control: Results from a Localized Management Approach**

**Stephen Ditchkoff**<sup>1</sup>, Robert Holtfreter<sup>1</sup>, Brian Williams<sup>1</sup>, James Grand<sup>2</sup>, <sup>1</sup>Auburn University, Auburn, AL, <sup>2</sup>Auburn University, Auburn, AL, Contact: [ditchss@auburn.edu](mailto:ditchss@auburn.edu)

Recent evidence indicates wild pig (*Sus scrofa*) matriarchal groups (sounders) maintain exclusive core-use areas and show little or no home range overlap with adjacent sounders. Based on this territorial behavior, we developed and tested methods for identifying and removing individual sounders on an 11,000-ha study area to determine the feasibility and effectiveness of a localized management, or whole-sounder removal, approach in controlling wild pig populations. Between July 2007 and May 2010, we surveyed our study area via game camera, and detected 19 sounders. Following detection, we captured and tagged pigs in each unique sounder and deployed 1-2 GPS collars on adult sows to delineate territorial boundaries of individual sounders. In May, 2009 we trapped and removed 100% (34/34) of pigs from 2 sounders, clearing 1,489 ha. To detect the presence of re-colonizing pigs in this removal area, we maintained camera monitoring sites within the home ranges of removed sounders. During November, 2009 we removed 100% (41/41) of pigs in 3 additional sounders, expanding our original removal area to 2,409 ha. In May, 2010 we removed 97% (136/140) of pigs in 13 of the remaining sounders within our study area, further expanding our removal area to 8,000 ha. Monitoring efforts revealed occasional sallies into the periphery of removal areas by adjacent sounders; however, no re-colonization of these areas occurred during the study. Results suggest that a whole-sounder removal approach is a more effective technique than previously reported strategies for eliminating wild pigs from areas they have become established.

## Session 47: Research and Conservation of the Cuban Solenodon, *Solenodon cubanus*: Challenges and Opportunities

### 4701 General Introduction to the Research History of the Cuban Solenodon

Lazaro M. Echenique-Diaz,<sup>1</sup> Contact: lazincip@gmail.com

*Solenodon cubanus* was described as similar to *S. paradoxus* 177 years ago by Dr. Felipe Poey, who first mentioned the giant insectivore in a local Havana newspaper. In the time since, the species has been written about by numerous authors, many of whom have highlighted the problems it presented for science, such as its origin, taxonomic position relative to other Eulipotyphlan species, potentially toxic saliva, and poor capture record. The first field studies on the ecology and behavior of the species came in the 1980s, 150 years after its discovery. However, most of what is known comes from only a few captive animals. The information reported on *S. cubanus* has not always been accurate, and incorrect assumptions on the species have been transmitted from author to author throughout the years. These errors often appear as contradictory facts, while others are simple assumptions, including the presumption of the species as “extinct” in the Sierra Maestra ridge given the last sighting reports, which in turn affects assumptions regarding current geographic distribution, with serious conservation implications. The scarcity of scientific expeditions aimed at searching for *S. cubanus* have also characterized its research record, as well as the simplicity of the analyses performed on captured individuals. The history of research on *S. cubanus* thus suggests that some long-held assumptions about its natural history may be the consequence of an inadequate approach to scientific inquiry, and that consistent studies can prove many of these assumptions regarding the species to be false.

### 4702 Comparative Analysis of Toxicity in the Cuban Solenodon and Its Potential Role in the Species

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The discovery of new bioactive molecules, facilitated by a deeper understanding of nature, will advance our knowledge of biological processes and lead to new strategies to treat disease. Among natural products, the toxic constituents produced by living organisms, commonly referred to as “venom,” have attracted wide attention due to their potent activity and innovative modes of action. Various toxic constituents from lower animals, such as insects, marine invertebrates, lizards, and snakes, have been well characterized. However, among mammals, only a few members of the order Insectivora (shrews and Solenodon) and Monotremata (platypus) possess toxic components. The short-tailed shrew *Blarina brevicauda* produces potent venom in its saliva, which is toxic to vertebrates. We identified blarina toxin (BLTX), lethal venom with a tissue kallikrein-like activity from its salivary glands. The adult male duckbilled platypus *Ornithorhynchus anatinus* carries a thorn on each hind leg, and uses this device to inject their competitors with poison. We identified 11 novel peptides from its venom fluid, including a heptapeptide, H-His-Asp-His-Pro-Asn-Pro-Arg-OH, which produced prominent inflammation and shaking behaviour in mice. I will present recent aspects of mammalian venoms from the viewpoint of bioorganic chemistry, including the comparative analysis of toxicity in the Cuban Solenodon and its potential role in the species.

#### **4703 Feeding Ecology of the Cuban Solenodon Based on Scat Analysis**

**Koji Mizota**, Miyagi University of Education, Sendai, Japan. Contact: mizota@staff.miyakyo-u.ac.jp

Knowledge of the feeding ecology of the Cuban Solenodon, *Solenodon cubanus*, is an essential component in understanding the role of this rare and endangered mammal in Cuban terrestrial ecosystems. Most of what is known about its feeding habits comes from observations made in a few surveys and a single study encompassing several years in the Sierra del Cristal mountain range. The information provided by these studies has been used in surveys aimed at finding the Cuban Solenodon. However, inconsistencies in the data provided by the authors raise doubts about some of their observations. To further clarify the feeding ecology of *S. cubanus*, the food habits of the species were investigated by analyzing scats collected in Alejandro de Humboldt National Park, and observing the species' behavior while in captivity. Food items identified in Solenodon scats were invertebrates such as insects, myriapods, chilopods, arachnids, crustaceans, gastropods, and oligochaete, with insect larvae predominant. Additionally, the scats contained evidence of vertebrate species such as reptiles, amphibians, and a mammal, possibly the black rat (*Rattus rattus*), along with abundant plant material. Data on the feeding behavior of co-occurrent naturalized species such as *R. rattus* suggest that previous reports of Solenodon preying on certain gastropod species have in fact been evidence of *R. rattus* activity. These results show that the diet of *S. cubanus* is highly diverse and includes species previously thought to be a threat to its survival. The implications of these results for the conservation of the species are considered.

#### **4704 Supermatrix Phylogenetic Analyses of the Cuban Solenodon Based on Nuclear DNA Sequences**

**Jun J. Sato**, Fukuyama University, Fukuyama, Japan. Contact: jsato@bt.fubt.fukuyama-u.ac.jp

The phylogenetic relationship among the Cuban Solenodon (*Solenodon cubanus*) and its congeneric species, *S. paradoxus*, with species of the other three extant lineages within the order Eulipotyphla (Mammalia) has remained elusive despite much research. This has been because, among other reasons, tissue samples from the Cuban Solenodon have seldom been obtained due to its rarity, and only museum samples have been examined. Therefore, only mitochondrial DNA (mtDNA), with higher copy numbers than nuclear DNA (nucDNA), had been available in previous studies, which, due to the severe saturation problem, may have affected phylogenetic analyses, resulting in overestimated divergence times. Tissue samples from recently captured living individuals enabled multiple nucDNA sequencing for this study (*Apob*, *Atp7a*, *Bdnf*, *Brca1*, and *Rag1*; in total 4,602 bp). Using the data matrix of 5 genes and 35 species from all four families, supermatrix phylogenetic analyses were conducted under maximum-parsimony, maximum-likelihood, and Bayesian-inference criteria. These analyses confirmed the first branching of Solenodontidae followed by Talpidae, and the close affinity between Erinaceidae and Soricidae. Bayesian relaxed-molecular clock analyses showed that the divergence time between Cuban and Hispaniolan solenodons was 5.3 Ma., significantly different from that inferred by mtDNA (25 Ma), which was interpreted as consistent with the Caribbean geologic history. However, our analyses suggest that dispersal after the Caribbean island formation may have been an important factor for the establishments of the two Solenodon species.

#### **4705 Acoustic Emissions of the Cuban Solenodon in the Sonic and Ultrasonic Frequency Range**

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The Cuban Solenodon (*Solenodon cubanus*) is one of the most endangered species on Earth. Many aspects of its natural history remain unknown due to a poor capture record, with approximately 55 captured individuals in the last two centuries. Of these, only two captive animals were the subject of research on acoustic emissions, results which still remain unpublished. Here, detailed information on the Cuban Solenodon's vocalizations are reported for the first time. Recordings were performed for 5 individuals in semi-captive conditions, and during their manipulation by researchers while collecting morphological data. Recorded signals covered the audible and ultrasonic frequency range, including tonal and noisy calls, and were classified in 6 types depending on their duration, frequency with the most energy, and spectro-temporal patterns. According to the acoustic features and call repetition rate, most of the calls emitted by the Cuban Solenodon are unlikely to be used for echo-based orientation, differing with what had been described for other eulipotyphlan species. Moreover, emissions in the ultrasonic frequency range are unlikely to be used in detecting the Solenodon potential preys, and may play a more important role in communication. The acoustic features present in these calls may be reflecting the characteristics of the extremely cluttered habitat occupied by this species, and a fossorial life style. The possible functions of these calls are discussed.

#### **4706 The Role of Local People in Ecological Research and Monitoring for Conservation of the Cuban Solenodon**

**Lazaro M. Echenique-Diaz**, Institute of Arts and Sciences, Yamagata University, Kojirakawa-machi, Yamagata, Japan. Contact: lazincip@gmail.com

Complex conservation contexts and imperfect species knowledge are the rule for most species at risk, and with the natural, social and political context of the areas where it occurs, the Cuban Solenodon is no exception. The rediscovery of the species in Alejandro de Humboldt National Park (AHNP) in 2012, achieved through the use of local hunting techniques, highlighted the potential for conservation that collaborating with local people imply. A program to involve local communities in ecological research and monitoring for conservation has since been conceived under the premise that conservation strategies for this endangered mammal require not only an understanding of the species' ecology, but also the willingness and capacity of local communities to aid in its preservation. In total, 6 expeditions conducted by AHNP staff, local people, and researchers to collect data on the Cuban Solenodon were carried out between 2012 and 2014. In these expeditions, local people received training on Solenodon scat sampling, tissue sampling for population genetics studies, ecological data gathering, and the use of non-invasive research equipment such as automatic sound recorders and camera traps. Concurrently, local people provided experience in using modified hunting techniques to trap the Cuban Solenodon and to control invasive species such as feral cats and dogs. As a result of this collaboration, the first protocol for the monitoring of the Cuban Solenodon was conceived, and the process of trust-building between the park and its residents has begun, with local knowledge recognized as a valid and often-ignored conservation tool.

## Session 48: Brown Bear Monitoring and Management in Human Biosphere

### **4801 The Achievement from the Last 30 Years of Brown Bear Population Monitoring in Hokkaido and Its Consequent Challenge**

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Population monitoring is essential for proper management of the brown bear (*Ursus arctos*) in Hokkaido. We have been continuing to collect brown bear kill records and the body parts necessary for biological inspection from the entire area of Hokkaido with the assistance of local governments and bear hunters since 1991. In addition to the fundamental biological information such as location of kills, sex, age, food habits, nutritional and reproductive condition and genetic traits of killed individuals, we also investigate the cause and situation of kills for the case of nuisance control kills. To monitor the trend of population in the whole Hokkaido area, we have an annual bear sign survey conducted by forestry workers and administer questionnaire surveys on distribution and/or abundance to hunters once or twice per decade. We also carried out radio-tracking and DNA mark-recapture studies in the several intensive study areas to investigate home-range, demography and population density of bears which are also essential information to correctly understand the situation in Hokkaido. We analyze population dynamics with a harvest-based estimator using these various data. In spite of current increase of human-bear conflicts occurrence and consequent control kill numbers, the brown bear population would be expanding. Because bear individuality formed through learning would influence conflicts with people, it is necessary to monitor the frequency of inappropriately learned individuals and reduce it by proper management actions. We discuss issues in establishing a constructive monitoring system in Hokkaido.

### **4802 Shift in Focus of Brown Bear Management in Hokkaido: From a Region to the Whole Island, in Response to the Increasing Conflict**

**Hifumi Tsuruga**, Hokkaido Research Organization, Esashi-cho, Hiyama-gun, Japan. Contact: tsuruga@hro.or.jp

The brown bear (*Ursus arctos*) management plan for the Oshima Peninsula was compiled in 2000 with aims of reducing human-bear conflicts and sustaining local bear populations. In order to achieve these aims, various measures have been implemented. A classification flow intended to evaluate the degree of noxiousness of bears was developed for local managers to take an effectual option against each conflict. In terms of monitoring for evaluating the progress of the management plan, population density was estimated by harvest based calculation model and the number of nuisance bears was estimated using the reports on conflicts gathered from all over the peninsula. These indices were used to employ an adaptive management system at the revision of the management plan in 2010, and a restriction on the total bear harvest was also placed. Meanwhile, in many areas of Hokkaido, the reported number of agricultural damage has been growing larger and the bear distribution has been extended to nearby the human residential areas. Along with the expansion, the frequency of bear appearance in human residential areas has been increasing. In 2014, the Hokkaido brown bear management plan was compiled based on the plan for the Oshima Peninsula and “to reduce frequency of bear appearance in human residential area” was added as an aim. However, lack of budget and adequate staff as wildlife managers at local areas are still critical

issues in establishment of appropriate management system in each local area. A decrease in experienced hunters is another factor to this complex issue.

#### **4803 Counting Bears Is Not as Simple as One, Two, Three: Estimating Bear Numbers in North America**

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Brown bears throughout most of their range occur at low densities and live in heavily forested environments. As such, estimating their numbers is not a simple counting exercise. Here I discuss several newer techniques used to estimate both bear numbers and density in heavily forested environments. I focus on capture-mark-recapture techniques. I will review methods that consider: 1) genetic markers, 2) unique physical characteristics of individuals, 3) use of radio-collars, and 4) use of chemical markers. Finally I provide a brief discussion of habitat based models to approximate bear density as a method to establish a population baseline for management purposes.

#### **4804 North American Brown Bears: History, Ecology, and Management**

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Prior to European colonization, brown bears were distributed across western North America from Mexico to the arctic. Active persecution dramatically reduced or eliminated bears from virtually all of their range south of the Canadian border in less than 200 years. Remnant populations in the contiguous United States were protected in 1975, and wide-ranging research and management programs were implemented to revitalize them. Grizzlies are now expanding in both in number and range near Yellowstone National Park. Grizzlies in Canada were less impacted by colonization and habitats remained largely intact until recent expansion of oil shale projects. Hunting is impacted by biological and political forces, and there are efforts in public education. Alaska, the least impacted region, is currently home for most of the brown bears on the continent. Predator control programs in the 1940-50s reduced populations by poisoning and aerial shooting, but active management since statehood has reversed most declines, including bears living in the largest city in the state. Current management includes closely monitored hunting, limited predator control, and a comprehensive education program. The lessons learned from the North American experience include: 1) brown bears have low fecundity and are vulnerable to human persecution; 2) they are generalists that use a wide array of habitats if given the chance; 3) human tolerance of bears decreases if lives or property are threatened; and, 4) tolerance increases when people understand and assess a value to them. The key to continued co-existence is adaptive management that recognizes these factors and addresses them.



## Session 49: Population Management

### 4901 Influence of Human Activities on the Activity Patterns of Japanese Sika Deer and Wild Boar in Central Japan

**Nick B.J.P. van Doormaal**<sup>1</sup>, Haraku Ohashi<sup>2</sup>, Shinsuke Koike<sup>3</sup>, Koichi Kaji<sup>3</sup>, <sup>1</sup>Wageningen University, Wageningen, Netherlands; <sup>2</sup>Forestry and Forest Products Research Institute, Ibaraki, Japan; <sup>3</sup>Graduate School of Tokyo University of Agriculture and Technology, Tokyo, Japan. Contact: nick.vandoormaal@gmail.com

Japanese sika deer (*Cervus nippon*) and wild boar (*Sus scrofa*) have expanded their distribution and increased in abundance across Japan and are causing increased agricultural damage. The aim of this study was to examine the effects of hunting and indirect human activities on the activity patterns of sika deer in central Japan and compare these with previous findings on wild boar. Camera traps were used to observe activity patterns of both species and that of humans in the hunting season and non-hunting season. Cameras were placed at varying distances from the nearest settlement. A relative activity index (RAI) was calculated separately for day and night to compare the species' diurnal and nocturnal activities and how they were influenced by humans. Generalized linear mixed models were used to test the effects of human activities on the RAI of sika deer and wild boar. The results showed that RAIs of sika deer and wild boar were higher in the non-hunting compared with the hunting season. The RAI of sika deer at night showed a negative response with increasing distance to the nearest settlements. The RAI of wild boar at night also showed a negative weak response with increasing distance to the nearest settlements. This study suggests that sika deer and wild boar avoid humans and human-dominated areas by being nocturnal. The recent introduction of night hunting might help to control wildlife populations, but monitoring will be necessary to confirm this expectation.

### 4902 Relationships between Annual Range Size and Attributes of Seasonal Ranges of Mongolian Gazelles

**Shunsuke Imai**<sup>1</sup>, Takehiko Ito<sup>1</sup>, Toshihiko Kinugasa<sup>1</sup>, Atsushi Tsunekawa<sup>1</sup>, Masato Shinoda<sup>2</sup>, Badamjav Lhagvasuren<sup>3</sup>, <sup>1</sup>Tottori University, Tottori-city, Japan; <sup>2</sup>Nagoya University, Nagoya-city, Japan; <sup>3</sup>Mongolian Academy of Sciences, Ulaanbaatar, Mongolia. Contact: rainbow\_f\_t@yahoo.co.jp

Annual home range size of Mongolian gazelle (*Procapra gutturosa*), a long-distance migratory ungulate, varies individually and/or regionally. There are two possibilities to explain this annual-range size variation; 1) larger annual range was due to longer seasonal movements, or 2) larger annual range was due to longer and non-seasonal nomadic movements, because movement pattern of Mongolian gazelles was suggested rather nomadic than typical migration between specific summer and winter ranges. To examine the reason of annual-range size variation, we analyzed relationships between annual range size and location, sizes, and overlap of seasonal ranges. We calculated 95% kernel annual, summer (Jun.-Aug.) and winter (Dec.-Feb.) ranges for 35 cases of 20 Mongolian gazelles tracked by satellite from 2002 to 2010 in Mongolia. We also calculated the distance between centroids of summer and winter ranges, and the overlap of the ranges for each individual and year. Mean, maximum, and minimum distances between the centroids were  $92 \pm 11$  km (mean  $\pm$  SE), 304 km, and 10 km, respectively. Annual range size increased with the distance. Overlap of summer and winter ranges was observed 14 of 35 cases and maximum overlap rate was 0.24. Any overlap was not observed where the distances between centroids of the seasonal ranges

were more than 80 km. Larger annual range of Mongolian gazelles was explained from seasonal movements, and the variations of seasonal-range attributes would indicate variations of movement pattern of the species.

#### **4903 Recolonization of Eurasian Otter (*Lutra lutra*) in South Korea in 1964 - 2014 Periods by Identifying through Information Review**

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Urbanization and other human impacts cause the reduction of distribution of large mammals in the world. In South Korea, urbanization and industrial development is among the fastest. As a consequence, the distribution of Eurasian otters (*Lutra lutra*) has been affected to exacerbate their habitat; however, the Korean government has turned the policy to coexist the nature and development two decade ago when people began to consider the nature protection. The Korean government designated otters as national monument and endangered species (I) in 1982 and has mitigated the stream and river since 1987 by investing the 1.5 billion dollars. We hypothesized that the distribution of otters as semi-aquatic mammals has been enlarged due to water purification. Therefore, we reviewed 4 distribution papers, 11783 other articles in newspapers from 1960 to 2014 and compared the environmental factors (water quality, land use, and topographical features) of the 111 river basins. In the early stage, otter distribution was in edge area, where are island, the remote small farmlands and mountainous area, and has been dramatically recolonized in the late 1990s. Nowadays, the recolonization excluded in the Seoul metropolitan region, capital city. The most important factors for recolonization were the proportion of forest and growing stocks (n/m<sup>2</sup>) while water quality did not discriminate the otter occurrence. In the history, otter restoration is necessary to forest development and suggested strict laws and policies for species protection is the most important in developing countries.

#### **4904 Reintroduction of a Large Herbivore in the Rothaargebirge, Germany: From Vision to Realization 2010-2015**

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The European bison (*Bison bonasus*), the largest terrestrial mammal in Europe, was historically distributed almost throughout all Europe. Overharvesting and increasing habitat loss since human settlement led to a continuous population decline and extinction in the wild in the early 20th century. After 10 years of preparation the reintroduction of a small population of European bison in the mountain range "Rothaargebirge" in Germany in 2013 is at this stage unique for Western Europe and aims on the one hand to contribute to the conservation of this highly endangered species and on the other hand to fill again its abandoned ecological niche in a central European forest landscape. A state-of-the-art environmental impact statement was prepared and additionally a broadly structured and well-integrated program of social assessment, stakeholder participation, and conflict management was established to overcome political and social obstacles and thereby enable

European bison reintroduction. During the captivity phase European bison were found to be manageable in this region and therefore the permission to release the herd was given in 2013. Ever since the free ranging bison are radio-tracked (GPS). The analysis of the spatio-temporal behavior is an important base to continuously adapt the management strategy. Since the release of the bison the management has to be adapted to new requirements that appear especially considering conflicts with commercial forestry in the region. This pilot project is of outstanding importance in developing sound and adaptive management concepts to serve as models and “icebreakers” in facilitating further reintroduction initiatives elsewhere.

#### **4905 Integrated Management of Trophic Interactions: Moose, Red Deer and Forest in Sweden, Belarus and Republic of Moldova**

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The effects on tree regeneration of herbivores depend on their density and the amount of food provided under different forest landscape management systems. Within the hemiboreal and temperate ecoregions different countries provide different social-ecological contexts and thus opportunity for comparative studies regarding the trade-offs among different variables. Currently, hunting management of wild herbivores is being reformed in Sweden, Belarus and Republic of Moldova, including several suggestions for improving the future of wildlife and forest management in these countries. The situation in southern Sweden is presently quite problematic concerning the chance to regenerate Scots pine for wood production and deciduous tree species for biodiversity conservation successfully in areas with even moderate populations of moose. In Belarus moose hunting is a significant product delivered by forest ecosystems, which can be steered by development and change of hunting and forest management. Decision to increase the number of red deer populations in Republic of Moldova may compromise other strategic national task, to increase forest area. First, based on interviews we assessed stakeholders’ perceived ecosystem services linked to moose, red deer and forests. Second, we assessed the carrying capacity for moose and red deer in case study landscapes in different three countries. The profiles of ecosystem services linked to the moose-red deer - forest system were different between Sweden, Belarus and Republic of Moldova. The big difference in moose and red deer density and harvest between the countries was linked to different carrying capacities. Finally, we propose a management model focused on integration of the interactions between wild herbivores populations and forests management.

#### **4906 Factors That Influence the “Carrying Capacity” of Game Species**

**Vitalie Gulca**<sup>1</sup>, Per Angelstam<sup>2</sup>, Reginald Barrett<sup>3</sup>, <sup>1</sup>Forest Research and Management Institute, Chisinau, Republic of Moldova; <sup>2</sup>Swedish University of Agricultural Sciences, School for Forest Management, Skinnskatteberg, Sweden; <sup>3</sup>University of California, Department of Environment Science, Policy, and Management, Berkeley, CA, Contact: vitalie.gulca@gmail.com

The term carrying capacity was coined by Aldo Leopold (1933:50-51) in his work “Game management”, and is one of the most common concepts in wildlife management (Caughley & Sinclair 1994). However, the interpretation of this concept and its application in practical management varies. For example, while Morrison 2000:46 argued that “... while carrying capacity

may be equated with a certain level of habitat quality, the quality itself should be based not on the number of organisms but on the demographics of individual populations.” From other parts of the world scholars have argued that the “concept of carrying capacity is the cornerstone for sustainable game management, because it brings clarity to many questions in the theory and practice of wildlife management” (Юргенсон 1969 quoted by Львов 1984). It is thus possible to identify management contexts professional wildlife management and conservation (public land in the US), opposing stakeholder views and unresolved conflict (Sweden) and with evident crisis in wildlife management and conservation (Moldova). First, we list reasons why it is important to estimate carrying capacity. Second, we identify what factors influence carrying capacity and how it is perceived among stakeholders. Finally, we discuss the need to include both target species, the ecosystem in which it lives and different stakeholders views to define different levels of carrying capacity. Research about carrying capacity thus encompasses a wide range of questions. What are different stakeholders’ views on the balance between game populations and other parts of ecosystems? What is the effect on population density, demography, health and trophy quality of different views on carrying capacity? What is the power of different stakeholders?

#### **4907 A Simple Explanation for Herbivore Irruptions and Their Control**

**Toshiyuki Namba**, Osaka Prefecture University, Sakai, Japan. Contact: tnamba@b.s.osakafu-u.ac.jp

In recent decades, ungulates have strikingly increased and expanded their ranges all over the world. Ungulate population dynamics often follows a process known as an irruption; rapid increase to peak abundance and the subsequent crash to lower abundance. In the process, overabundant ungulates alter natural plant communities into those dominated by less palatable species. In this talk, we will explain how the palatability of plants and the existence of carnivores affect herbivore dynamics using a simple mathematical model. We consider a simple three-species Lotka-Volterra model of a palatable and an unpalatable plant and an herbivore, assuming that the unpalatable species is inferior to the palatable one in competition because of the cost of anti-herbivore defense. Then, we add a carnivore to the model and examine the effects of carnivore on the herbivore dynamics. Under the assumptions, all the steady states become unstable if self-regulation of the palatable plant is weak. Thus, population oscillations appear and the herbivore nearly extirpates the palatable plant. Then, the unpalatable plant dominates the plant community for a long time. This cycle seems to describe the irruptive dynamics of herbivores adequately. When a carnivore invades the plant-herbivore system, it causes a positive trophic cascade to the palatable plant, which negatively affects the unpalatable one and the oscillation will be terminated. Thus, the existence of palatable and unpalatable plants leads to herbivore irruptions and the nonlinear nature of carnivore predation is a key to control herbivore populations.

#### **4908 Half Century of Failing Ungulate Management: Data, Relationships, Conclusions**

**Sándor Csányi**, Szent István University, Gödöllő, Hungary. Contact: s.csanyi@gmail.com

During the last half century continuous increase of ungulate populations could be observed in the developed world (e.g. red deer and wild boar in Europe and North America, sika deer in Japan, roe deer in Europe, white-tailed deer in North America). Once rare and scarce animals become common, providing abundant wildlife resources never imagined before. At the same time they have become agricultural pests, invading urban areas, raising public concerns because of zoonoses and wildlife-

vehicle collisions etc. During the last 50 years the harvest of big game (red deer, fallow deer, roe deer, mouflon, wild boar) reached a >13-fold increase and these species occur in large parts of Hungary. The growing numbers and area occupied by big game have provided increasing shooting opportunities and incomes for game managers but the multiplying damages to forests, agricultural crops, and the threats to biodiversity have also kept the issue hot. This study presents history of failures to stop the increase of ungulate populations based on 50-year long data collected by the Hungarian Game Management Database. It also numerically analyze the most important causes of lengthy and repeated failures. Since the mid-1970s government offices initiated 5-6 campaigns to reduce the ungulate populations without lasting successes. The main causes of reiterating failures can be summarized as follows: 1) Lack of long term commitment to keep higher harvest rates (short-sighted management and lack of framework); 2) Outdated management philosophy and practice (protection of females, mismanagement of males); 3) Overregulation of hunting (methods, tools, seasons) resulting in inflexibility; 4) Misappreciation of data and professional knowledge as a consequence of mixing value judgement and technical judgements.

**Wednesday, July 29, 2015**

## **Plenary**

### **Session 50: Long-Term Research and Monitoring**

#### **5001 Long-Term Research and Monitoring**

**Dale R. McCullough**, University of California, Berkeley, Kensington, California, CA, Contact: [mcculla@berkeley.edu](mailto:mcculla@berkeley.edu)

Detailed short-term studies (reductionist approaches) are most effective in answering highly specific questions through experimental hypothesis tests, whereas long-term studies (integrative approaches) are required to synthesize the wider context and all levels of the system to understand how individuals, populations, communities, ecosystems, and physical environments interact on a large scale in time and space. Four main advantages of long-term research and monitoring programs of specific populations of wildlife are as follows. 1) Hypothesis tests on long-lived species can be conducted through controlled manipulations where experimental design is limited by lack of matched areas. The manipulations are like “treatments” where one variable, such as population size, or composition, or an environmental variable is altered over time. 2) The outcome often leads to further, more detailed questions. Thus, a series of sequentially more detailed hypotheses or biological processes can be tested. 3) Monitoring or research data over longer time periods allow time-series analysis to elucidate cyclic and/or periodic events to help understand longer term environmental variables. Time series analyses become stronger with longer data sets, a necessity for events that occur at longer intervals. 4) New technology that becomes available can be applied to continuing studies to obtain results previously not possible. Major new technologies in recent decades include remote and satellite imagery for large scale questions about habitats and environments, radio telemetry including GPS technology for individual animal monitoring, and DNA analysis for an array of questions from genetic relationships to non-invasive sampling of rare species, to mention a few important advances. Greater collaboration between researchers has become necessary in recent years to bring together the varied expertise required to address the complexity of such research endeavors. Examples of these approaches will be illustrated by research conducted on George Reserve Michigan white-tailed deer, California Hopland Field Station black-tailed deer, domestic sheep and coyotes, California tule elk and bighorn sheep, outback Australia kangaroos, and Amur leopards and tigers in Far East Russia. Each of these studies extended over many years, and addressed questions about population dynamics and carrying capacity, response to hunter harvest, nutrition, animal behavior, genetic structure, ecological community interactions, response to environmental extremes, and conserving rare species. The broader understanding obtained helped to frame how management and conservation could be most effectively pursued.

#### **5002 Longterm Monitoring for the Future of Conservation and Society: Lessons from 50 Years in Serengeti and the Need for Restoration of Ecosystems**

**Anthony R.E Sinclair**, University of British Columbia, Vancouver, BC, Canada. Contact: [sinclair@zoology.ubc.ca](mailto:sinclair@zoology.ubc.ca)

Fifty years of baseline research and continuous monitoring in the Serengeti ecosystem of Tanzania, East Africa, have produced results important for both conservation and the sustainability of human ecosystems. Four themes emerge from the research. First, we see that populations of individual species are stabilized through food resources or predation.

Secondly, we find that the diversity of species is important in stabilizing the whole community. Many species of predators feeding on many species of prey allow a stable community. This means that if some species are lost from the ecosystem through human disturbance such as habitat destruction, conversion to agriculture, or human predation, then the ecosystem will become unstable.

Thirdly, long term data show that ecosystems are continuously changing. This is seen over at all time scales from thousands of years to decades. Ecosystem change is caused by slow change in climate. The consequence for conservation is that individual species distributions change so that some species come in while others leave so that the diversity of species changes.

Fourthly, ecosystems that are slowly changing reach a limit where they break into a new system. This can happen with sudden disturbances such as fire or floods, or with major impacts such as agriculture. When this happens there is a major change in the types of species in the community.

Two important lessons come from long term monitoring. First, it is necessary to know historical changes over the past thousand years to understand present day changes in ecosystems. Secondly, conservation relies on using Protected Areas to preserve wildlife but the long term results show that both continuous slow change and sudden major change mean that the ecosystem inside a Protected Area will be very different in 100 years from now from what it was originally intended to preserve. This means that static boundaries around Protected Areas will not be sufficient for long term conservation. Boundaries of Protected Areas will have to change, new Protected Areas will have to be set up, or areas of human use, such as agriculture will have to be modified to allow more species to live in them. I describe how we can do this restoration.

# Symposia and Contributed Papers

## Session 51: Making Effective Use of Data from Captured Bears to Improve Bear Management

### 5101 Using Captured Bear Data for Better Bear Management

**Toru Oi**, Ishikawa Prefectural University, Ishikawa, Japan. Contact: toruoi@ishikawa-pu.ac.jp

To accurately understand and monitor wild bears, we must synthesize information from a variety of sources, such as public bear sightings, field signs, records from bear tracking using radio or GPS collars, and captured bears, each of which has its own advantages and disadvantages. Because 1500-5500 black bears and 500-800 brown bears are killed as game or nuisances every year in Japan, captured bears can provide a large amount of data, including sex, age, morphology, diet, body condition, reproductive status, and genetic characteristics. The greatest contribution of such data to bear management in Japan has been the establishment of local populations as management units using geographic distributions of mtDNA types. Captured bear data can also aid in determining population estimates and key foods for invasive bears, among other uses. However, obtaining useful data from captured bears depends on population size; for example, endangered or small populations do not provide adequate sample sizes for analysis because capture is generally prohibited. More expensive methods for handling living bears, such as mark and release are necessary in such cases. For large populations, only data describing sex/age and capture site are needed to analyze distributions and population trends, and these can be obtained from hunters. If cooperation between hunters and local governments is well established, these data are cheap to collect. However, to build a successful information collection system, local governments must also provide feedback to hunters.

### 5102 The Incidental Capture Problem of Asiatic Black Bear: the Current Status and Technical Challenges

**Kousuke Nakagawa**<sup>1</sup>, Fumihiro Kaneko<sup>2</sup>, Tetsuji Itoh<sup>1</sup>, <sup>1</sup>Wildlife Management Office, Inc., Kobe, Japan; <sup>2</sup>Wildlife Management Office, Inc., Tokyo, Japan. Contact: nakagawa@wmo.co.jp

One of the main issues in the management and conservation of Asiatic black bear (*Ursus thibetanus*) in Japan is the incidental capture of bears in traps set for deer or wild boar, where habitat of these species overlap. The distribution of black bears in Japan is currently expanding, and bears are now living much closer to human residential areas. Furthermore, trapping pressure on deer and wild boar is expected to grow, raising our concerns about further increases in unintentional bear captures. In order to reduce or prevent incidental captures of bears, and to allow bears caught to be safely released, developing appropriate procedures, establishing a well thought-out release system and improving immobilization techniques should play key roles. Since it is illegal in Japan to kill a bear accidentally captured, safely immobilizing and releasing these bears is essential to reducing risks to people and bears. Our company has dealt with 691 cases of incidental captured bears in 8 prefectures over the past 17 years. We will share our knowledge, present techniques used, and discuss challenges involved in immobilizing and releasing bears accidentally caught in a box or snare trap.



**5103 Evaluating the Biological Evidence for Using Translocation and Aversive Conditioning on Released Bears to Reduce Human-Bear Conflicts**

**Mayumi Yokoyama**, University of Hyogo, Tanba-city, Hyogo, Japan. Contact: yokoyama@wmi-hyogo.jp

The population of Asiatic black bear in western Japan has been isolated and threatened with local extinction due to hunting and controlled-killing of bears causing conflicts. In order to reduce bear mortality and minimize human-bear conflict, from 2003 to 2012 black bears captured in Hyogo prefecture were aversively conditioned upon release. The behavior of these bears was then monitored and evaluated using GPS collars. The effectiveness of aversive conditioning varied depending on how often the bears had been involved in conflicts in residential areas. It was most effective for those bears that just started to appear in residential areas. However, no effect was found on older bears with a history of frequent and repeated conflicts. Unless attractants are carefully managed, new bears can move in and start causing conflicts after previously captured bears have been translocated. Translocation and aversive conditioning must be part of a bigger conservation strategy that takes into consideration the behaviors of bears and attractant management, as well as raising awareness and educating the public on how to prevent human-bear conflicts. Fortunately, the status of the bear population in Hyogo prefecture has recently shown steady improvement.

**5104 Non-Lethal Approaches for Managing Problem Bears**

**John Hechtel**, Bearsense, Fairbanks, AK, Contact: john.hechtel@gmail.com

Traditionally bears that caused problems in most areas of the world were killed, either by local residents, or by employees of government agencies. As bear populations were greatly reduced or eliminated in many regions, bear managers sought alternatives to killing problem bears. These have ranged from moving bears to new areas far from their home ranges, to moving bears within their home range away from conflict sites, to capturing and releasing bears at the sites of conflicts accompanied by aversive stimuli such as noise, rubber bullets and harassment by dogs. Managers have also experimented with aversive conditioning of bears living close to human activity to either prevent undesirable behavior from developing, or to change problematic behavior so bears can continue to use the natural foods and habitat close to humans without conflicts. I will review the results of some North American attempts to use non-lethal techniques to address human bear conflicts and provide some background on bear behavior and aversive conditioning to help explain the promise and problems associated with such approaches.

**5105 The Importance of Nongovernmental Organizations for Capturing Bears and Reducing Human-Bear Conflicts**

Toshio Tsubota<sup>1</sup>, Atsushi Katayama<sup>2</sup>, <sup>1</sup>Hokkaido University, Sapporo, Japan; <sup>2</sup>Wildlife Management Office, Inc., Kobe, Japan. Contact: tsubota@vetmed.hokudai.ac.jp

In Japan, there is no well-established government administration for bear management and conservation. Therefore, nongovernmental organizations (NGOs) and private corporations have made important contributions to this work, especially related to fieldwork and bear capture. Also, the absence of government bear management specialists in the field often results in poor collection

of data and scientific samples. Government officers are usually given the opportunity to gain practical training and learn how to deal with bears in workshops offered by NGOs. However, these experienced officers may be transferred to a different post due to government personal reshuffling. On the other hand, private organizations are more closely tied to an area, but they often face the challenge of uncertain funding. Therefore it is necessary to establish a strong funding base for private organizations to promote better bear management. Japan Bear Network (JBN), an NGO, has been playing an important role in management and conservation of bears in Japan. JBN supports local human-bear conflict mitigation and educates the public on preventing human-bear conflicts around residential areas. JBN has made a range-map of bears in Japan and distributed information to nearby human residential areas. We will discuss how NGOs and private corporations can work with government to advance a cooperative system for capturing bears and reducing human-bear conflicts.

## Session 52: Struggles for Effective and Sustained Control of Invasive Alien Species: Toward Improved Control and Eradication in the Future

### 5201 Current Status, Challenges and Future Perspective on Controlling Invasive Alien Raccoons in Japan

**Tohru Ikeda**, Ken-ichiro Shimada, Takaaki Suzuki, Hokkaido University, Sapporo, Japan. Contact: [tikeda@let.hokudai.ac.jp](mailto:tikeda@let.hokudai.ac.jp)

Raccoons (*Procyon lotor*) are now naturalized throughout Japan and have significant impacts on native species, ecosystems, agricultural crops and livestock. The Invasive Alien Species Act 2005 designated raccoons as invasive alien species, and control measures have been undertaken since then. Intensive trapping campaigns have begun to reduce raccoon damage in some regions, but there are a number of remaining problems. Little attention is paid to responding to initial invasion of new areas. Most attention is focused on agricultural damage and control is only implemented after agricultural damage occurs. In addition, effective coordination of control by local governments and information sharing are lacking. To remedy this situation, we developed a new comprehensive raccoon control project. First, we implemented an information sharing network with local governments to promote exchange of information about raccoon control. Second we developed an effective device for control of raccoons at low density. This nest-box trap is based on the raccoon's cavity-nesting habit and does not require attractive baits. Third, we started a community-based raccoon control campaign at an early stage of raccoon invasion in Oita City involving local government, environmental organization and local residents. This aims to minimize the impacts of raccoons on native biodiversity, especially endangered sea turtles. Members of the environmental organization detected raccoon breeding sites quickly and we decreased numbers of raccoons trapped by nearly 90% over 3 trapping sessions over an area of about 160 ha. We would now like to expand this type of campaign throughout the country.

## **5202 Business Sector Contribution to Management of Alien Species: the Example of a Restaurant Company**

**Yoshinori Hashibe**, Aleph Inc., Eniwa, Japan. Contact: yo\_hasibe@aleph-inc.co.jp

Aleph Inc. is a Japanese company that runs about 300 restaurants throughout Japan. Because we procure many food resources from nature, we pay special attention to ecosystem conservation. We think it is very important for food company not only to guarantee healthy and safe life of customers, but also properly to conserve our natural environments. I will show our IAS control activities (*Bombus terrestris* and *Pelophylax nigromaculatus*) that are closely related to our major food materials, cherry tomatoes and rice. The activities are conducted mainly at Ecorin-village, a theme park that is managed by ourselves in Eniwa city, Hokkaido, in cooperation with local residents, Hokkaido government and researchers.

## **5203 Challenges in Controlling Invasive Species in a Hyper-Arid Climate: A Case Study from the United Arab Emirates**

**Pritpal Soorae**, Environment Agency-ABU DHABI, Abu Dhabi, United Arab Emirates. Contact: psoorae@wildlife-services.com

The United Arab Emirates (UAE) has a hyper-arid climate which itself poses a challenge to non-native species getting established in the ecosystem. Examples are given of some species that have become established and methods undertaken to control their numbers. Examples are given of freshwater species e.g. tilapia and tropical aquarium fish getting established in wadi ecosystems, bird species such as Indian house crows and Mynahs being controlled in urbanized areas and some species of plants such as mesquite and prickly-pear that have been controlled. The methods used for eradicating or controlling are described and illustrated whilst the success rates of these control measures discussed.

## **5204 Improving Long-Term Management of Introduced Wild Deer in New Zealand**

**A. David M. Latham**<sup>1</sup>, Dan Herries<sup>2</sup>, M. Cecilia Latham<sup>1</sup>, Mandy C. Barron<sup>1</sup>, Jen Cruz<sup>1</sup>, Dean P. Anderson<sup>1</sup>, Clare Veltman<sup>3</sup>, Graham Nugent<sup>1</sup>, <sup>1</sup>Landcare Research; Department: Wildlife Ecology and Management, Lincoln, New Zealand; <sup>2</sup>Department of Conservation: Conservation Services Group, Napier, New Zealand; <sup>3</sup>Department of Conservation; Department: Science and Capability, Palmerston North, New Zealand. Contact: lathamd@landcareresearch.co.nz

Seven species of introduced deer have well-established populations and in some cases, widespread distributions in New Zealand. In many areas, they have attained high densities (10-15 deer/km<sup>2</sup>), with subsequent unwanted impacts on environmental and economic values. They are also an important game species for recreational hunters, and this is being increasingly recognised by managers, particularly for some herds and species. Effective management of deer requires knowledge about the habitats important to them and how selection for these habitats changes temporally, and the relationship between these factors and unwanted impacts. To highlight this, we used GPS location data collected from 26 sika deer (*Cervus nippon*) in Kaweka Forest Park (KFP) to fit Resource Selection Functions to assess seasonal and daily patterns of selection for open habitats. We hypothesized that deer are most easily observed in open habitats, potentially increasing the ability of helicopter hunters to reduce female numbers to target densities to control population size.

To test this hypothesis, we used helicopter hunting data to estimate predation risk (probability of encounter and probability of kill given an encounter) for sika deer in KFP in relation to habitat and other landscape features. We found complex temporal patterns in deer selection of open habitats that may have been related to seasonal food availability and the risk of being seen and shot. We compare analyses of habitat selection with predation risk to demonstrate how the efficacy of helicopter hunting to control deer can be increased.

#### **5205 Limiting Factor to Nutria (*Myocastor coypus*) Population in South Korea**

Gea-Jae Joo, **Sungwon Hong**, Pusan National University, Busan, Republic of Korea. Contact: nanhsw@naver.com

Different geographical and climate factors would limit invasion risk. The successful management of invasive species like nutria (*Myocastor coypus*) could be established under the comprehensive knowledge of limiting factors to spread. In South Korea, nutria were imported in 1985 for fur farming and meat production. Sequential failures of nutria farm management in the late 1990s resulted in the accidental and/or intentional release into the wild. However, relatively colder climate and mountainous area could restrain nutria spread. We approached (1) distribution, spread, habitat preferences in South Korea, and (2) the feeding property dividing aquatic and terrestrial region at the Eul-suk Island using the  $\delta^{15}\text{N}$  ratios of the plants. Nutria populations were recorded in 49 of 236 sites investigated in 2014. The distribution patterns revealed that the spread of nutria from farming sites has mainly proceeded along rivers via tributaries. Food availability, levees with suitable burrow materials, and slow water flow defined nutria habitats. The cold climate was also important, and the total number of days below  $-4^{\circ}\text{C}$  significantly delineated nutria distribution. The isotopic relationship between prey and predator, nutria feeding was fully rooted from aquatic plants. In accordance with low temperature, the assimilation rates decreased in the hind-leg muscles which have relatively longer turnover rate comparing to sustain the rate in the liver tissues. To ensure the successful control, the best use of ecological information should make the high efficiency.

#### **5206 How to Effectively Manage a Widespread Invasive Species: The Coypu in Europe**

**Sandro Bertolino**, University of Turin, Grugliasco (TO), Italy. Contact: sandro.bertolino@unito.it

Coypu (*Myocastor coypus*) is one of the most widespread and harmful invasive species in the European Union, with populations established in at least 14 of the 28 countries. Climatic conditions in most of Europe are considered suitable for coypu, except for the northern countries, therefore, in the future this species will continue to spread. The main ecological impacts caused by this species are changes in the composition of local plant communities and disturbance to waterbird nests. A huge economic loss is associated to damage to agriculture, river banks and control costs. Coypu dig extensive burrow systems into riverbanks and ditches, disrupting drainage systems. The cost of coypu management (damage and species control) for the whole current European range is estimated at 65.7 million €/year. Management actions aimed at limiting damage and/or populations are ongoing in some countries, but results are not always known and their effectiveness is often questionable. Aims of this presentation will be to review the distribution of this species in Europe, its impacts and control activities. A management strategy will be presented learning from few effective eradication and control experiences.

## **5207 Nutria Impacts and Management in the United States**

**Stephen R. Kendrot**, US Department of Agriculture, APHIS Wildlife Services, Riverdale, MD, Contact: [stephen.r.kendrot@aphis.usda.gov](mailto:stephen.r.kendrot@aphis.usda.gov)

Nutria, (*Myocastor coypus*), are a semi-aquatic mammal native to South America that once prized for their fur. Commercial fur farms established throughout the world were responsible for the introduction and establishment of feral populations in every continent except Australia and Antarctica. Nutria are tolerant of a wide range of climactic conditions and have adapted well to urbanized and natural aquatic habitats. In many landscapes, their digging and feeding habits result in severe environmental degradation to wetland and riparian habitats as well as to anthropogenic landscape features including levees, roadways, horticultural and agricultural resources. Nutria have established populations in 18 states in the southeastern, south-central, and northwestern United States. Expanding populations in the Pacific Northwest and impacts on wetlands, urban, and riparian habitats are increasingly the subject of research and localized control. Destruction of wetlands in coastal regions has been a primary justification for control efforts in Louisiana and Maryland, where two distinctly different approaches to managing nutria damage are taking place. In Louisiana, where millions of nutria inhabit coastal wetlands along the Gulf Coast, private fur harvesters receive incentive payments for nutria harvested under the Coast-wide Nutria Control Program. In Maryland's Chesapeake Bay, where a more localized population has had similar catastrophic impacts on wetlands, a partnership of federal, state, and private entities has implemented a highly effective eradication campaign. We will present an overview of nutria impacts and management with special emphasis on the ongoing eradication campaign in Maryland, USA.

## **5208 Sustaining Control of Introduced Wildlife: Failures and Successes from New Zealand**

**John Parkes**, Kurahaupo Consulting, Christchurch, New Zealand. Contact: [john.parkes1080@gmail.com](mailto:john.parkes1080@gmail.com)

Sustained control of IAS is a form of harvesting, but unlike harvesting of resources the goal is to reduce the population to some level that protects the asset being affected and not to aim for a harvest per se. An ideal management strategy requires (a) understanding of the relationship between IAS density and asset condition; a simple damage function or density-dependent model when the relationship is general and not affected by external events, or by more complex interactive models when the IAS and/or the asset are affected by density independent environmental events; (b) this sets a target density from zero upwards for the IAS, that (c) sets rules for the intensity and frequency of the control given the expected rates of population increase, that (d) determines who and how control is efficiently delivered. I use three case studies to show how the above logic for pest control has informed management. Himalayan thar (*Hemitragus jemlahicus*) are managed under the assumption of a simple damage function (impact on alpine vegetation) to set densities and thus regular control interventions by different various hunters and government culling. Ship rats (*Rattus rattus*) and their predators such as stoats (*Mustela erminea*) in beech forests are driven by periodic, predictable mast seeding events that allow large-scale emergency responses to be planned - although the availability of such contingency funding is always uncertain. Finally, I will discuss the complexities when multiple IAS are themselves part of a trophic system and control of one has adverse consequences for others.

## Session 53: Radiation Monitoring and Conservation of Wildlife after Fukushima

### 5301 International Research Needs for the Effects of Radiation on Non-Human Biota and Ecosystems

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Most of the present systems of radiation protection have been developed to protect human health. However, increasing attention has been paid over the last two decades on the protection of the environment (i.e., non-human biota and ecosystems) from ionizing radiation. International organizations, such as International Commission on Radiological Protection (ICRP), International Atomic Energy Agency (IAEA) and United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), have organized meetings on environmental effect of radiation and published the up-to-date outcome as official reports. A series of European projects have played an important role in collecting scientific data currently available. However, they have also pointed out existing gaps of data. For example, data on the effect of exposed radiation dose (especially by chronic exposure) on biota is limited though essential for risk assessment. Many projects have attempted risk assessment in the contaminated areas of Chernobyl. Radiation exposure by the accident of Fukushima Daiichi Nuclear Power Plant in 2011 could be at a considerable level for non-human biota in highly contaminated areas, according to the derived consideration reference levels (DCRLs) proposed by ICRP. Although an extreme consequence, such as “red forests” seen in Chernobyl, has not been observed in Fukushima, several existing studies note possible effects of radiation exposure on some species in biota. This paper summarizes international and national efforts to protect non-human biota from ionizing radiation in the last two decades, and discusses research needs after the accident of Fukushima Daiichi Nuclear Power Plant.

### 5302 Establishment of Animal Archives in and around the Ex-Evacuation Zone of the Fukushima Nuclear Power Plant Accident

**Manabu Fukumoto**, Yusuke Urushihara, Masatoshi Suzuki, Yoshikazu Kuwahara, Gohei Hayashi, Tohoku University, Institute of Development Aging and Cancer, Aoba-ku, Sendai, Japan. Contact: fukumoto@idac.tohoku.ac.jp

We have been establishing an archive system composed of animal tissue, grass and soil samples in and around the ex-evacuation zone of the Fukushima Nuclear Power Plant (FNPP) accident. We intend to make use of it for the assessment of radiation effects on ecosystem and the future radioprotection. As of December 1, 2014, we collected samples from 301 cattle, 57 pigs and 162 Japanese macaques. Four years after the accident, among radionuclides attributable to the accident, only radiocesium was detectable. Radiocesium concentration in each organ was proportional to that in peripheral blood and the highest in the skeletal muscle among organs examined irrespective of animal species. However, we have not observed abnormal findings in animals in and around the ex-evacuation including the leukocyte count in peripheral blood of Japanese macaques. Some of antioxidant activities examined were significantly correlated with the blood radiocesium level in cattle. These observations suggest that animals affected by the FNPP accident are under a stressful

environment. However, we need a long-term follow-up study for decades to conclude whether the notions above are correct and how irradiation is involved in them.

### **5303 Hematological Characteristics and Muscle Radiocesium Concentrations in Wild Japanese Monkeys after Fukushima Disaster**

**Takuya Kato**, Nippon Veterinary and Life Science University, Musashino-shi, Tokyo, Japan. Contact: tkato@nvl.ac.jp

The objective of this study is to monitor concentration of radiocesium Cs-134 and Cs-137 over time in the muscle of Japanese monkeys (*Macaca fuscata*) inhabiting Fukushima City located 70 km from the Fukushima Daiichi Nuclear Power Plant (NPP), and their health effect due to exposure to radioactive materials using the blood data. Cesium concentration in the muscle of monkeys was 6,000-25,000 Bq/kg in April 2011 and decreased over 3 months to around 1,000 Bq/kg. However, the concentration increased again to 2,000-3,000 Bq/kg for some individuals during winter period before returning to 1,000 Bq/kg in April 2012. In 2012, we carried out a one-year hematological study on a population of Fukushima City ( $n = 61$ ) and the Shimokita Peninsula ( $n = 31$ ) located approximately 400 km from the NPP as a control. Total muscle cesium concentration in Fukushima monkeys was in the range of 78-1778 Bq/kg, whereas the level of cesium was below the detection limit in all Shimokita monkeys. Compared to Shimokita monkeys, Fukushima monkeys had significantly low white and red blood cell counts, hemoglobin, and hematocrit. In Fukushima immature monkeys the white blood cell count showed a significant negative correlation with muscle cesium concentration. These results suggest that the exposure to some form of radioactive material contributed to hematological changes in Fukushima monkeys.

### **5304 The Pale Grass Blue Butterfly in Fukushima.**

**Joji Otaki**, Atsuki Hiyama, Wataru Taira, Chiyo Nohara, Mayo Iwasaki, Seira Kinjo, Masaki Iwata, University of the Ryukyus, Nishihara, Okinawa, Japan. Contact: otaki@sci.u-ryukyu.ac.jp

To fully understand what has happened to organisms living in the radiation polluted areas, long-term monitoring of the biological impacts on organisms is required. We investigated spatial and temporal changes of the abnormality rate (AR) in both field-caught adult and laboratory-reared offspring populations of the pale grass blue butterfly, *Zizeeria maha*. They have generation time of approximately one month. We monitored 7 localities in and around Fukushima Prefecture every spring and fall over 3 years between 2011 and 2013 ( $n = 1,713$  for field caught;  $n = 9,663$  for offspring). The adult ARs peaked in the fall of 2011, while no AR increase was observed in non-contaminated localities. Among offspring, the total ARs, which include deaths at premature stages and morphological abnormalities at the adult, peaked either in the fall of 2011 or in the spring of 2012. The AR level was much higher than those of the parent field populations for those periods, suggesting that the similarly high level of deaths and abnormalities might have occurred also among the field populations. Importantly, the elevated ARs in the field and offspring came back to normal by the fall of 2012 and by the spring of 2013, respectively. These results demonstrate an occurrence and an accumulation of adverse physiological and genetic effects in early generations, followed by their decrease in AR and recovery to the normal. The study provides one of the most comprehensive records of biological dynamics after a nuclear accident available today.

### **5305 Effects of Radioactive Contamination around Fukushima Daiichi on the Morphology and Genetics on Aphids**

**Shin-ichi Akimoto**, Izumi Yao, Graduate School of Agriculture, Hokkaido University, Sapporo, Japan.  
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To evaluate the impact of fallout from the Fukushima Daiichi Nuclear Power Plant accident on organisms, the morphology and viability of the gall-forming aphid *Tetraneura sorini* were compared between a Fukushima population and seven populations from non-contaminated areas. The present study focused on first-instar gall formers derived from the first sexual reproduction after the accident. Of 164 first instars from *T. sorini* galls collected 32 km from Fukushima Daiichi in spring 2012, 13.2% exhibited morphological abnormalities, including 4 conspicuously malformed individuals (2.4%). In contrast, in the control populations, first instars with abnormal morphology accounted for 0.0-5.1% (on average, 3.8%). The incidence of abnormalities was significantly higher in Fukushima than in the control populations. We morphologically compared first instars of the first generation (hatching from eggs on the bark surface and inducing galls) with those of the second generation ("clones" of the first generation and produced parthenogenetically in the galls as larvae). Of 543 second-generation first instars in the Fukushima population, only 0.37% had abnormalities. This result suggests that radioactive contamination had deleterious effects on embryogenesis in eggs deposited on the bark surface, but a negligible influence on the second generation produced in closed galls. Analysis of samples collected in spring 2013 indicated that the viability and healthiness of the aphids were recovered compared to those in the 2012 samples. Thus, a reduced level of radiation may have led to the recovery of viability and healthiness of the Fukushima population.

### **5306 Research on Breeding of Ural Owl Using Nest-Boxes in Fukushima**

**Isao Nishiumi**, National Museum of Nature and Science, Tokyo, Tsukuba, Japan. Contact: nishiumi@kahaku.go.jp

Birds of prey are top level consumers in terrestrial ecosystems and are known to be less abundant with increasing levels of radiation around Chernobyl and Fukushima. Causes of the declining predators in radioactively contaminated areas are assumed to be both the ecological concentration of radioactive substances and reduced abundance of the prey. The Ural Owl *Strix uralensis* is one of the top predators in the forest of Fukushima, and is known as an opportunistic predator, namely opportunistically hunts any rodents, moles and/or small birds which is abundant and easy to catch in their territory. We can easily investigate the contents of their food by setting video cameras in the nest, by collecting the remnant of the nest after breeding (composed of the pellet of chicks) or even by directly collecting their food because they often keep the food in the nest during early stage of their nestling period. I set 81 nests in total: 42 nest-boxes in Iitate village as highly contaminated areas, where air radiation dose is from 0.8 to 4.0  $\mu\text{Sv/h}$ ; 23 nests in Tsuchiyu-onsen as low contaminated areas of 0.2 to 0.3  $\mu\text{Sv/h}$ ; and 16 nests in Aizu as control areas of 0.06 to 0.15  $\mu\text{Sv/h}$ . I will report the results of our on-going investigation on how much the breeding of predatory species is influenced by radiation exposure. Nest-boxes of Ural Owl would provide us with an excellent monitoring window to evaluate the effect of radiation to terrestrial ecosystem.



**5307 The Effects of Radiation for Non-Human Biota in Marine Environment since the Fukushima NPS Accident**

**Tatsuo Aono**, National Institute of Radiological Sciences, Chiba, Japan. Contact: [t\\_aono@nirs.go.jp](mailto:t_aono@nirs.go.jp)

Monitoring and surveying of radioactivity in seawater, sediments and biota in the marine environment around the eastern Japan in the Pacific were carried out for understanding the dispersion of artificial radionuclides after the Fukushima Daiichi Nuclear Power Station (FD1NPS) accident. The Fukushima-derived radionuclides in the ocean were not only the release of the high level contaminated water from FD1NPS but also the deposition directly from atmosphere. The maximum of Cs-137 concentrations at the FD1NPS were about 70,000 Bq /L on March, 2011 and then the activity of Cs-137 in seawater had decreased gradually to 1-2 mBq /L in a few months after this accident, approaching the pre-accident levels. However, the Cs-137 activity variation in marine environment differed among seawater, sediments and marine biota. The monitoring was reported only on the gamma-emitting radionuclides iodine-131 and radioactive cesium (Cs-134 and Cs-137) in the marine environment after this accident. It is well known that marine biota concentrates elements in their organ. The observed artificial gamma emitter radionuclides include not only I and Cs but also Ag-110m in marine biota. It is necessary to clarify the effects of the Fukushima-derived radionuclides in marine biota off Fukushima. The aim of the study is to examine the temporal and spatial variation of radioactivity in marine biota after this accident. Studies on the effects of radiation on marine biota off Fukushima will be presented with some assessment models.

**5308 Studying Immunological Effects of Ionizing Radiation through Microbiome**

**Tomoko Steen**, Georgetown University, School of Medicine, Washington, DC, Contact: [tys8@georgetown.edu](mailto:tys8@georgetown.edu)

Since the nuclear power plant accidents of Chernobyl and of Fukushima, the main concern has been the biological effects of ionizing radiation on organisms including humans and wild animals resident in affected areas. It has been very difficult, however, to assess the actual short- and long-term effects of radiation on organisms accurately. Ionizing radiation is invisible, and the level of some isotope such as strontium cannot be assessed using a standard Geiger counter. Radioactive isotopes released by the nuclear accidents have long half-lives, thus they continue to expose organisms and accumulate in their bodies. Biological accumulation differs from simple physical assessments of isotopes and further complicates measurement of biological effects. In searching of a reliable tool to assess the health effects of radiation on organisms, I have been investigating the use of the microbial commensals found with every animal - the microbiome. Recent advances and sequencing cost reductions have significantly improved studies on microbiome composition. Recent studies clearly show that the composition of the gut microbiome changes to reflect an organisms' health, age, and immune system status. In some cases, the use of microbiome as treatment of patients in the form of fecal transplant shows success. In this talk, I will discuss possibilities of using the gut microbiome to investigate minute effects of ionizing radiation on wild animals and potential use of the system to aid ecosystem recovery.

## Session 54: Wildlife Conservation and Management in Shiretoko National Park, 2015: Sharing Experience and Knowledge with Yellowstone, Sikhote-Alin and Shiretoko

### 5401 Conservation and Management Policy in Shiretoko National Park

**Takashi Sakaguchi**, Ministry of the Environment, Kushiro, Japan. Contact: takashi\_sakaguchi@env.go.jp

Shiretoko National Park (386 km<sup>2</sup>) was designated in 1964 to conserve the magnificent landscape and various ecosystems in the Shiretoko Peninsula. Among the Japanese national parks with relatively high ratio of private land, Shiretoko National Park, with 99 % of its area belonging to the official organizations (national and local governments), is comparable to the U.S. national parks in terms of land ownership. Also, as the access roads to the park are limited, the nature is well preserved, and the visitor control is relatively easy. The Japanese Government nominated Shiretoko as UNESCO World Natural Heritage Site in 2004. In the “Management Plan for the Shiretoko World Natural Heritage Nominated Site,” the basic policy on conservation for the Core area is focused on allowing natural processes to occur without human intervention. Based on this Plan, the Ministry of the Environment has taken the following measures and strengthened the conservation and management of this area under the cooperation of related organizations: establishment of a Liaison Committee composed of the official and local sectors to promote cooperation; establishment of a Scientific Council organized by zoologist, botanists, and ecologists; development of “Shiretoko Sika Deer Management Plan”; development of “Multiple-use Integrated Marine Management Plan” in/around Shiretoko Peninsula; and development of “Ecotourism Strategy” to promote eco-tourism in Shiretoko National Park.

### 5402 Conservation and Management of Sika Deer in Shiretoko National Park

**Tsuyoshi Ishinazaka**<sup>1</sup>, Yasushi Masuda<sup>1</sup>, Masami Yamanaka<sup>2</sup>, <sup>1</sup>Shiretoko Nature Foundation, Shari, Japan; <sup>2</sup>Shiretoko Museum, Shari, Japan. Contact: ishina@shiretoko.or.jp

Sika deer (*Cervus nippon*) had locally been extinct in the Shiretoko Peninsula due to heavy snow in 1879; however, a small number of deer survived in Akan area which is about 100 km away from Shiretoko. They had been re-distributed into Shiretoko since the 1970s. Shiretoko National Park and Shiretoko National Wildlife Protection Area were established in 1964 and 1982, respectively. These nature reserves had worked as deer sanctuary. In addition, hunting of females had been prohibited in the remaining hunting zone of the peninsula until 1997; therefore, deer had rapidly increased all over the peninsula. Overpopulated sika deer have caused serious damages to forests and coastal grasslands of Shiretoko, and population crashes occurred in some wintering places such as Cape Shiretoko in the late 1990s. However, the population recovered to a level as high as before the crashes. Part of the peninsula, including the whole Shiretoko National Park, was registered as a natural World Heritage site in 2005. The Scientific Committee has recommended controlling deer population within the core area of the property. Culling of deer in the National Park was initiated by the Ministry of the Environment in 2007 at Cape Shiretoko, and then culling areas were extended to three wintering places in 2011. A total of 2424 individuals were culled within the National Park between 2007 and 2014, by methods such as sharpshooting, corral trap and drive hunting. The vegetation have gradually recovered in the areas where culling have been conducted.

#### **5403 Conservation and Management of Large Ungulates in and near Yellowstone National Park**

**Keith Aune**, The Wildlife Conservation Society, Bozeman, MT, Contact: kaune@wcs.org

Yellowstone National Park forms an important core protected area at the center of a larger region called the Greater Yellowstone Ecosystem (GYE). The GYE is one of the last remaining large, nearly intact ecosystems in the northern temperate zone of the earth. It is approximately 76,890 square kilometers in size and embraces many management jurisdictions and land types. This region is home to a wide suite of ungulate species including bison (*Bison bison*), elk (*Cervus elaphus*), mule deer (*Odocoileus hemionus*), white-tailed deer (*Odocoileus virginianus*), moose (*Alces alces*), pronghorn antelope (*Antilocapra americana*), bighorn sheep (*Ovis canadensis*) and mountain goats (*Oreamnos americanus*). These ungulates are widely distributed across the Greater Yellowstone Ecosystem but are naturally segregated by space, time, habitat preference and elevation. Moose and white-tailed deer are dominant in forested and riparian habitats. Bison, elk, mule deer, and antelope select the middle elevation grasslands. Bighorn sheep and mountain goats are mountain ungulates that occupy xeric habitats at higher elevations up to the mountain peaks. These species serve as the prey base for a complementary suite of carnivores and are a major biological driver in this fully functional ecosystem. There are many threats facing wild ungulates in the GYE including; timber harvest, mining, roads, livestock grazing, human development, diseases and recreational activity. These threats are anthropogenic in nature so must be mitigated by human decisions and land use policies. Resolving conservation problems in this ecosystem requires novel policies and practices that embrace multiple interests from many stakeholders, economic sectors, and jurisdictional bodies.

#### **5404 Recent Advances in the Conservation and Management of Brown Bears in Shiretoko National Park**

**Masami Yamanaka**<sup>1</sup>, Yasushi Masuda<sup>2</sup>, Tsuyoshi Ishinazaka<sup>2</sup>, <sup>1</sup>Shiretoko Museum, Shari, Japan; <sup>2</sup>Shiretoko Nature Foundation, Shari, Japan. Contact: masami-y@apost.plala.or.jp

In Shiretoko National Park (SNP) and the surrounding area, brown bear (*Ursus arctos*) sightings and encounters with bears have rapidly increased since 1995. Bear sightings in the Shari and Rausu local townships have approached 1,000 annually since the late 2000s. Concurrently, a variety of conflicts among brown bears, local residents and tourists have arisen. Shiretoko was designated as a Natural World Heritage Site (NWHS) in 2005. Following this designation, Japan's Ministry of the Environment (MOE), the Forestry Agency, and the Hokkaido Government developed the Shiretoko World Natural Heritage Site Management Plan in 2009. Despite these efforts, implementation of management actions for brown bears lagged and problems with bears increased. The MOE subsequently collaborated with the Forestry Agency, the Hokkaido Government, and the towns of Shari and Rausu to establish the Shiretoko Peninsula Brown Bear Management Plan in 2012. Under the plan, countermeasures to reduce and address conflicts were based on previous approaches implemented by the local town governments and the Shiretoko Foundation. A new system of zoning based on residential population density and human activity levels was incorporated into the plan. Responses to bear conflicts vary by zone and the particular behavior encountered. We will report on the status of brown bears in the Shiretoko Peninsula, describe new insights obtained from research and the implementation of these plans, and discuss suggestions for co-existing with brown bears.

#### **5405 Conservation and Management of Bears in Yellowstone National Park**

**Frank T. van Manen<sup>1</sup>, Charles Schwartz<sup>2</sup>**, <sup>1</sup>U.S. Geological Survey, Northern Rocky Mountain Science Center, Bozeman, MT, <sup>2</sup>Retired Certified Wildlife Biologist, Bozeman, MT, Contact: fvanmanen@usgs.gov

Conservation and management of grizzly bears (*Ursus arctos*) in Yellowstone National Park has evolved over several decades since the bear was listed in 1973 as threatened under the Endangered Species Act. Creation of the Interagency Grizzly Bear Study Team based upon Recommendations from a National Academy of Sciences panel ensured that long-term data collection was prioritized and consistent across management jurisdictions. As a result, we probably know more about grizzly bears in the Greater Yellowstone Ecosystem than bears anywhere else in the world. Here I will review the status and trends of this bear population since 2005 and discuss some of the more recent research evaluating bear demographics, the impacts of declines in some major foods, and a shift in bear numbers toward carrying capacity. I will also discuss the most recent recommendations for continued monitoring and management as the U.S. Fish and Wildlife Service once again moves to remove grizzly bears from the threatened list.

#### **5406 Conservation and Management of Large Wildlife in the Sikhote-Alin Reserve**

**Svetlana Soutyrina**, Sikhote-Alin State Nature Biosphere Reserve n.a. K.G. Abramov, Terney, Russian Federation. Contact: sikhote-science@mail.ru

The Sikhote-Alin mountain range contains one of the richest and most unusual temperate forests of the World. In this mixed zone between tiga and subtropics, southern species such as tiger and Himalayan black bear cohabit with northern species such as brown bear and lynx. They are major predators of ungulates, such as wild boar, red deer, roe deer, and sika deer. Monitoring of these populations allow us to evaluate population trends and so to measure effectiveness of conservation efforts. Comparing to Sikhote-Alin, there is overabundant deer population in Shiretoko. Lack of predator in Shiretoko may have caused this situation.

One of the major concerns for conservation of large mammals is hunting pressure around the reserve and poaching inside the reserve. Thus, protection of habitat is important strategy of large mammal conservation in the reserve. For example, 70% of Far East Leopard and 11% of Amur tiger habitats are protected. In addition, Research is necessary part of effective conservation programs. There are many scientific projects working in protected areas. Data we get from these projects allow us to improve conservation plans. Network of reserves and national parks provide necessary experiences of studying animals for young researchers. Young generation of scientists and conservationists is the key for long-term successful programs.

## Session 55: The Role of Human Dimensions Research in Wildlife Management

### **5501 Integrating Human Dimensions Research into Wildlife Management Research, Program Planning and Evaluation**

**Craig Miller**, University of Illinois, Champaign, IL, Contact: craigm@illinois.edu

Wildlife management involves not only the biological and ecological components, but the social and economic as well. Individuals may hold positive or negative beliefs, as well as different values and attitudes toward the same species. Stakeholder groups wanting different management approaches for a species often come into conflict with one another and with agency managers. Human dimensions research provides a scientific approach to determine public acceptance for proposed management actions, affords understanding of public perceptions regarding issues, and allows managers to better understand stakeholder positions to ensure greater success of management programs. By incorporating human dimensions research into wildlife program planning and implementation, wildlife managers can monitor changes (both positive and negative) in public attitudes toward and perceptions of individual species, management efforts, and agencies. In this way human dimensions research becomes an integral component of adaptive management. Reliable human dimensions data allows agencies to understand not only areas of potential conflict before launching management programs, but underlying factors leading to conflict - thereby providing potential opportunities to address or mitigate these factors wherever possible. Comprehensive human dimensions research approaches also afford managers the opportunity to test messaging, evaluate program acceptance, and determine stakeholder trust in the agency itself.

### **5502 Collaborative Human Dimensions Research between University and Government: Case Study of Black Bear Management in Japan**

**Ryo Sakurai**, Ritsumeikan University, Osaka, Japan. Contact: ryo223sak@gmail.com

This presentation overviews the research regarding black bear management the author conducted as a university researcher with a government official. Human-bear conflicts, consisting mainly of human casualties and agricultural damage, are challenging issues in Japan. Residents' participation in damage preventative actions is necessary to mitigate human-bear conflicts. We first conducted interviews (n=77) with local residents and other stakeholders and revealed that there were various reasons that made it difficult for local residents to engage in intervention. We then conducted a survey of local residents (n=2,298) and revealed that a majority of respondents in one town were not engaged in damage preventative behaviors. The Potential for Conflict Index implied the gap between actions that residents wanted government to take and actual policy that the government was implementing. These findings encouraged the Tajima Branch Office of Hyogo Prefecture to implement a series of community education seminars regarding bears, the first time in the prefecture, a few months after the survey. Content of seminars was designed to reflect residents' needs based on results of interviews and the survey. We also conducted pre- and post-seminar surveys (n=227) of participants of these seminars that revealed a majority of them engaged in damage preventative actions and most of respondents stating that participating in the seminar prompted their behaviors. These series of studies implied that collaboration with governmental

officials could enable researchers to conduct a practical research project that meets the needs of a local situation, and results could be applied to decision making by governmental agencies.

**5503 Communicating Human Dimensions Findings to Non-Technical Audiences: The Potential for Conflict Index.**

Jerry Vaske<sup>1</sup>, **Craig Miller**<sup>2</sup>, <sup>1</sup>Colorado State University, Fort Collins, CO; <sup>2</sup>University of Illinois, Champaign, IL, Contact: craigm@illinois.edu

A primary goal of human dimensions research is to provide information that can inform and improve decision-making. The Potential for Conflict Index (PCI) and associated graphical display were developed to facilitate understanding and applicability of human dimensions findings to managerial concerns and to non-technical audiences. The approach requires little statistical training to understand results, minimizes effort required to process information, and improves comprehension. This presentation will: (a) introduce the second generation of the PCI (PCI2), (b) demonstrate how to calculate, graph and statistically compare PCI2 values, and (c) illustrate the practical applications of using the statistic in human dimensions decision making.

**5504 Integrating Human Dimensions Research into Wildlife Management in Hyogo Prefecture, Japan**

**Gouhei Ueda**, Asago Agriculture & Forestry Office, Hyogo Prefectural Government, Asago, Japan. Contact: go-hei@nifty.com

Wildlife management policy that intends to promote behavioral change of stakeholders is an important tool for improving the relationships between wildlife and human society. For better selection, design, and evaluation of the policy, human dimensions research provides useful information to policy makers. In this symposium, I will introduce the case where integrated human dimensions research was included into the decision-making process for an effective wildlife management policy in Tajima, located in the northern part of Hyogo, western Japan. In Japan, collaborative hunting activities targeting sika deer (*Cervus nippon*) and wild boar (*Sus scrofa*) with local communities is important for nuisance control due decreased and aging population of hunters. Each municipality has been providing subsidies to communities whereby local residents can purchase box traps for capturing species to be managed. In spite of these efforts, our research suggests capture efficiency of the communities using these box traps was very low, and improving this efficiency was a challenge for implementing better wildlife management. In the process of policy making, we investigated the reasons for low capture efficiency and considered what program we should create for resolving the issue. We investigated changes in participants' knowledge, attitudes, and behavior regarding trapping activities before and after implementing the program. We made continuous efforts for improving the program over three years by using scientific data and communicating with participants. As a result of the three-year implementation, one-third of our targeted communities (n=163) participated in the program, and we succeeded in improving their capture efficiency.

### **5505 Human Dimensions Research in Park and Wildlife Management: Gaps between Stakeholders' Perceptions of Brown Bear Management in Shiretoko, Japan**

**Takahiro Kubo**, Kyoto University, Kyoto, Japan. Contact: kubo.takahiro.78e@st.kyoto-u.ac.jp

National parks not only provide significant wildlife habitats but also recreational opportunities. While bear viewing is one of the most popular attractions in many parks, local communities around these parks face the high risk of encounters with bears. To improve park and wildlife management, it is essential to reconcile conservation and management preferences of local residents and tourists. The study identifies differences in stakeholders' risk perceptions associated with fatal brown bear accidents and attitudes toward bear conservation in Shiretoko Peninsula, Japan. An UNESCO World Natural Heritage site and a national park, the peninsula is one of the highest density bear habitats in Japan with a high rate of human-bear conflicts. The study found that while both tourists and residents agreed that a human-habituated bear is a problem, the tourists regarded accidents with bears as voluntary/controllable risk and had strong preferences for bear conservation. The residents, however, indicated that the risk should be controlled by lethal management options especially in case of bear appearance in towns. These findings imply that these stakeholders have different management preferences which might potentially pose obstacles when reaching a consensus over bear management strategies in the park although they share the same understanding regarding the issue/conflict. Understanding the perception gaps would be important for designing and implementing effective risk communication and education programs to stakeholders and for promoting wildlife management in parks.

## **Session 56: Conservation and Long-Term Research of Marine and Terrestrial Large Mammals in the Russian Far East and Eastern Siberia**

### **5601 Preservation of Large Terrestrial Mammals of Fel (North-East Russia) in the Conditions of the Region's Industrial Development**

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The Sakha Republic (Yakutia) is located in the continental and Arctic parts of the Far East and is characterized by extreme natural and climatic conditions; almost the entire territory is located within the permafrost area and over 40% of the territory is located beyond the Arctic Circle. Less than 1 million people live in the vast territory (3,1 million square km - the largest region of Russia). The leading sectors of economy are mining (about 40 percent), trade, transport and communication. Mining of diamonds, oil, gas, coal and gold as well as power generating industry take the leading positions. Cattle breeding, horse breeding and hunting economy dominate in agriculture. Out of 64 mammal species inhabiting in Yakutia, about 11 species can be attributed to the large ones. These include moose, wild reindeer, red deer, mountain sheep, muskox, Siberian roe deer, Siberian musk deer, brown bear, polar bear, wolf, wolverine; most of them inhabit here at the edge of their range and are small in number, that is why their populations are easily impacted by anthropogenic pressure. Mistakes made at the development of natural, primarily mining, resources result in the reduction of the latter ones in the last decades. Defragmentation of large mammals' habitat caused by mining industry, as well as increased hunting pressure caused by the areas' increasing

accessibility resulting from the construction of new line infrastructure, is of special concern. Red Book of Yakutia is in place to protect the large mammals, and almost 30% of the republic's territory is protected areas of federal and regional significance. However, intensive development of oil and gas producing industries in the region pose new challenges to enhance the protection of animals using international experience.

### **5602 Diversity of Large Mammals in the Sikhote-Alin Mountain Range**

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The Sikhote-Alin Mountains have unique natural ecosystems with rich variety of fauna and flora in Primorsky Krai. The aim of this report was to analyze modern information on large mammals of the Sikhote-Alin and to reveal differences between southern and central parts of this mountain range. There are two protected areas that were established in 1935: Sikhote-Alin Biosphere State Nature Reserve with area of 4,100 km<sup>2</sup> and Lazovsky State Nature Reserve of 1,210 km<sup>2</sup>. Species richness, distribution and population density were discussed. Sikhote-Alin is occupied by 13 species of large mammals. A coefficient of faunistic similarity for large mammals between the southern and central parts of the Sikhote-Alin is 85 %. We analyzed the increase in annual air temperature from 1967 to 2007 and supposed that global warming is one reason for the increase of sika deer numbers and its range expansion. Key species of large mammal community are: amur tiger, lynx, asiatic black bear, sika deer, red deer, and wild boar. The differences between central and south parts of the Sikhote-Alin are very clear in prey selection by large predators. Aerial surveys of ungulates were conducted on both protected areas and adjacent hunting grounds. The Lazovsky Reserve has one of the highest tiger densities for this subspecies - 0.9 animals/100 km<sup>2</sup> because it has the highest sika deer density - 8 animals/1 km<sup>2</sup>. Protection of ecosystems of the Sikhote-Alin Mountains and studying of large mammal community is necessary for ecologically correct sustainable use of natural resources.

### **5603 Population Dynamics of Mammals in the South Sikhote-Alin Mountains**

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The monitoring program of mammals was conducted from 1958 to 2014 in Sikhote -Alin Mountains in Lazovsky Nature Reserve. The aim of program was to analyze the distribution and development of mammal populations. The coordinates of each observation was mapped in Arc View GIS 3.2a. We used MaxEnt program for spatial modeling of 29 mammal species in the reserve. The diversity of mammals is 80 species for Reserve. Habitat models of abundance and occurrence of 29 mammal species were building using 56 years of data collected of reserve's staff. As covariates, we used 12 environmental layers for example, forest type, temperature and precipitation according to World Climate. Maps and models were validated using point count data obtained from data base for each mammal species.

The data for each species were grouped by decades. Predictive models showed that the ranges fluctuated significantly, and in some species went locally extinct in the reserve. A range of Roe deer, Red deer, Lynx, Wolf and Brown bear was very much reduced, but the range and population number of Sika deer, Amur tiger, Yellow throated marten, Asiatic Black bear have increased. The main cause



of change of habitats was warming of a climate on 2 degrees and consequently a major factor of increase of a Sika deer numbers was the temperature of summer months. The River otter and the American mink habitats were destroyed by typhoons. The most stable ecosystem for water mammals is the coast of Sea of Japan.

#### **5604 Patterns of Beluga Whale Distribution in the Okhotsk Sea: As Shown by Genetic Analysis**

**Ilya Meschersky**<sup>1</sup>, Olga Shpak<sup>2</sup>, Dmitriy Glazov<sup>3</sup>, Viatcheslav Rozhnov<sup>4</sup>, <sup>1</sup>A.N.Severtsov Institute of Ecology and Evolution, RAS, Moscow, Russian Federation; <sup>2</sup>A.N.Severtsov Institute of Ecology and Evolution, RAS, Moscow, Russian Federation; <sup>3</sup>A.N.Severtsov Institute of Ecology and Evolution, RAS, Moscow, Russian Federation; <sup>4</sup>A.N.Severtsov Institute of Ecology and Evolution, RAS, Moscow, Russian Federation. Contact: meschersky@rambler.ru

Belugas (*Delphinapterus leucas*) living in Bering, Chukchi and Beaufort Seas are strongly philopatric to their summering areas, but are believed to share a single gene pool presumably mating on common winter grounds or during seasonal migration in spring (Brown Gladden et al., 1999; O’Corry-Crowe et al., 1997, 2010). Also, the groups known to occupy the same summering area may consist of animals of distant phylogenetic lineages, which suggests that the pattern of spatial distribution is recent compared to phylogenetic structure of the species in the region. Belugas occupying the Okhotsk Sea are isolated of the main range and seem to have more complicated population structure. Whales that spend summers in Sakhalinsky Bay and off the Western coast of Kamchatka with almost no exception belong to two distant mitochondrial lineages, and each lineage is presented by a set of related haplotypes of a high diversity in each of the two regions. In the Shantar region (western part of the Okhotsk Sea) both lineages are present, but the diversity of each one is reduced and presented mainly by the most common in the two other regions haplotypes. At the same time, analysis of recombining part of genome has shown that belugas summering in the Shantar region and in Sakhalinsky Bay belong (as separate genetic units) to one population, whereas the whales found off the western Kamchatka coast are notably isolated. Thus, the Okhotsk Sea belugas have more evident phylogeographic structure than belugas from Bering, Chukchi and Beaufort Seas.

### **Session 57: Evolutionary Aspects of Genetic Diversity of Asian Murine Rodents in the Genomic Era**

#### **5701 A World of Opportunity: The Murine Rodents in Their Homeland of Asia and beyond**

**Ken Aplin**, National Museum of Natural History, Smithsonian Institution, Washington, DC, Contact: aplin.ken@gmail.com

The recent and explosive radiation of the Murinae, with > 550 species spread across the Old World including Australasia, is without parallel among mammals, nor is it equaled among other groups of vertebrates. Molecular studies over the past two decades have provided a robust phylogenetic framework for the group, with few gaps now remaining, at least at generic level, while a steadily improving fossil record provides increasing numbers of well-dated anchor points to calculate rates of speciation and molecular evolution. Murine phylogeography is characterized by: 1) strong regionalism, with most Tribes confined to one major zoogeographic province; 2) multiple examples of phyletic ‘layering’, produced by successive invasions of peripheral regions and archipelagoes, followed by *in situ* radiations; and 3) numerous instances of sibling parapatry, some of which are

among the best-studied examples of stable hybrid zones. Strongly contrasting signals are present regarding the role of competition in shaping the adaptive radiation of Murinae. On the one hand, a strong role for competition is evinced by the fact that phenotypic diversity of Murinae is highest where radiations occurred without competition from other groups of mammals (i.e., Philippines, Melanesia). On the other hand, the phenomenon of phyletic 'layering' appears, in Australia at least, not to have been accompanied by competitive extinctions but rather led to enrichment of local communities. The prehistoric to contemporary dispersal of 'commensal' rats and mice has created innumerable new contexts for local adaptation and interactions by Murinae, and has generated a rich field of study for evolutionary biologists.

### **5702 Natural History of Asian Wild Mice and Origin of the Laboratory Inbred Strains, Inferred from Whole-Genome-Resequencing**

**Toyoyuki Takada**, Toshihiko Shiroishi, National Institute of Genetics, Mishima, Japan. Contact: ttakada@nig.ac.jp

The house mouse, *Mus musculus*, is not only used as an animal model of biomedical researches, but it also serves as a prominent model species for studies of phylogenetics and evolution. At least three major subspecies distribute in Eurasian continent. They are west European subspecies *M. m. domesticus*, east European subspecies *M. m. musculus* and southeastern Asian subspecies *M. m. castaneus*.

The classical inbred strains have mosaic genomes predominantly derived from *M. m. domesticus*, with the remaining sequences derived mostly from Japanese subspecies *M. m. molossinus*. Our recent whole-genome-resequencing of *M. m. molossinus*-derived two inbred strains, MSM/Ms and JF1/Ms, and subsequent comparative analysis of their genome sequences with those of the classical inbred strains revealed over ten millions of SNPs due to large genetic distance between *M. m. molossinus* and *M. m. domesticus*. Furthermore, detailed phylogenetic studies unveiled that ancestor of the extant inbred strain JF1/Ms, which was established from old Japanese fancy mice, could be the direct origin of the *M. m. molossinus* genome in the classical inbred strains.

To deepen our knowledge of genome polymorphism of the entire species of *M. musculus* and the natural history of this species, we are expanding whole-genome-resequencing of additional wild-derived inbred strains, including *M. m. musculus*-derived BLG2/Ms, NJL/Ms, CHD/Ms, SWN/Ms and KJR/Ms, *M. m. domesticus*-derived PGN2/Ms and BFM/Ms, and *M. m. castaneus*-derived HMI/Ms, all of which were established as inbred strains at NIG by Prof. Moriwaki since 1970's. In this talk, we introduce current progress in this project.

### **5703 Evolution of the Black Rat *Rattus rattus* Species Complex Based on Genomic Data**

**Stephen Donnellan**<sup>1</sup>, Andrew Wiewel<sup>2</sup>, Terry Bertozzi<sup>3</sup>, Ken Aplin<sup>4</sup>, <sup>1</sup>South Australian Museum, North Ter, North Terrace, Australia; <sup>2</sup>University of Adelaide, North Terrace, Australia; <sup>3</sup>South Australian Museum, North Terrace, Australia; <sup>4</sup>Smithsonian Institution, Washington, DC, Contact: Steve.Donnellan@samuseum.sa.gov.au

The 'Black Rat' (*Rattus rattus* sensu lato) is a notorious commensal pest, yet it also holds enormous promise for the study of speciation, hybrid interactions, and adaptation. Recent global sampling of mtDNA sequence diversity has revealed 12 major phyletic lineages (many with an associated, distinct Y-chromosome lineage), each seemingly native to a particular area within the broad region

of South, Southeast and East Asia. Analysis of large numbers of nuclear gene loci for small numbers of representatives of major lineages supports the notion that the mtDNA lineages represent long-standing evolutionary units, either species or geographic isolates well on the way to speciation. Sampling at several contact zones within the inferred natural ranges, and in several areas where different mtDNA and Y lineages have been co-introduced historically, in each case revealed dissociated admixture of mtDNA and Y lineages, suggestive of introgression of these uniparental, non-recombining genomic elements. By contrast, microsatellite DNA profiling of the same populations failed to detect evidence of introgression. Instead, the microsat data suggest that the nuclear identity of each of the major Black Rat lineages is at least partly defended against introgression, presumably by post-zygotic incompatibilities. This possibility is being further investigated by several methods including RADseq analysis and gene capture methods of key populations, and full-genome sequencing of individuals drawn from across the native and introduced range of the Black Rat. The same datasets also offer genomic insights into the eco-physiological and behavioral adaptations that allowed black rats to colonize almost every part of the world.

#### **5704 Genome Sequencing Project of Wood Mouse (*Apodemus speciosus*) and its Use for Evolutionary Study**

**Masatoshi Matsunami**<sup>1</sup>, Daiji Endo<sup>2</sup>, Isaac Babarinde<sup>3</sup>, Naruya Saitou<sup>3</sup>, Hitoshi Suzuki<sup>1</sup>, Manabu Onuma<sup>4</sup>, <sup>1</sup>Hokkaido University, Sapporo, Japan; <sup>2</sup>Rakuno Gakuen University, Ebetsu, Japan; <sup>3</sup>Graduate University for Advanced Studies (SOKENDAI), Mishima, Japan; <sup>4</sup>National Institute for Environmental Studies, Tsukuba, Japan. Contact: mmatsunami@ees.hokudai.ac.jp

The wood mouse (*Apodemus speciosus*) is one of the most common rodents in broad-leaf forests in the temperate zone of Palaearctic region. Molecular studies of wood mice provide important clues for understanding their evolutions and ancestral biogeographic history. The Fukushima population of wood mice was exposed to radiation at the Tohoku earthquake, so that this species is also a model organism to evaluate the effect of radiation on wild animals. At present, their molecular data are limited to partial mitochondrial sequences and a few nuclear genes. We sequenced and analyzed the wood mouse genome and transcriptome as a resource for studying their molecular evolution. We sampled wild wood mouse at Tsukuba. Their whole-genome was sequenced using Illumina HiSeq 2000. In order to reduce the risk of non-randomness, 4 paired-end libraries, with insert sizes of about 0, 250 bp, 8 kbp, and 20 kbp, were constructed. In total, we generated about 210 Gbp data. In addition, we also sequenced a transcriptome to predict open reading frames of genes. Analysis of the genomic data will enhance our understanding of how this species evolved, how ecological factors have influenced their life histories, and how they are being impacted by the recent radiation.

#### **5705 Genomic Properties of the Ryukyu Spiny Rats (Genus *Tokudaia*) and Evolutionary Perspectives**

**Asato Kuroiwa**, Hokkaido University, Sapporo, Japan. Contact: asatok@sci.hokudai.ac.jp

The Ryukyu spiny rats that are native in Japan have uniquely evolved in the Y chromosome and sex-determining mechanism. The Ryukyu spiny rats belong to genus *Tokudaia*, Muridae Rodentia and are classified into three species. The Y chromosome and *SRY* which is a sex-determining gene of placenta mammals, have been lost in two species, *Tokudaia osimensis* (the Amami spiny rat) and

*Tokudaia tokunoshimensis* (the Tokunoshima spiny rat). These species have a single X chromosome in males and females resulting that the sex chromosome constitution is XO/XO. The chromosome number is uniquely odd number: *T. osimensis* is 25 and *T. tokunoshimensis* is 45. Although *Tokudaia muenninki* (the Okinawa spiny rat) has a normal sex chromosome constitution, the neo-X and neo-Y chromosomes have been acquired by fusion with a pair of autosome. In this lecture, I will show a quite unique evolution of sex chromosomes and sex-determining mechanism in genus *Tokudaia* that revealed by our recent data.

## Session 58: Conservation of Amphibians and Reptiles Considering Linkage between Terrestrial and Aquatic Ecosystems

### 5801 Terrestrial Resource Selection in Amphibious Sea Snakes of the Genus *Laticauda*, Drinking Freshwater at Coastal Sites

**Noriko Kidera**, National Institute for Environmental Studies, Tsukuba, Japan. Contact: kidenon@gmail.com

Amphibious animals depend on both aquatic and terrestrial environments. Of those, some are more aquatic species and others are more terrestrial ones. Because physical properties of air vs. water are very different, the species which is more adaptive to either environment can be more severely restricted to use the other environmental resources. Thus, such trade-off would result in different degree of impact among the species when an environmental modification happens. Three species of amphibious sea snakes, *Laticauda semifasciata*, *L. laticaudata* and *L. colubrina*, have secondarily invaded marine environment but still remain dependence on terrestrial environment. They forage at sea and periodically come onto land to digest their prey and drink freshwater for water balance in their bodies. The degree of adaptation to marine environment in physiology and behavior is known to differ among the species. *Laticauda semifasciata* is most adaptive to marine environment and dehydrates most easily on land, while *L. colubrina* exhibits the reverse and *L. laticaudata* is intermediate. Thus, this group of amphibious snakes provides a good opportunity to examine relationships between adaptation to aquatic environment and availability of terrestrial resources. In this presentation, I will introduce terrestrial habitat selection in the amphibious sea snakes with an attention to the extent of available freshwater resources at coastal sites.

### 5802 Oviposition Sites of Rhacophorid Frog Inhabiting Natural Coastal Environment

**Takashi Haramura**, Kyoto University, Kyoto, Japan. Contact: haramura.takashi.2n@kyoto-u.ac.jp

Some amphibians use specific kind of water bodies as a breeding site and severely investigate the environment in choosing the site. However, recently, aquatic environment as oviposition sites have been developed into artificial structures by human activities, which may lead to inappropriate choice of oviposition site. In my presentation, I introduce the oviposition site choice by unique frog (*Buergeria japonica*) living in coastal area. Because frog egg survivorship remarkably decreases with slight increases of salinity, females of *B. japonica* had an ability to distinguish salinity levels when laying eggs, and avoided high salinity area to reduce egg mortality by high salinity. Females selected oviposition sites above the high tide line at spring tide, where eggs would not be disturbed by incursion of seawater. Above this high tide line, females selected oviposition sites from which eggs would not be washed out by using cues such as water depth and substrate (shallower water and

bigger substrate). Eggs attached to bigger substrate would not be washed out to the sea by unexpected squalls. Because artificial shoreline does not have the lower salinity sites, shallower water area, and various substrate types, female of *B. japonica* living in coastal area wouldn't lay eggs. The results suggested that the artificial modification of aquatic environment can have great impact on amphibians because appropriate oviposition site is necessary for maintaining the populations.

### **5803 Food Habits of Japanese Giant Salamander in Different Land Use Gradients Adjacent to Streams**

**Sumio Okada**, Japan Hanzaki Institute, Asago, Japan. Contact: shichibu@mocha.ocn.ne.jp

Terrestrial land use by humans change the environment for terrestrial animals, but sometimes also change the environment for aquatic ones. Thus, amphibians can be affected by terrestrial environment even if the species depends greatly on aquatic environment. *Andrias japonicus*, the Japanese giant salamander is one of the largest extant amphibians of the world, and is endemic to western Japan. This species lives almost all its life in stream and rarely got out on land. I surveyed diet composition of *A. japonicus* inhabiting very different land use areas (the upper portion: mainly forested, the lower portion: mainly dominated by agricultural and human residential activities) in the Hino River, Tottori Prefecture, Japan. In the upper portion, freshwater crabs were the dominant food item through spring to early winter, whereas aquatic insects were the most important food items in spring. In the lower portion, freshwater crabs were the dominant food items. Surprisingly, the second most important prey category was human garbage. Salamanders often consumed potentially harmful garbage such as plastic bags and aluminum foils with leftovers. These observations showed that food item of *A. japonicus* reflects land use around the stream probably because this species is a generalist opportunistic consumer and hunt whatever comes in front of them. Terrestrial land use can be lethal factor affecting this completely aquatic amphibian species.

### **5804 Habitat Use and Population Dynamics of the Japanese Treefrog Breeding in Artificial Ponds in Kanazawa Castle Park, Japan**

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Some amphibians use artificial ponds as breeding sites. The treefrog *Rhacophorus arboreus* is a Japanese endemic species in the family Rhacophoridae, and one of such artificial pond users. The species is known for its habit of laying eggs in nest forms created on tree branches hanging over lentic water bodies. I monitored the breeding sites and population dynamics of *R. arboreus* in Kanazawa Castle Park in Ishikawa Prefecture, Japan, from 1984 to 2013. The frogs had bred in a total of nine artificial ponds that had existed at different times in the Park. By 1997, in association with land-use changes, all but one of the original ponds used by the frogs had been removed, but in 1999 the frogs started to use newly formed ponds. Although the number of *R. arboreus* declined rapidly from 1994 to 1998, the population increased from 2002 to 2007 and was stable thereafter. Configuration of multiple breeding sites and retention of continuous forest are key factors for the species' survival, despite the loss of most of its original breeding sites. The results suggested that connection between terrestrial habitat and multiple water bodies allowed sustainable breeding, although the artificial water bodies tend to appear and disappear at an unnatural time scale. When

creating artificial ponds, appropriate spatial designing would be important for allowing effective use by amphibians.

#### **5805 Regional Variation in Size of Metamorphs and Adults in Amami Ishikawa's Frog**

**Noriko Iwai**, Tokyo University of Agriculture and Technology, Tokyo, Japan. Contact: iwain@cc.tuat.ac.jp

Larvae and adults of amphibians use extremely different habitats - aquatic and terrestrial. Therefore, a human impact on a certain region including both habitats may lead to different outcome on each life stage. Amami Ishikawa's frog, *Odorrana splendida* is endemic to Amami Island, south Japan, and known as the most beautiful frogs in the country, but endangered because of several human impacts such as logging, construction of forest roads, and introduction of non-native predators. Larvae of this species grow in headwater stream spending 1 - 2 years, extraordinarily long compared to common frogs, whereas after metamorphosis, juveniles grow to adult by 100-fold in weight. Assuming that the size of metamorphs and adults should reflect the condition of aquatic and terrestrial habitat respectively, I compared these sizes among multiple regions in Amami Island under different human impacts. The regional variation in sizes was observed, and the potentially favorable areas for the growth of two life stages were not the same. This may be because larvae and adults of the same region responded to human impacts differently. It was also suggested that the size acquired in aquatic or terrestrial habitat was not strongly carried over to the other habitat, but was instead offset by the condition of habitat where each life stage inhabits. When considering the effect of human impacts on amphibians, it will be important to know how each life stage responds to each impact, and how far the outcome can be carried over to the other stage.

### **Session 59: Ecology, Conservation, and Management of Birds**

#### **5901 Lead Poisoning and Source Identification in Raptors from Japan**

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Lead (Pb) poisoning is a widespread occurrence among raptors. Raptors ingest Pb bullets or shot when consuming Pb gunshot embedded animals. Hokkaido, the northern part of Japan has prohibited use of Pb bullets for deer hunting since 2001; however, the cause of death of some sea eagles is suspected to be Pb poisoning. Furthermore, other areas of Japan have few regulations and the current situation of Pb poisoning is not clarified. In this study, we measured the Pb concentrations and the Pb stable isotope ratio (Pb-IRs) to determine the source of poisoning of raptors. Liver samples of 12 species of raptors (n=117), such as white-tailed sea eagle (*Haliaeetus pelagicus*, n=32), Steller's sea eagle (*Haliaeetus pelagicus*, 31), golden eagle (*Aquila chrysaetos*, 13), mountain hawk eagle (*Spizaetus nipalensis*, 7) and Blakiston's fish owl (*Ketupa blakistoni*, 6) and a blood sample of one golden eagle were collected from Hokkaido, Honshu and Shikoku from 1993 to 2014. Samples were dried and digested in a microwave digestion system. Concentrations of Pb and Pb-IRs were measured by using inductively coupled plasma-mass spectrometry. In Hokkaido, high

concentrations of Pb were found in sea eagles collected before and after the regulation. In Honshu and Shikoku, golden eagles and black kite accumulated high Pb concentrations, indicating the Pb exposure. The results of Pb-IRs suggested that sea eagles are still contaminated by Pb bullets in Hokkaido, and both of bullets and shot have the risk of causing Pb poisoning in all parts of Japan.

### **5902 Phylogeographic Analysis of Golden Eagles Reveals Two Distinct Lineages and Surprisingly High Diversity in the Japanese Subspecies**

**Frank E. Zachos**<sup>1</sup>, Carina Nebel<sup>2,3</sup>, Anita Gamauf<sup>2,3</sup>, Elisabeth Haring<sup>2,3</sup>, Gernot Segelbacher<sup>4</sup>, Alexandre Villers<sup>5,6</sup>, <sup>1</sup>Natural History Museum Vienna, Vienna, Austria; <sup>2</sup>Natural History Museum Vienna, Vienna, Austria; <sup>3</sup>Department of Integrative Zoology, University of Vienna, Vienna, Austria; <sup>4</sup>Wildlife Ecology and Management, Universität Freiburg, Freiburg, Germany; <sup>5</sup>Centre d'Etudes Biologiques de Chizé, CNRS, Université de la Rochelle, Beauvoir sur Niort, France; <sup>6</sup>Section of Ecology, University of Turku, Turku, Finland. Contact: frank.zachos@nhm-wien.ac.at

We studied 283 Golden eagles (*Aquila chrysaetos*) from throughout their Holarctic distribution range with the aim of uncovering their phylogeographic structure and establishing whether past persecution has left a genetic bottleneck signature in their gene pool. Drawing mainly from museum material we analysed mitochondrial DNA sequences (control region) and carried out state-of-the-art phylogenetic tree/network reconstructions and analyses of demographic history (incl. neutrality tests, mismatch analyses and Bayesian Skyline Plots). The analysis revealed two distinct mtDNA lineages with an unusual geographic pattern: one was confined around the Mediterranean basin in southern Europe, North Africa and southwestern Asia, while the other one spanned the complete Holarctic from western Europe through mainland Asia and Japan to North America. Single haplotypes were found in areas as far apart as the European Alps and Japan. Interestingly, the threatened island subspecies of Japan (*A. c. japonica*) exhibited the highest diversity values and covered the whole diversity of the Holarctic lineage. In general, genetic variability was high and showed signs of expansion events but not of severe bottlenecks. The huge distribution range and long generation times may have buffered the reduction of effective population sizes and safeguarded the species against genetic depletion. Our results offer insights into the postglacial history of widespread and mobile Holarctic species and are relevant to the future conservation of Golden eagles, particularly in Japan.

### **5903 Phylogeography of the Bobwhite Quails**

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The bobwhites (*Colinus*) consist of 3 grassland-associated, allopatric species of New World quails: the northern bobwhite (*C. virginianus*) ranges from the eastern US to Guatemala; the black-throated bobwhite (*C. nigrogularis*) in the Yucatán Peninsula, Nicaragua, and Honduras; and the crested bobwhite (*C. cristatus*) from Guatemala to northern Brazil. We used mitochondrial DNA (mtDNA) sequences from museum specimens to study the phylogeography of the 3 species and evaluated the conclusions using ecological niche models. *Colinus* was composed of 2 deeply divergent lineages, the crested bobwhite and northern and black-throated bobwhites, both of which were genetically distinct. The northern bobwhite had high haplotype diversity and displayed evidence of past

demographic and geographic expansion, but no phylogeographic structure. Ecological niche modeling was congruent with a recent range expansion for the northern bobwhite from Late Pleistocene refugia in Mexico and the southeastern US. The black-throated bobwhites from the Yucatán Peninsula were distinct from those in Nicaragua, with little evidence of population expansion. Ecological niche modeling suggested that the fragmented distribution of the black-throated bobwhite has existed for the past 130,000 years. Although the crested bobwhite displayed little evidence of population expansion, the mtDNA data revealed 3-4 geographically and genetically distinct lineages. Results of niche modeling suggest that the crested bobwhite had a much wider distribution in Central and South America during the Last Glacial Maximum. Given the sensitivity of all 3 bobwhites to climatic cycles, managers should consider impacts of current global warming when crafting conservation plans.

#### **5904 Temperature and Exotic Grasses Influence Habitat Selection by Scaled Quail**

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High temperatures and dense stands of exotic grasses limit usable space for northern bobwhites (*Colinus virginianus*), but how these variables influence habitat selection by Chestnut-bellied scaled quail (*Callipepla squamata castanogastris*) is unknown. Our objective was to determine if thermal environment and vegetation characteristics influence habitat selection by scaled quail. We conducted research at 5 different locations in southern Texas, USA. We radio-marked 80 scaled quail during April-August 2013 and 2014 and relocated marked birds 2-3 times per week. We recorded vegetation characteristics, ground surface temperature, black globe temperature, relative humidity, and wind speed at each bird location and at paired random locations. We calculated resource selection functions using *a priori* logistic regression models. In the model with the highest AICc weight, use of locations by scaled quail declined with increasing canopy cover of exotic grasses, increasing vertical vegetation cover, and increasing ground surface temperature. Habitat use also depended on time of day. Odds of a scaled quail being present at a location declined 47% for every 1°C increase in ground surface temperature after accounting for exotic grass canopy cover, vertical cover, and time of day. Odds of a scaled quail being present declined 37% with every 1% increase in vertical cover and declined 35% with every 1% increase in exotic grass canopy cover after accounting for other variables in the model. Our results suggest that heat and increased abundance of exotic grasses may reduce the amount of habitat usable by scaled quail.

#### **5905 Habitat Use of the Crested Ibis: New Insights Based on Bayesian Hierarchical Models**

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The habitat use of species can be quantified using species distribution models based on the association of species distribution and environmental variables. Such association is often complicated, since nonlinear and interacting effects of environmental variables usually exist. The crested ibis (*Nipponia nippon*) has attracted much attention in the past 30 years due to its extremely low population level, and now it has recovered to over 1000 individuals in the wild. We used watersheds (95 watersheds covering the whole area of the nesting sites of the bird in Shaanxi



Province, China) as the sample plots, and built Bayesian hierarchical models to analyze the association between the number of nests of the crested ibis and nine environmental variables in every watershed. The results, which are different from our previous studies, indicated that the interaction term of the areas of rice paddy and water body (i.e. rivers, lakes and ponds) had most contribution to the nest site selection of the crested ibis, whereas the linear terms of rice paddy or water body had not. The detection rate of the nests during the surveys is associated with elevation and the standard deviation of elevation (i.e. roughness of the landform) in the watershed. This region-based model gave us the insight that the crested ibis need both rice paddies and water bodies in their annual life cycle.

#### **5906 Initial Response of Caspian Terns to a Managed Reduction in Nesting Habitat**

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One technique to reduce conflicts between piscivorous waterbirds and fish of conservation concern is to manage the availability of waterbird nesting habitat - reduce habitat in areas with threatened fish populations and enhance habitat in areas with robust fish populations. In recent years, the availability of Caspian Tern (*Hydroprogne caspia*) nesting habitat in the northwest United States has been managed with the intent to reduce predation on imperiled juvenile anadromous salmonids. Among piscivorous waterbirds, Caspian terns are particularly amenable to this management approach, given their high vagility and narrow nesting habitat preferences. In 2014, we evaluated the individual response of 28 Caspian Terns fitted with satellite telemetry tags to a reduction in nesting habitat at a colony in eastern Washington State. The former colony site was made unavailable by covering the nesting area with elevated ropes and flagging; however, a smaller amount of suitable habitat was left available on a rocky islet immediately adjacent (~100 m away). We observed three types of initial response to nesting habitat reduction: (1) stay at the site and compete for reduced available habitat, (2) move to one of several nearby colonies (70 - 125 km away) and attempt to nest there, returning to the former colony if nesting failed, and (3) nomadic wandering throughout the region, without a sustained association with any colony. Habitat management approaches to reduce conflicts between piscivorous waterbirds and imperiled fish populations have potential, but will often require multi-year efforts. The availability of high-quality alternative nesting habitat is likely critical to success.

#### **5907 Non-Additive Effects of Climate and Landscape on Spatiotemporal Dynamics of Southern Peripheral Wild Turkey Populations**

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Dynamic patterns and regulation of wildlife populations may vary across space. Synchronous or asynchronous population dynamics may demand different management strategies for regional wildlife populations. Climatic changes may synchronize dynamics of wildlife populations subjected to similar intrinsic regulation, such as density dependence (i.e., the Moran effect). Nevertheless, the central-marginal hypothesis predicts that populations undergo weaker density dependence moving

from the central to peripheral areas of species' range. Therefore, peripheral populations would exhibit greater spatial variability and asynchronous dynamics. The eastern wild turkey (*Meleagris gallapavo*) is the largest galliform and an important game bird in North America. Time series of captures (harvest) per unit effort (CPUE) of wild turkeys from 27 wildlife management areas (30.63-34.64N, 88.276-91.15W), Mississippi, USA, were weakly synchronized from 1993 to 2004. We built hierarchical Poisson state space models for 16 time series of wild turkey CPUE from 1982 to 2004 to estimate strength of direct density dependence (DDD). We found a geographic gradient of decreasing DDD strengths and decreasing relative abundances from north to the southern range periphery. Increases in annual mean temperature and landscape edge density weakened density dependence. We used Bayesian space-time models to estimate spatial and temporal variability of the 27 CPUE time series. Wild turkey populations exhibited greater spatial variability (91% of total variability) than temporal variability (1%), with space-time interactions constituting 8% of total variability. Substantial spatial variation in wild turkey populations may suggest region-specific management for future sustainable use.

## Session 60: Conservation and Management of Endangered Birds (Blakiston's Fish-Owl, Red-Crowned Cranes, White-Tailed Sea Eagle) in Hokkaido

### 6001 Environmental Features of Hokkaido

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A natural environment in Hokkaido has been developed in the last 100 years. Many primeval forest was felled, and a big tree with a tree cave has almost disappeared. Forest and grassland in lowland have changed to arable land and factory areas and residential land. Secondary forest was convalescent in a mountain, but there are almost no big trees. It's different from a natural environment in the Honshu, Shikoku and Kyushu that we developed gradually in long years as hundreds of years big.

But recently almost no large-scale development have been performed on the mountain in Hokkaido. A small scale construction of photovoltaic generation and wind power generation and residential development have increased in coastal and lowland after an eastern Japan great earthquake. Their development has given various effects to birds that inhabit the grasslands and coastal.

I am a construction consultant engaged in the environmental assessment research. Many researchers exist in our industry. Rare birds to be a hot topic in this symposium are both long life, home range is wide. It is difficult to continue to monitor them over time with only a small number of scientists. Once scientists working on protection, we've been a help of development. However, the era of development come to an end, the natural environment is recovering. By that we work together, or not than those of long-term monitoring is possible?

### 6002 Current Status of White-Tailed Eagles (*Haliaeetus albicilla*) Breeding in Japan: The Trend and Future Conservation

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In Japan, white-tailed eagles (WTEs) breed only in Hokkaido and the breeding pairs are considered residents. Meanwhile, 500-700 individuals, including migrants from the breeding areas in Russia,

winter in Japan, particularly in Hokkaido. Ca.150 pairs of WTEs bred in Hokkaido during the 2009 breeding season, and the number of confirmed breeding pairs has increased approximately three-fold this past decade (Shiraki 2013). Although, there have not been any positive habitat conservation practices for this species, such as improvements in natural nesting or feeding sites, or settings of sanctuaries, a rapid increase in the number of nests close to urban areas or roads has been seen around a decade. The bird's adaptation to human beings and artificial environments is considered as one of the factors contributing to the increase observed in breeding pairs in Hokkaido. Meanwhile, food conditions during wintering seasons, which have large effects on the survival rates and breeding successes of WTEs, are assumed to be quantitatively fairly good because of food supplies from human activities. Thus, the breeding population of WTEs in Hokkaido has grown recently under many human influences with some problems. Now is the time to fully consider future conservation policies of this species. In my opinion, to reduce artificial factors effect on inner population parameters, such as food supplies and human-induced mortalities, and to set sanctuaries with adequate control on human activities would be required to sustain the population of WTEs without human interventions.

### **6003 Blakiston's Fish Owl: Population Recovery and Beyond**

**Takenaka Takeshi**, Fish Owl Institute, Sapporo, Japan. Contact: fishowl.takenaka@nifty.com

Blakiston's Fish Owl (*Ketupa blakistoni blakistoni*) is mainly distributed in Hokkaido, Japan's northernmost prefecture. Its diet mainly consists of fluvial fish, and the species uses the large deciduous tree cavities for nesting. Until the 1990s, the population had declined as a result of damage to its habitat by the rapid development led by the National and Prefectural government. In early 1990s only 49 Fish Owl sites were identified with at least 10% of the pairs the result of inbreeding. A National conservation program that included provision of nest boxes and supplemental feeding was initiated in the middle 1980s and, as a result of concerted conservation activities, the population of Fish Owls began to stabilize in the early 2000s. In a 2014 survey, 62 owl sites were identified. They represented a considerable population increase over a 20 year period. Although, so far, conservation of owls has been focused on the resolution of actual problems to individuals and to each specific habitat, new strategies will be needed to sustain population recovery. The improvement of Fish Owl habitat is one of the keys to the next step and new approaches, including the conversion of conifer plantations to indigenous forest and reengineering of dams to permit fish migration, have only just begun. Such trials should significantly contribute to the recovery of both Fish Owl populations and of its habitats. Another key to future success will be the sharing of information regarding Fish Owl conservation methods.

### **6004 Conservation Efforts for Red-Crowned Crane in Hokkaido**

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In Hokkaido, many people bereaved that the Red-crowned Crane was extinct at the time of 1920. But it recovered dramatically by the feeding in winter. At the winter of 1952, 33 cranes were counted with the first winter census. It is ongoing every winter and the population arrived about 1,500 in 2012. The breeding pairs are researching by air plane or helicopter at the hole breeding area, it was 412 in 2013. Almost the crane breed at eastern Hokkaido but in 2004 first breeding pair

observed at Sarobetsu, Northern Hokkaido and 4 pairs are breeding in their now. Also one pair started to breed at the center part of Hokkaido in 2012. Banding project for Red-crowned Crane started in 1988, and 479 cranes were banded in total. Several surveys are being carried out such as mortality, breeding result of individuals, longevity. Winter feeding have been doing by the government led. Total 33 tons of dent corn is feeding at 28 feeding stations from November to March. The current straightforward activity for the crane conservation is mainly this feeding, but several adverse effects has arisen cause of centralization, and accustomed to the human. On the other hand, private conservation organizations have promoted the trust activities to the purpose of habitat conservation there is no frame of legal protection. Their total area reached to 3,500 ha.

## Session 61: The Advanced Approaches for Eradication of Invasive Alien Species

### 6101 Scaling up: From Island to Mainland Eradication

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New Zealand has been very successful at eradicating invasive mammals from small to medium sized offshore islands and from areas surrounded by pest-proof fences. This has prompted discussion about the feasibility of eradication on very large islands, at catchment and regional scales, and even nationally - the proposed Predator-free New Zealand initiative. Cape to City is one such regional project in the Eastern North Island. It is a collaboration between the Department of Conservation, Hawke's Bay Regional Council, Landcare Research and Cape Sanctuary, supported by the Aotearoa Foundation. It aims to coordinate mammal pest control and conservation work across wide areas of land, from conservation areas through to actively farmed land and semi-urban areas. Cape to City builds on successful pest control techniques used in the Poutiri Ao ō Tāne project, which is already restoring sea birds and other native species to part of the area. The Cape to City project will be used to demonstrate how regional projects are vital in any move to national eradication of mammal pests. In addition to being test grounds for novel and incremental improvements in predator control and monitoring techniques, they will provide new information on the importance of core/halo effects and landscape connectivity. This will enable better strategic planning of multi-region eradication. Equally importantly, they will engage with all the social dimensions involved in pest management from community engagement via citizen science and direct action to accessing private land and addressing the broader outcomes of the regional community.

### 6102 Augmenting Our Armoury in the War against Invasive Species: Adding to the Techniques Used to Find, Attract, Catch and Remove Introduced Carnivores

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The management of invasive species has advanced hugely over the last few decades. This is particularly true of eradications where species such as brown and black rats, feral cats and rabbits have been removed from islands of ever increasing size. Managing invasive species however is still

expensive. Invasive species, particularly mammals, are illusive and hard to detect or monitor at low density. The areas from which they need to be removed are often vast or topographically challenging, making the costs of removal prohibitively expensive. They are difficult to then remove from the environment, either lethally or through live-capture trapping, due to many reasons such as neophobia, or lack of species specificity in the techniques available. This presentation looks at how some of these challenges have been overcome at each stage of the management process. We explore novel methods that are being developed to detect species, such as the use of e-dna techniques and camera trapping. We look at how live capture techniques can be made more attractive through the use of scent glands, lures and attractants. Efforts to improve the effectiveness of lethal and non-lethal management techniques are discussed by exploring ways in which they are being made more affordable, species specific or less resource hungry. Strategies discussed include the use of taxon specific toxins, and self-setting or self-reporting traps. These advances in technology are described using case examples, and highlight how they have enabled managers to cover larger areas for less cost.

### **6103 The Eradication Case in Final Monitoring of Taiwanese Macaque in Wakayama, Japan**

**Kei Shirai**, Wildlife Management Office, Inc., Machida, Japan. Contact: shirai@wmo.co.jp

We know that it is possible to create hybrid species of the genus *Macaca*, for example, a cross between Japanese macaques (*M. fuscata*) and Taiwanese macaques (*M. cyclopis*), in about 20 species in captivity. The habitat one such hybrid population of Japanese and Taiwanese macaques was found near a large native population of Japanese macaques in northern Wakayama Prefecture. The origin of this hybrid population was from a group of Taiwanese macaques that escaped from a small private zoo in about 1954. The number of captive macaques at the zoo was estimated at approximately 20.

The Wakayama Prefecture Government, Ministry of the Environment and Wakayama Taiwanese Macaques Problem Working Group began employing active countermeasures for the eradication of the hybrid population. We conducted six censuses from 1999 to 2006, and estimated the population growth by conduction simulations using the census data. We estimated ca. 200 animals in two social groups in 1999, and nearly 270 animals in four groups in 2003. Thus far, we have captured a total of 480 Taiwanese or hybrid or Japanese macaques and have successfully removed 366 Taiwanese or hybrid macaques since 2002.

Currently, we are monitoring whether the eradication program is successful by using sensor cameras, footprint traps, hearing investigation to inhabitants, and detection dogs. In February 2015, it will be one year and nine months since the last capture, and to date, we have not obtained evidence of Taiwanese or hybrid macaques' in the area, suggesting that the eradication program was indeed successful.

#### **6104 Mongoose Eradication Operations on Amami-Oshima and Okinawa Island in Japan**

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The small Indian mongoose, *Herpestes auropunctatus* was introduced to Okinawa Island (1,208 sq. km) in 1910 introduced from there to Amami-Oshima Island (712 sq. km) in 1979 to control invasive rats, and the habu, a native poisonous pit vipers. On both islands, population size and distribution of endemic species have decreased with the expansion of the range of the mongoose. A mongoose eradication project was launched on both islands in 2000, through the wide scale use of both live capture and kill traps covering; 650 sq. km on Amami-Oshima and 300 sq. km in the northern part of Okinawa (Yambaru). Two lines of mongoose proof fences were established at the southern edge of Yambaru to prevent mongooses from invading the area from the south. The mongoose population has declined gradually and annual catches both by traps and by sniffer dogs in FY 2013 were 130 (110 and 20) and 199 (172 and 27), CPUE (C/100Trap-days) was 0.004 and 0.010 for Amami-Oshima and Okinawa, respectively. Though the second ten-year phase of the projects started in 2013, the biggest challenge is how we detect and catch low density mongooses in forested areas. Even hundreds of camera traps and hair traps are insufficient to detect them at such low density. In this situation, sniffer dogs are the most effective tool for detecting animals. In order to completely eradicate them, we have to introduce the combination of techniques including the use of toxins and immunocontraception to attract, find and catch mongooses more effectively.

#### **6105 Some Advanced Approaches for Invasive Mongoose in Amami-Oshima and Okinawa Island in Japan**

**Takamichi Jogahara**<sup>1</sup>, Katsushi Nakata<sup>2</sup>, Robert T. Sugihara<sup>3</sup>, Takuma Hashimoto<sup>4</sup>, Fumio Yamada<sup>5</sup>, <sup>1</sup>Okayama University of Science, Okayama, Japan; <sup>2</sup>Yambaru Wildlife Conservation Center, Kunigami, Japan; <sup>3</sup>USDA, National Wildlife Research Center, Hilo, HI, <sup>4</sup>Japan Wildlife Research Center, Tokyo, Japan; <sup>5</sup>Forestry and Forest Products Research Institute, Tsukuba, Japan. Contact: jogahara@zool.ous.ac.jp

The small Indian mongoose was introduced to Okinawa and Amami-oshima Islands to control invasive rats and habu. On both islands, mongooses inhabit many natural areas and are a major threat to endemic and endanger species. The mongoose eradication projects have started on both islands since 2000. Mongooses populations have been significantly reduced using live traps, kill traps and sniffer dogs. Currently, the annual capture rates are extremely low. In many of invasive species control and eradication programs worldwide toxicants have proved to be a cost-effective, labor-saving and efficacious method of control. In Hawaii, researchers discovered that mongooses were highly susceptible to diphacinone, a common rodenticide agent. Hence, we performed experiments to verify the effects of diphacinone for mongooses in laboratory condition. Laboratory feeding trials are being conducted in Okinawa and Hawaii to verify the effectiveness of diphacinone for mongooses. 50ppm and 25ppm diphacinone was formulated with lean chicken meat in a 1-day and 3-days feeding regime with 10 mongooses (equal sex) for each concentration. The results of 50ppm experiments were 7/10 (1day) and 9/10 (3day) individuals died. The 25ppm experiments were 6/10

(1day) and 8/10 (3day) individuals were died. All affected individuals were hemorrhage from some organs. Especially, pregnant female was very sensitive and hemorrhage from placentas. We found that the diphacinone bait is very effective for mongooses. Separate laboratory trials are also planned with other toxins. We also need to evaluate the effects of these candidate baits in field trials to determine potential non-target hazards associated with its use.

#### **6106 Immunocontraceptive Vaccines for Alien Mongoose and Raccoon**

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Alien small Indian mongoose and raccoon are causing serious damage to native ecosystem and agricultural crops in Japan. For population control of both invasive species, national and local governments have principally used live and/or kill traps. This has resulted in a reduction in agricultural-products damage and a population increase of native species. However, especially for mongoose, as the pest population has declined the bycatch of rare native species has increased, causing concern. The development of other population control techniques is therefore required to reduce risks to non-target native species.

Immunocontraception of wildlife has been researched in variety of overabundant species. Since 2011, we have investigated immunological fertility-control for mongooses and raccoons, particularly focused on zona pellucida (ZP) protein based vaccines. The ZPC (ZP3) genes of both species were sequenced and the amino acid sequence of the sperm-binding region identified, a potential component of the target antigen. After comparing the homology of amino acid sequence in the sperm-binding region among a range of species, we produced two synthetic peptides for each species as antigen candidates for immunocontraceptive vaccines. Antibody binding of immunized rabbit sera was demonstrated through immune-histochemistry in some carnivore ovaries, and showed a species-specific reaction in mongoose and a cross-reaction in raccoon. Our next step was to evaluate the effect of the antigen candidates in vivo. The further studies will be needed to develop practical fertility-control oral vaccines but our immunocontraceptive vaccine shows promise as a new tool to assist with eradicating alien small Indian mongoose and raccoon.

## **Session 62: Instrumental Studies of Large Mammals in the Russian Far East and Siberian Arctic**

#### **6201 Vulnerability Assessment of Ice Polar Bear Habitats of the Eastern Sector of the Russian Arctic**

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East-Siberian and Chukchi Seas of Russian Arctic is the part of range for polar bears. The vastness of territory, outdated or incomplete results of previous researches of marine mammals in the Russian Arctic, the uncertainty of adaptability and vulnerability of polar bears under the climate changes, the increasing interaction between polar bears and people in result of industrial and recreation activity in the Arctic - all these problems were the reasons for development of the Program for polar bear study in the Russian Arctic. The main goal of the multidisciplinary approach of the Program appears in the three topics.

1. Distribution, space use and population structure of polar bears. Shipboard and stationary observations, questionnaire design of native and worker people in the Arctic, traditional ecological knowledge are used to estimate distribution of polar bears. Satellite biotelemetry and observations data indicates polar bears' space use for sea ice and terrestrial habitats.
2. Population welfare. Starvation, proximity to people and domestic animals could result in high susceptibility of polar bears to the broad range of pathogens. Change in nutrition is an obvious indicator of population and individuals' health. Non-invasive methods are used for samples collection in the collaboration with conservation organizations and inter-disciplinary specialists.
3. Habitat vulnerability. Sea ice characteristics and seasonality change under environmental forcing. The understanding such mechanisms contributes development forecast and hindcast models for polar bear habitat. Satellite imagery, observed and derived spatiotemporal data are used to estimate habitat characteristics.

#### **6202 Ecological Changes and Conservation of Wild Tundra Reindeer in the Eastern Siberia under the Global Warming Condition**

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“Dynamics destabilization” has been reported in many populations of wild tundra reindeer (*Rangier tarandus tarandus*). But, present status of tundra reindeer is not well-known in the republic of Sakha (Yakutia), even though it is the largest habitat of this species in the Eurasian continent. So we have conducted a satellite-tracking survey of about 30 animals of the Anabar-Olenek population which is the newest and most stable population in Siberia. Although summer range of this population is stable on the upstream of the Anabar and Olenek rivers, its wintering grounds were clearly recognized as two locations: north and south. Therefore, this new population is thought to be originated from Taimyr population which was the largest population in the world and Lena-Olenek population. In wintering grounds, both of two sub-populations were unstable because warm Arctic Ocean and the industrial zone prohibited them to get to satisfactory habitats. Distance and speed of their migrations are standard, but there is a strong tendency to stagnation in crossing rivers and the delay of river freezing (autumn) and accelerated melting of river ice (spring) had further strengthened it. In addition, ROS (rain-on-snow events) seems to have a strong effect of increasing mortality of tundra reindeer. From above results, we proposed expanding of protected area system for wintering ground to the regional government and is has been realized. More effective conservation measures for the northern small-numbered peoples and wild tundra reindeer should be discussed now.

#### **6203 Monitoring of Social Structure and Space Use by Amur Tigers (*Panthera tigris* Temminck, 1884) in Russian Far East Based on GPS Telemetry and Phototraps Data**

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To better understand spatial structure of Amur tigers at the southern edge of their range we fitted 14 tigers (6♀ and 8♂) with 15 GPS-Argos collars between 2008 and 2011 in Ussuriskii Reserve and Land of the Leopard National Park, Russia. Also we used 54 camera traps in Ussuriskii reserve. 24447 trap-days were worked out. We recorded 14 tigers in the studied area. Population density (SPACECAP) fluctuate from 0.11 tigers/100 km<sup>2</sup> to 0.58 tigers/100 km<sup>2</sup>. Fixed kernel estimates of male home-ranges were larger than those of females (Mean 95%-FK<sub>♀</sub>=401±205 km<sup>2</sup>; Mean 95%-FK<sub>♂</sub>=778±267 km<sup>2</sup>). Home-range size of females was similar to estimates derived from earlier work further north. Low overlap of adjacent home-ranges suggested that females retained exclusive territories. Real core-areas of females overlapped only slightly. Home ranges of males were smaller than those of males to the north, and in contrast to previous studies, high overlap amongst males indicated the absence of territoriality. Nonetheless, real core-areas of males did not overlap, suggesting some spatial separation. In comparison to other tiger populations, the sex ratio in our two study areas was highly skewed towards males. We believe this skewed sex ratio resulted in the dissolution of territoriality of males due to an inability to defend individual females, with males resorting to scramble competition for mates. Continued monitoring of these sites to determine whether shifts in the sex ratio might result in a return to male territoriality would provide confirmation of our tentative hypothesis.

#### **6204 Estimation of Physiological Status of Large Carnivores: Objective Tool for Population Management of Endangered and Game Species**

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Monitoring and knowledge of population status of endangered and game species is the base for their successful conservation and management. Although anthropogenic pressure assumed to be the main crucial factor for the survivorship of large carnivores the infectious diseases attract more and more attention. We estimated distribution of 16 different pathogens in Amur tiger population in Russia (n=43). To understand pathways of pathogens transmission we checked serum prevalence of wild (bears, leopards, raccoon dogs, badgers) and feral (dogs, cats) carnivores to the same pathogens. Canine distemper virus and feline calicivirus have resulted in to the death of animals in some cases. Although feral dogs were the main reservoir for CDV (more than 60% of animals were serum positive) wild carnivores were also important for virus transmission. High level of serum prevalence was described for Trichenella and Toxoplasma. Due the difficulties of capture procedures new approaches were developed to estimate animals' welfare/stress level. We developed non-invasive method of estimation of fecal glucocorticoids metabolites (FGM) for Amur tiger and Far-East leopard. This method was validated with ACTH and transportation test. We showed that low ambient temperature had negative effect on large cat organisms and led to the increase of FGM level. Snow depth in winter period also affected FGM concentration in Amur tiger. It seems that

these factors at the edge of range of these tropical species may have negative effect on their welfare. However, case study on far-east leopard shows that high prey availability may reverse negative effect of low temperatures.

#### **6205 Genetic Structure of Amur Tiger (*Panthera tigris altaica*) Population: How Are Segregated Sikhote-Alin and Southwest Primorye Groups?**

**Pavel Sorokin**<sup>1</sup>, Vyatcheslav Rozhnov<sup>2</sup>, Victor Lukarevskiy<sup>3</sup>, Sergey Naidenko<sup>2</sup>, Jose Hernandez-Blanco<sup>2</sup>, <sup>1</sup>A. N. Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences, Moscow, Russian Federation; <sup>2</sup>A. N. Severtsov Institute of Ecology and Evolution, Moscow, Russian Federation; <sup>3</sup>Sayano-Shushensky Nature Reserve, Krasnoyarsk, Russian Federation. Contact: sorokin-p@yandex.ru

We developed the procedure of noninvasive individual identification of the Amur tigers by molecular genetic methods. Using this technique, relationships in groups of tigers in the Russian Far East was defined. We identified 63 different animals as a result of genotyping 240 feces, 7 hair and 10 blood samples collected within southern Sikhote-Alin (Ussurisky Reserve), northern Sikhote-Alin (Khabarovskiy Krai) and Southwest Primorye. Analysis of nuclear DNA at 9 microsatellite loci has demonstrated genetic similarity of animals from the Ussurisky Reserve and Khabarovskiy Krai, and their difference in comparison to the animals in Southwest Primorye. Genetic differentiation between the Sikhote-Alin and Southwest Primorye populations was not very high (RST = 0.22;  $P < 0.05$ ). Four individuals genetically associated with the Sikhote-Alin samples were geographically located within the Southwest Primorye population, with over 90% of their genotypes assigned to Sikhote-Alin. There were no animals that were genetically assigned to the Southwest Primorye that were sampled in Sikhote-Alin. Thus gene flow is conducted between these two populations mainly in one direction, from a large group to a small one. Genetic diversity of the population from Southwest Primorye is higher than that of the Sikhote-Alin population. According to our data the average observed heterozygosity for the Sikhote-Alin population is  $H_o=0.57\pm 0.02$ , for the tigers from Southwest Primorye  $H_o=0.61\pm 0.04$ . The average number of alleles per locus is  $3.33\pm 1.00$  and  $3.56\pm 0.73$  respectively. The research was supported by the Russian Geographic Society and the grant of the President of the Russia Federation № MK-4313.2014.4.

### **Session 63: Wildlife Management and Local Community in Third World: The Approach from Social Science**

#### **6301 Peccary Hunting Among Local People and Animal Management in the Peruvian Amazon**

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The sustainability of hunting in the Amazonia forests can be evaluated through more intensive field research. This study clarifies the practice of peccary hunting and aspects of other animal resource use among the Indians in the Peruvian Amazon from the perspective of ecological anthropology. Peccaries of two types--collared and white-lipped, deer, tapir, monkeys, tortoises, agouti etc., have been hunted by 15 local hunters using shotguns in the study area. Peccary hunting is the most important activity for village livelihood because of commercial hunting for meats and skins. Capybara and deer hides were also sold if the animals are taken during hunting with shotguns. Peccary meat is reportedly consumed by local people and is sold. Hunting is conducted mainly

during the dry season (June-September). Two types of hunting were conducted in August, 2011. First, after about 50 peccaries together visited and fed on palm-tree fruit and cassava crops surrounding the settlement, seven hunters followed their footprints. Two animals were caught. Secondly, one or two persons went hunting for peccaries at the upper Sukusari River on one day or several days. They use canoe boats to travel from place to place. This study summarizes the importance of peccary hunting for meat and skins according to movement of animals for the local people's livelihood, and consider the sustainability of commercial hunting in the tropical rainforest of Peruvian Amazon, comparing for wild boar hunting in the forest of Japan.

### **6302 Wildlife Tourism in Sri Lanka and Rural Community**

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In Sri Lanka, wildlife conservation involves several costs to rural community, such as inaccessibility to protected areas for resources and wildlife-induced damage to crops, properties and lives, which make them less supportive for conservation efforts. Wildlife tourism is recognized as an important tool to reduce costs of wildlife conservation on rural community. This study examines the involvement of rural community residents in wildlife tourism, with a case study in a main wildlife conservation area in the country, and reveals the challenges in sustaining community involvement and support for wildlife conservation. Wildlife tourism enables direct involvement of rural community in park activities through various employment opportunities such as volunteer guides, wildlife guards or safari jeep drivers, and utilizes traditional knowledge of community residents for wildlife conservation. However, several issues exist in terms of job security, training and communication, which weaken the involvement of local community and opportunities in developing or improving skills to perform the duties well. At the same time, the opportunities of wildlife tourism are not distributed to all the villages around the park due to unavailability of a collective tourism plan, and there are many villages that are not involved in the park or its activities. However, these villages often suffer from wildlife-induced damage, and loss of agricultural land as a result of park expansion. Therefore, it is important to plan wildlife tourism based on an understanding of the rural livelihood and potentials in order to facilitate the rural community largely, and to obtain their support for conservation.

### **6303 Oversights on Human-Wildlife Relations in Republic of Kenya: From the Perspective of Environmental Sociology**

**Toshio Meguro**, Tokyo University of Foreign Studies, Fuchu, Japan. Contact: meguroguro@gmail.com

The coexistence of people and wildlife is one of the major issues in wildlife management today, and the field of "human dimensions of wildlife management" emerged. Also, the need to change the "agricultural paradigm" of wildlife management to the "ecological paradigm" is posed. However, as far as a discussion is based on wildlife management as a discipline, it is confined to its technical frameworks and terms, and may diverge from the lived experience in a local society. In Africa, many non-domestic animals live outside protected areas, having continual contacts with local people including crop raiding, livestock depredation, property destruction and human injury. In order to improve such a situation, various stakeholders now adopt and implement "community-based" approaches. However, their discussions often fail in grasping the local situation. This presentation

takes up an example of the Amboseli ecosystem in Kenya. Kenya is one of the countries in Africa where tourism and protection of wildlife are massively practiced. Its wildlife policy is strongly influenced by the animal welfare movement, and due to it, draw mercilessly criticism. With an analytical framework derived from the studies of environmental sociology in Japan, which is characterized by studying both the collective values and practices in local societies with reference to various humanities and social science, the human-wildlife relations in the study area is analysed. The oversights committed by the specialist whether for or against the current Kenyan wildlife policy is clarified, and in conclusion, the role of humanities and social science as critique is discussed.

#### **6304 Recreational Hunting in Cameroon: “Meat” or “Poison” for Local Community**

**Akito Yasuda**, Kyushu University, Fukuoka, Japan. Contact: yasudakeyaki@gmail.com

Recreational hunting is one of the oldest known tourism activities using wildlife. Leader-Williams (2009) defined it as the hunting where the hunter or hunters pursue their quarry for recreation or pleasure. Some researchers have suggested that controlled recreational hunting can benefit the development of local communities in Third world, thereby promoting the protection of wildlife resources as well as both ecological and economic sustainability. However, important debates remain regarding the social impacts of conservation and tourism on local communities. This presentation aimed to introduce a social impact of recreational hunting on local community in Cameroon. Approximately two years of fieldwork, mainly based on interviews and observations, showed that recreational hunting in North Province, Cameroon generated tax revenues more than safari in National parks did. A part of economical benefits shared with local communities as profit sharing and employment opportunities. However, the local inhabitants were affected by regulations of their rights to use natural resources. Moreover, some villages experienced forced migration because of the beginning of hunting tourism in this area.

Recreational hunting brings to local community not only positive impacts such as profit sharing and employment opportunity, but also negative one as control of the livelihoods of local people and forced migration. Even if recreational hunting can play an important role in community conservation and wildlife management with its great economic benefit, the independence of local people and their connection with wildlife should be considered to re-conceptualize "Sustainability".

### **Session 64: Marine Mammal Managements: Methodologies and Case Studies by Their Application in Some Pinniped and Cetacean Populations**

#### **6401 Management of ‘Aboriginal Subsistence’ Whaling under the IWC**

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The International Whaling Commission (IWC) recognises aboriginal subsistence whaling (ASW) as separate from commercial whaling. Scientific advice on aboriginal subsistence whaling used to be provided on an *ad hoc* basis but since the completion of the Revised Management Procedure (RMP) for commercial whaling in 1992, the IWC Scientific Committee has been following a similar ‘management strategy evaluation’ approach for the aboriginal subsistence hunts. The primary

differences with respect to the approach used for commercial whaling are (1) a separate harvest control law ('Strike Limit Algorithm or SLA') is developed for each hunt i.e. there is no single generic algorithm; (2) the 'user' objective relates to documented cultural and nutritional 'need' rather than the maximum sustainable catch; (3) populations must move towards a target level (60% of unexploited level) over the 100-year simulation period but there is no formal protection level (this is 54% of unexploited level in commercial whaling). The rationale for these differences will be discussed. To date, SLAs have been developed for the hunts of bowhead whales off Alaska and Chukotka, and humpback whales off Greenland. Work is continuing on SLA development for hunts of bowhead, fin and common minke whales off Greenland. The authors will discuss the successes and different challenges faced for some example hunts, summarise lessons learned thus far (including comparisons with the RMP) and reflect upon possible future developments.

#### **6402 Development and Applications of the IWC's Revised Management Procedure**

**Toshihide Kitakado**<sup>1</sup>, Greg Donovan<sup>2</sup>, <sup>1</sup>Tokyo University of Marine Science and Technology, Tokyo, Japan; <sup>2</sup>International Whaling Commission, Impington Cambridge, United Kingdom. Contact: kitakado@kaiyodai.ac.jp

The Scientific Committee of the International Whaling Commission (IWC/SC) completed, in 1992, its 6-year development of a generic 'single-stock' management procedure for commercial whaling on baleen whales, called the 'Revised Management Procedure (RMP)'. A major component of the RMP is its 'Catch Limit Algorithm (CLA)', a model-based harvest control rule found to be robust to inevitable scientific uncertainty through comprehensive simulation testing. Performance was judged against 'conservation' and 'user' objectives set by the IWC with priority being given to the former. The remainder of the RMP relates to the process of implementing this single-stock algorithm in a 'multi-stock' world taking into account the additional uncertainty this brings. The process of development can be regarded as the primary pioneering work in what is now termed 'Management Strategy Evaluation', i.e. the use of simulation frameworks for comparing and evaluating alternative management procedures in wildlife resource management. Since 1992, the IWC/SC has undertaken trial applications ('Implementations') of the RMP for several species in regions, through 'implementation simulation trials'; the IWC introduced a pause in commercial whaling in the mid-1980s known as the 'moratorium'. The RMP has been updated several times in the light of the implementation experience. In this talk, we will introduce the concept of RMP, its associated guidelines and examples of its application to multiple stocks. Finally, we will discuss possible future developments of the RMP (including incorporation of multispecies considerations) and uses outside the commercial whaling scenario in which it was developed.

#### **6403 Principal of Management Methodology on Small Cetacean Fisheries, in Japan**

**Kanaji Yu**, Toshiya Kishiro, Tomio Miyashita, National Research Institute of Far Seas Fisheries, Yokohama, Japan. Contact: kanaji@fra.affrc.go.jp

The nine small cetacean species, Baird's beaked whale, short-finned pilot whale, false killer whale, Risso's dolphin, bottlenose dolphin, striped dolphin, pantropical spotted dolphin, Dall's porpoise, and Pacific white-sided dolphin, have been targeted by small-type whaling, drive, and hand-harpoon fisheries in the coastal waters off Japan. Since the mid-1980s, when the blanket moratorium on commercial whaling was introduced for the 13 species of larger cetacean that fall under the

jurisdiction of the International Whaling Commission (IWC), small cetaceans have been the most important targets for these fisheries. The government of Japan manages these species outside the framework of IWC. Annual catch quotas were previously determined based on the best estimates of abundance and the assumed increasing rate, while management based on the potential biological removal (PBR) has been implemented since 2007. PBR was originally developed to define how much anthropogenic mortality can be accepted for avoiding the risk of extinction. As the PBR is determined based on the minimum population estimate of the stock, as well as the intrinsic growth rate of the stock and a recovery factor, reliable estimates of abundance and its uncertainty are fundamental to effective management. National Research Institute of Far Seas Fisheries has conducted cetacean sighting surveys, and information from these surveys has been used to estimate abundance and set quotas of small cetacean species. Here we review recent and previous sighting surveys and outline principal of PBR-based management methodology on small cetacean fisheries in Japan.

#### **6404 Current Trials on Kuril harbor Seal Population Management for Mitigating the Damage to Fishery at Cape Erimo, Hokkaido, Japan**

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Although the Kuril harbor seals on Cape Erimo have once been facing with a risk of extinction, their numbers have been increased since the 1970s. Accordingly, damage to salmon set net fishery by the seals has also increased, and it has become a serious problem nowadays. Conservation of the population should of course be prioritized, but it is also necessary to develop a resource management strategy which can achieve a balanced objective between the conservation of population and mitigation of the damage to fishery. Fortunately, surveys of the harbor seal population have been continuously conducted in the breeding season and molting season over a long period until today. In addition, several experiments have been undertaken to draw information on the landing rate and detection probability to adjust those observations. In this talk, based on these pieces of information, we will report on some results of population assessment using a production model and an age-structured model for the Kuril harbor seals on Cape Erimo. We will also discuss some possible future management strategies with culling adults while avoiding unintentional by-catch of yearling animals.

#### **6405 Management of Steller Sea Lion on the Western Coast of Hokkaido Island, Japan**

**Orio Yamamura**<sup>1</sup>, Toshihide Kitakado<sup>2</sup>, Hattori Kaoru<sup>1</sup>, Takeomi Isono<sup>1</sup>, <sup>1</sup>Hokkaido National Fisheries Research Institute, Fisheries Research Agency, Kushiro, Japan; <sup>2</sup>Tokyo University of Marine Science and Technology, Minato-ku, Japan. Contact: orioy@affrc.go.jp

The Western Asian Subpopulation (WAS) Steller Sea lions *Eumetopias jubatus* experienced an acute population decline by half from the 1960s to the 1980s mainly due to hunting, on which virtually no regulation had been enforced. A provisional annual quota of 116 animals was mandated in the early 1990s, and then WAS began to rebound at the rate of 4% a year. However, fishing damages due to SSLs has been serious accounting for >1 billion JPY yr<sup>-1</sup> for the last 20 yrs. Hunting has been one of the mitigating measures of the damages, and has been regulated by means of PBR during 2008-2013.

After the degrading of SSL in the Red List in 2012, the management has been requested to be revised. The revision intended to control the number of SSLs migrating to the western coast of the Hokkaido Island, and a virtual population comprising the migrators has been assumed. In the purpose of fishing damage mitigation, the target level of the migrators in 2024 was set to be 60% of the present level. We constructed a simple population model to describe the dynamics of the population based on the catch history and aerial surveys, and an annual harvest level including by-catch was calculated. This may be the first implementation of the “*from conservation to management*” volte-face in the pinniped around the Pacific Rim, and should be followed by a careful monitoring of WHP and precautionary and adaptive management revisions, to avoid its fall below the endangered level again.

## Session 65: Species Diversity of Mammals and Birds in Asian Countries

### 6501 Phylogeographical Analysis and Molecular Species Delimitation Approaches Reveal a Complex of Cryptic Species within the Edward's Rat (*Leopoldamys edwardsi* Thomas, 1882)

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Rodents are the most diversified mammals with more than two thousand species. Because of conserved morphology, the level of rodent biodiversity is underestimated. We investigated the Edward's rat (*Leopoldamys edwardsi* Thomas, 1882), a species with wide distribution ranges, on the basis of mitochondrial DNA mitochondrial cytochrome c oxidase subunit I (COXI, 1524 bp) and cytochrome b (Cyt b, 1140 bp) analyses. In our study, three well-supported main lineages were evidenced by Bayesian approach (BI) tree, maximum likelihood (ML) tree and median-joining network analyses. The three main lineages were separated by the Kimura-2-parameter (K2P) divergences based on Cyt b (mean K2P for lineage 1 vs. 2: 8.9%; lineage 1 vs. 3: 9.7%; lineage 2 vs. 3: 5.2%). The coalescent-based method (BP&P) clearly supported that three separate evolutionary units represented three distinct species. Using combined genes and two calibrated nodes under a Bayesian relaxed-clock framework, we inferred the divergence time among the three lineages fell in the Pleistocene (0.98 and 2.13 Mya, respectively). The analyses of population genetics and demographic history indicated both biogeographical barriers and Pleistocene climatic fluctuations promoted genetic divergence of *L. edwardsi* complex

**6502 Biogeography of Raccoon Dogs in East Asia: Implications for Phylogeographic and Ecomorphological Variation**

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*Nyctereutes* is one of most primitive genera consisting of one species, raccoon dog (*Nyctereutes procyonoides*). Its conserved characteristics could be an important evidence of tracing evolutionary history. Raccoon dog is known as a dominant species in East Asia: Russian Far East (*N. p. ussuriensis*), China (*N. p. procyonoides* and *N. p. orestes*), Korea (*N. p. koreensis*), northern Vietnam (*N. p. procyonoides*), and Japanese Islands (*N. p. viverrinus*, and *N. p. albus*). Currently, this species is rarely observed in China and Vietnam due to the poaching, desertification, and habitat destruction. Contrary to the endemic population, introduced raccoon dogs are rapidly expanding their distribution in Northern and Eastern Europe, from Finland to Germany and Bulgaria. Their intraspecific difference among six subspecies is ambiguous so far. Previous studies on the cytogenetics, molecular phylogeny and craniodental variation determined two distinct taxa, Japanese raccoon dogs and other populations in East Asia. In the present study, craniometric data were compared with molecular and environmental traits to clarify the biogeographic pattern and taxonomic status of raccoon dogs. Significant correlation between genetic distance and the Mahalanobis distance of skull morphological traits was found. Raccoon dog has larger skull in cold environment and carnivorous tendency in humid condition. Also, drastic size variation and allometric difference of island population indicated its remarkably adaptive response to particular insular condition. Our results support the Japanese population underwent different evolutionary history after the geographic isolation. We suggest two Japanese raccoon dog subspecies could be classified as distinct species from *Nyctereutes procyonoides* of mainland.

**6503 Reappraisal of the Taxonomic Status of the House Shrew *Suncus murinus* (Soricidae: Crocidurinae) from Peninsular Malaysia**

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The large Crocidurinae shrews from Malaysia have been poorly studied and their distributions records remain incomplete. Consequently, their taxonomic status is still debated and most large shrews encountered previously were recorded under the species name: *Suncus murinus*, a widespread species that occurs throughout Southeast Asia. In this study we used partial sequences of the mitochondrial Cytochrome b gene and the nuclear Rag1 gene to investigate the genetic relationships between the Malaysian *Suncus murinus* and the geographically restricted subspecies, and to clarify the taxonomic status of *S. murinus* in Malaysia. Our data showed that *S. murinus* from the northwest coast of Peninsular Malaysia is distinct from *S. murinus* from the southwest coast, and both groups are distinct from *S. murinus* from East and West Asia (>5% K2P distance in cyt b sequences). However, *S. murinus* from southern areas of Peninsular Malaysia (Ulu Gombak and



Melaka) showed closer similarity to *S. murinus caerulescens* from Sri Lanka and *S. murinus* from Taiwan and the Philippines (<0.8% K2P distance in cyt b sequences). These results are concordant with morphological analyses based on 14 skull measurements that showed *S. murinus* from Ulu Gombak and Melaka are similar size to *S. murinus caerulescens* from Sri Lanka, but slightly smaller than *S. murinus* from the northwest coast of Peninsular Malaysia. Broader geographical sampling, particularly from Thailand and Indonesia, of both morphological and genetic characters should help to resolve the relationships of the *S. murinus* species complex across the Sundaland region.

#### **6504 Roosting Territory of White Ear-Lobed Red Jungle Fowl**

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Between 2005 and 2009, 10 dominant males of the red jungle fowl (RJF), *Gallus gallus gallus*, were intensively monitored and we identified their night roosts by tracking their specific crows coupled with radio telemetry for the individuals. Outermost locations of individual's roosts were connected to form territory and a distance of 50m was buffered to individual's territory to yield home range. All roost trees were exclusively examined and compared with the same parameters 20m away. The longest territory tenure was 31 months. The life time territory of males was on average 10.79ha ( $\pm 1.51SE$ ) and a home range was 17.59ha ( $\pm 2.15SE$ ). Yearly territory varied between 3.38-13.89ha per individual and rarely overlapped. Among individuals, roosting sites were not strikingly different but significantly differed from the surrounding areas 20m away. Some roosts were used repeatedly at the same point. In the night, RJF were relatively safe and difficult to approach both vertically and horizontally. Roost site selections were a trade off between security and territory proclamation.

#### **6505 Molecular Phylogeography of the Brown Bear in Asia, Revealed by Complete Mitochondrial DNA Sequences**

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The brown bear (*Ursus arctos*) is widely distributed in the Northern Hemisphere, including Hokkaido and southern Kuril Islands, and Sakhalin. To elucidate the migration history of brown bears on Hokkaido, we analyzed the complete mitochondrial DNA (mtDNA) sequences of brown bears from Hokkaido, southern Kuril Islands, Sakhalin, and the Eurasian Continent. We reconstructed the maternal phylogeny of the brown bear and estimated divergence times to investigate the timing of brown bear migrations, especially in northeastern Eurasia. The brown bear on Hokkaido was divided into three lineages (central, eastern, and southern). Brown bears from southern Kuril Islands were closely related to eastern Hokkaido brown bears and could have diverged from the eastern Hokkaido lineage after formation of the channel between Hokkaido and southern Kuril Islands. The Sakhalin brown bear grouped with eastern European and western Alaskan brown bears. In addition, we developed an amplified product length polymorphism (APLP) analysis for mtDNA-haplogrouping of the brown bear by detecting haplogroup-specific single nucleotide polymorphisms. The APLP analysis is suitable for degraded DNA samples such as stuffed specimens. We verified the validity by analyzing up to 170 year-old skin samples from brown bears collected across continental Eurasia. Some of the haplogroups same as those occurring in eastern Hokkaido and eastern Alaska were found in continental Eurasia (Altai and Caucasus). The results show that brown bears in eastern

Hokkaido and eastern Alaska descended from common ancestors in Eurasia, and suggest that brown bears occupied several refugia in inner Eurasia during the Last Glacial Maximum.

**6506 Phylogeographic and Demographic Analysis of the Asian Black Bear (*Ursus thibetanus*) Based on Mitochondrial DNA**

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Asian black bear is widely distributed in Asia, and adapted to broadleaved deciduous forests, playing an important ecological role in the natural environment. However little is known about this animal's evolutionary history. Several subspecies were recognized within this species, and one of them distributed in Japanese archipelago, is the Japanese black bear. Recent molecular phylogeographic studies clarified this subspecies is genetically distantly related to continental subspecies. In order to understand the evolutionary process of this species, in relation to the geological events, a reliable time estimation is also essential. Here, we newly determined mitochondrial genome of the Japanese black bear, and indicated that the Japanese subspecies initially diverged from continental populations. The Northern continental population (northeast China, Russia, Korea) subsequently evolved, relatively recently, from the Southern continental population (southern China and Southeast Asia). The tMRCA of Asian black bears was estimated to be around 1.46Ma. While the Japanese black bear has a very early origin, the tMRCA's and the dynamics of population sizes suggest that Japanese population dispersed relatively recently: during the late Middle and Late Pleistocene, probably during/after the extinction of the brown bear in Honshu in the same period. Our estimation of the rapid increase of the population size of the Japanese black bear, during the Late Pleistocene is the first evidential signal of the niche exchange between the brown bears and black bears in the Japanese main islands. Here, we also report the new fossil record of the oldest Japanese black bear from the Middle Pleistocene.

**6507 Multivariate Analysis of the Skull Size and Shape in Genus *Murina* and Subfamily Kerivoulinae (Chiroptera: Vespertilionidae) from Vietnam**

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Fourteen bat species of the genus *Murina* and six species of the subfamily Kerivoulinae (Chiroptera: Vespertilionidae) have been recorded from Vietnam. Skull of the species of *Murina* and Kerivoulinae were osteometrically examined using principal component analyses (PCA) from 216 specimens of *Murina* and 170 specimens of Kerivoulinae from 35 localities of Vietnam. The species of *Murina* could be divided into three groups: the large-sized group (*M. leucogaster*, *M. harrisoni* and *M. fionae*), the medium-sized group (*M. annamitica*, *M. beelzebub*, *M. cyclotis*, *M. loreliae*, *M. feae*, *M. huttoni*, *Murina* sp., and *M. walstoni*), and the small-sized groups (*M. eleryi*, *M. chrysochaetes*, and *M. harpioloides*). The species of Kerivoulinae could also be allocated in the three groups: the large-sized group (*Kerivoula kachinensis* and *K. papillosa*), the medium-sized group (*Phoniscus jagorii* and

*K. titania*) and the small-sized group (*K. hardwickii* and *K. picta*). Our morphological results suggest that the species of *Murina* in Vietnam can be distinguished from each other by a combination of the skull size and shape. Sexual dimorphism was confirmed in *M. cyclotis*, *M. annamitica* and *M. harrisoni*, whereas the sexual dimorphism was unclear in the species of Kerivoulinae. Based on the shape of the skull, nasal sinus and canines, the species of Kerivoulinae can be placed in two genera *Kerivoula* and *Phoniscus*. In addition, variation in skull morphology of *Kerivoula hardwickii* showed that this is a cryptic species with four morphotypes.

#### **6508 Systematic and Biogeography of Southeast Asian Spiny Rats (Genus *Maxomys*: Family Muridae)**

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Species of the genus *Maxomys* are one of the most common rats in the Southeast Asian region. They are distributed widespread throughout Southeast Asia start from mainland Southeast Asia, throughout much of the Peninsular Malaysia to Borneo, Sulawesi, Sumatera, Java and Palawan island in the Phillipines, as well as on several of the smaller islands of Sunda Self. Unfortunately, the knowledge of taxonomy, diversity, relationships, systematic and biogeography of this genus is very limited. We documented a various information of phylogeny, diversity, biogeography, systematic and variations within *Maxomys* from specimens datasets collected from several fieldworks in Indonesia and Malaysia and collections deposited at several museums in Indonesia, United States, Australia, and Canada. We are using craniometric measurements and molecular approaches to solve the problem within *Maxomys*. Recently, we are updating the taxonomical status and morphological variations among species within *Maxomys* from Indonesia and Malaysia. Otherwise, we generated a 3-locus DNA sequence data set to estimate phylogenetic relationships among species and populations of *Maxomys*. Our analyses additionally revealed unrecognized diversity in the form of divergent populations both between and within islands and the presence of 2 potentially undescribed species from Sulawesi.

### **Session 67: Damage Prevention**

#### **6702 Intestinal Parasites May Affect Forest Succession via the Debarking Behavior of Formosan Sambar**

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Debarking behaviors by deer have been exhibited throughout the world, causing economic loss and affecting ecosystem dynamics. All current hypotheses to explain such behaviors center on the bark contents themselves. Taiwan's Formosan sambar (*Rusa unicolor swinhoii*) has been displaying such behavior in mid-to high level elevations for around 10-20 years. We assumed that the Formosan sambar debark for supplementary nutrition or condensed tannin for self-medication. At seven locations we measured the preference for tree species and debarking frequencies by Formosan sambar and regressed the two variables on population density, sex ratio, intestinal parasite loading of sambar populations as well as bark thickness and nutritional and tannin contents in barks. Results

showed that barks and major forages did not differ in nutritional contents but only barks contained tannin. Formosan sambar strongly prefer and significantly affected the renewal of Taiwan hemlock and Taiwan fir, the major canopy species of a climax community, while avoiding Taiwan red pine, the major canopy species preceding a climax community. The preference for tree species was negatively correlated with tannin concentration and bark thickness. The tannin concentrations of the most preferred tree species fell within the optimal range for ungulates to consume. Debarking frequencies positively correlated with intestinal parasite loading of sambar population. We propose that Formosan sambar practice debarking to gain appropriate concentrations of tannins for mitigation against intestinal parasite infection, resulting in selectivity on tree species and the reversal of forest succession.

### **6703 Predicting Hotspots of Human-Wild Boar Conflict to Inform Mitigation Strategies in Xishuangbanna, Southwest China**

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In order to understand, and thereby to mitigate, human-wildlife conflict, it can be important to research patterns in the conflict, to reveal the underlying mechanisms and predict likely future hotspots. In Xishuangbanna (XSBN), China's largest tropical forest, the imbalance between economic development and nature conservation is leading to increasing conflicts between humans and wild boar (*Sus scrofa*), with significant financial costs. Based on five years (2008-2012) government compensation data, we built a Zero Altered Negative Binomial model to analyze the occurrence, frequency and intensity of wild boar crop raiding events in settlements and, using a Geographic Information System, extrapolated across the XSBN State. There were 21,790 reported incidents, including damage to rubber tree plantations (n=3,170) and crops (n=21,790, including paddy, upland rice, corn and sugarcane), incidents of damage to rubber trees paralleled those of crop damage. Conflicts were more frequent during the rainy season (n=20,104 and 1,611 for rainy and dry season, respectively). The probability of crop raiding was driven by lower settlement density and increasing elevation, cropland and slope. This pattern was consistent across seasons but different with damage to rubbers, which occurred more frequent with proximity to protected areas and decreasing rubber plantation coverage. A predictive map revealed hotspots of crop raiding at high elevations and fewer human footprints, or a clear edge effect around protected areas when damaging rubber trees. The results provide new insights into the management of local wild boar populations, and solid scientific foundations for mitigation plans in its entire ranges of China.

### **6704 Urban Wild Boar Damage in Kobe City and the Causal Relationship between Their Damage and Feeding by People**

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Human-wildlife conflicts in urban areas are increasing in Japan. In Kobe City, wild boars (*Sus scrofa*) invade the city and cause serious damage, e.g., injuring people and scavenging garbage. They have become habituated to people because they are being fed by people. Therefore, the aim of this study

is to elucidate the causal relationship between the wild boar damage and feeding by the people and to identify their damage patterns. From Kobe City's government records, we collected the data on the complaints from residents related to wild boars and gathered the information on the sites where people feed wild boars in area A and area B in Kobe City during 2009-2013. First, we identified the seasonal pattern regarding the damage. Second, we calculated the distances between the damage points and feeding points using GIS. The number of wild boar damage increased from August to October and decreased since November during 2009-2013. The most observed damage in area A was human injury, whereas area B reported numerous wild boar sightings. Major damage occurred when the damage points were close to the feeding points. Particularly, the damage occurred near the feeding points that were close to forests. We concluded that feeding the wild boars led to an increase in the damage caused by them. To prevent this damage, it is important that the government notifies the people living in areas near the feeding points to be vigilant against the wild boar damage from August to October.

#### **6705 Evaluation the Effect of Measures Related to Japanese Monkey (*Macaca fuscata*) Damage in Sasayama City, Hyogo, Japan**

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There are a lot of monkeys living in Sasayama City, Hyogo Prefecture. In Sasayama City, where the human population has been declining and aging, there have been human-macaques conflicts. In order to reduce the animal damage, especially the damage by Japanese monkeys (*Macaca fuscata*), Sayama City has carried out a series of measures which include community-based damage management and planned population control approach. Recently, Sasayama City started to heavily subsidize the villages for building electric fences. However, it has not been demonstrated whether those measures have contributed to decreasing the monkey damage. Thus, in this research, we first examine how often monkeys appear to be at the village where the electric fences have been built. Next, we compare the changes in crop production per farm before and after the electric fences have been built. From those results, we finally discuss the evaluation of local-level policy for monkey damage, by taking account of both the changes in the monkey movement and the farmers' production activities.

#### **6706 Location and Group Specific Differences in Human-Macaque Interactions in Singapore: Implications for Conflict Management**

**Jayasri Srikantan Lakshminarayanan**, James Gan, National Parks Board, Singapore, Singapore. Contact: jayasri\_lakshminarayanan@nparks.gov.sg

The changes in Singapore's land use, natural preference of long-tailed macaques (*Macaca fascicularis*) to live in forest edges and their adaptability has led to interface between humans and macaques. Studies have shown that two-third of human-macaque interactions in Singapore were related to human food. We aimed to assess differences among macaques groups in their dependence on human food and interaction with humans as indicators of the level of interface. Field observations using instantaneous scan sampling and all occurrence ad-lib sampling were carried out for 23 macaque groups over 28 days recording 71.5 hours of observations. Data on macaque behavior, demography, frequency and nature of human-macaque interactions were collected. None

of the groups were found to completely rely on human food source. Of the 23 groups, 40% of them were directly or indirectly provisioned by humans. One-third of the groups observed engaged in some form of interactions with the humans. Three groups that were directly fed by humans contributed to 83% of the total human-macaque interactions observed during the study. Our study indicated that interactions between humans and macaques exist in specific groups and in those fed by humans regularly. Although feeding monkeys is illegal in Singapore, such incidents seem to persist in specific locations. We emphasize the importance of group and location specific assessment of the existing human-wildlife interactions. Conflict management strategies developed should be location specific to address the cause of interactions.

#### **6707 Habituated Bear Behavior in Romania**

**Jurj R. Ramon**<sup>1</sup>, Ionescu Ovidiu<sup>2,3</sup>, Simon Dieter<sup>4</sup>, Ionescu Georgeta<sup>1,3</sup>, Cotovelea Ancuta<sup>1</sup>, Popa Marius<sup>5</sup>, <sup>1</sup>Forest Research and Management Institute/Transilvania University of Brasov, Brasov, Romania; <sup>2</sup>Forest Research and Management Institute/Transilvania University of Brasov, Brasov, Romania; <sup>3</sup>Forest Research and Management Institute, Romania, Brasov, Romania; <sup>4</sup>Transilvania University of Brasov, Brasov, Romania; <sup>5</sup>Forest Research and Management Institute, Romania, Brasov, Romania. Contact: ramon@icaswildlife.ro

This study was done in Central Romania, where a tremendous development has occurred in the past 30 years. Habitat for brown bears (*Ursus arctos*) have been altered since new residential homes and tourist complexes have been built in the forest and forest edge. We studied a total of 102 bears. Frequent invasion into human settlements by these bears caused changes such as increasing of litter sizes: to 3-4 cubs (even five) and 2 years inter-litter interval due to the increase in food intake; behavioral changes in such as increasing of litter sizes. Bears have lost their fear of humans and associate them with a food source; habituated bears can be captured much easier than the wild ones. Captured bears were relocated to other areas but frequently returned to areas where human-derived food sources such as household waste were available. These behavioral changes have caused more bear attacks on human than in normal situation. In this period 38 cases of bear attacks on human were registered and 6 people died in these attacks. To reduce direct human-bear conflicts and to keep the bears' natural behavior several management actions were conducted by local authorities, hunters and the local community in these areas.

#### **6708 Management Particularities of Beaver Population, Reintroduced 15 Years Ago, as Romania Joined the European Union**

**Ionescu V. Georgeta**<sup>1</sup>, Claudiu Pasca<sup>2</sup>, Alexandru Gridan<sup>3</sup>, Marius Popa<sup>2</sup>, Ovidiu Ionescu<sup>3</sup>, George Sirbu<sup>2</sup>, Ramon Jurj<sup>3</sup>, Ancuta Cotovelea<sup>3</sup>, Ioana Negrea<sup>3</sup>, <sup>1</sup>Forest Research and Management Institute/Transilvania University of Brasov, BRASOV, Romania; <sup>2</sup>Forest Research and Management Institute, Brasov, Romania; <sup>3</sup>Forest Research and Management Institute/Transilvania University of Brasov, Brasov, Romania. Contact: titi@icaswildlife.ro

Since the nineteenth century beavers had been extinct in Romania, then between 1998-2003, 191 beavers were reintroduced into the main river basins of the country (Mures River, Ialomita). Sixteen years after the reintroduction, the beaver population has increased to an estimated 1500 individuals. Even if at the time of reintroduction, studies predicted positive attitudes for both authorities and the local population. After becoming a part of the European Union and the development of hydrological

infrastructure projects, the establishment of compensations in agriculture, communities have changed their favorable attitudes imposing management measures to mitigate these conflicts. A number of management issues that are favorable to beaver populations including: stray dogs, overgrazing, burning vegetation, habitat fragmentation through the construction of dams and small hydropowers, regulation works of river beds, drainage and consolidation of banks allow for an increase in the beaver population. Conflict prevention measures adopted so far can solve some of these, but serious issues remain and these must be addressed in order to maintain conservation, biodiversity laws, and community development.

**Thursday, July 30, 2015**

## **Plenary**

### **Session 68: Hunting as Sustainable Wildlife Management**

#### **6801 Hunting as Sustainable Wildlife Management**

**Leonid M. Baskin**, Institute of Ecology and Evolution, Moscow, Russian Federation. Contact: baskin@orc.ru

During 1650-2015, in the territory of the former Soviet Union, numbers and distribution of game species fluctuated from abundant to extirpate to restore. We developed an index to abundance for the 'tsar' year and for the later period; we used modern estimations of game animal's numbers. In addition, we collected data on annual crop of fur animal's pelts and awards for killing predators. Therefore, we were able to discover correlations with the main variables as forestation, human population's density, as well as relationship of predator and prey species. Our analysis illustrates periods of famine and social turbulent times strongly influenced subsistence hunting. We compare different types of hunting (professional, subsistent, sport) in two different parts of Russia - European and Siberian. In vast Russian plain, forest is only shelter for large mammals. However, low fragmentation and visibility characterize forest's fitness as a refuge. In Siberia, professional and subsistent hunting correspond with fluctuations of species' numbers and migrations. Ethic attention at animals in archaic and modern society is important factor in species conservation or extermination. We observe that totalitarian regime of Soviet Union ensured restoration of game species but after socio-economic revolution of 1991, the new decline occurred because of limited game management. There are a number of potential causes for this trend, some species developed behavioral adaptations, and professional hunting negatively affected population as well as habitat fragmentation. Our 300-year-long data set of wildlife management demonstrates the role of regulated hunting as a necessary method of sustainable wildlife management. Currently in Russia a trend in the privatization of hunting grounds, while maintaining the state control on hunting on valuable game species is growing introducing a new model for the management of game in Russia.

#### **6802 The North American Model of Wildlife Conservation: Past, Present, and Future**

**Darren A. Miller**, Weyerhaeuser Company, Columbus, MS, Contact: darren.miller@weyerhaeuser.com

The North American Model of Wildlife Conservation (hereafter, Model) is a set of 7 principles, developed separately but in concert with each other, and first formalized as "The Model" by Dr. Valerius Geist in 1995. However, conceptualization of the model began at the turn of the 20<sup>th</sup> century as North American wildlife and wildlife habitat, after decades of unsustainable exploitation, was near the brink of no return; for some species, such as passenger pigeons (*Ectopistes migratorius*), it was already too late. The dramatic decline of wildlife resources led to development of a conservation ethic, championed by conservation leaders who were also largely sport hunters, that was instrumental in significantly changing North Americans' view of wildlife resources and advancing policies and practices that, in concert with recovering wildlife habitat conditions across



the continent, led to recovery of most wildlife populations on the continent. Today, the Model is viewed as foundational to arguably the most successful system of conserving wildlife resources ever conceived and one that is based largely on sustainable hunting as a key driver. I will discuss the historical roots of the Model and briefly describe each of the model's 7 tenants: (1) wildlife is a public trust resource; (2) markets for dead wildlife should be eliminated; (3) wildlife should be allocated to the public by law rather than by market, land ownership, or other privileges; (4) wildlife should only be killed for legitimate reasons such as food, fur, and personal or property defense; (5) wildlife is an international resource; (6) science should be the basis for wildlife conservation decisions and policies; and (7) hunting is an activity open to all citizens.

# Symposia and Contributed Papers

## Session 69: Bird Migration Tracked by Radio Telemetry

### 6902 Migration Patterns for Cinereous Vultures Tracked by Using GPS and Mobile Phone Based Telemetry System in East Asia

**Hansoo Lee**<sup>1</sup>, In Kyu Kim<sup>1</sup>, Oun Kyong Moon<sup>2</sup>, Woon Kee Paek<sup>3</sup>, Richard P. Reading<sup>4</sup>, David Kenny<sup>4</sup>,  
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The Cinereous Vulture (*Aegypuis monachus*) is the largest raptor in East Asia. The vulture's primary breeding ground is Mongolia. Adults and many juveniles remain in Mongolia year round. But we have discovered that some of young vultures leave Mongolia in the winter. South Korea, China and Southern Mongolia are important wintering grounds for these young vultures. In order to better understand the migration patterns for Cinereous Vultures which migrate between the Republic of Korea, China, and Southern Mongolia and Mongolia we used the WT-200 (GPS and Mobile Phone Based Telemetry System). This is a new telemetry device designed and engineered by KoEco. This device when attached on free-ranging wildlife will record GPS coordinates at programmed time intervals and transmit the data at programmed time intervals using the public mobile phone systems. Researchers can retrieve the tracking data at the KoEco website. We captured vultures at Goseong, Korea using a baited cannon net system. In January 2014 we deployed 9 WT-200 transmitters. The birds migrated north to Mongolia in March and April. We believe they travel individually and not in groups. During the summer season they remained in Mongolia until October. From November to December, three vultures with the telemetry devices successfully returned to Korea. In the wintering ground they remained in close proximity to vulture restaurants in the southern part of the Republic of Korea. Thus, their wintering home ranges were correlated with the presence of an artificial food supply. In the summer time the telemetry data demonstrated the vultures were utilizing broad areas both east and west of Ulaanbaatar in Mongolia.

### 6903 Post-Fledgling Habitats and Wintering Grounds of Juvenile Black-Faced Spoonbills Tracked by GPS and Mobile Phone Based Telemetry System

**Hansoo Lee**<sup>1</sup>, In Kyu Kim<sup>1</sup>, Ki Sup Lee<sup>1</sup>, Si Wan Lee<sup>1</sup>, Dal Ho Kim<sup>1</sup>, Seung Woo Han<sup>1</sup>, Shin Jae Rhim<sup>2</sup>, Jung Hoon Kang<sup>3</sup>, <sup>1</sup>KoEco, Daejeon, Republic of Korea; <sup>2</sup>Chung-Ang University, Ansong, Republic of Korea; <sup>3</sup>National Research Institute of Cultural Heritage, Daejeon, Republic of Korea. Contact: hslee0509@gmail.com

Uninhabited islands along the west coast of Korea are the major breeding grounds of the Black-faced Spoonbill (*Platalea minor*). The spoonbill is listed as an endangered species because it has a very small population size. To conserve this species, it is important to know their post-fledgling habitats, stopover sites, and wintering grounds. For tracking spoonbills after fledgling, we used WT-200 tracking devices (GPS and Mobile Phone Based Telemetry System) produced by KoEco. During the breeding season in 2014, we captured and deployed the WT-200 transmitters on the 9 and 5 juvenile spoonbills in Gyunggi and Jeonbuk Provinces at the four breeding islands, respectively. The juvenile

spoonbills used adjacent mudflat area less than 30 km from the breeding islands as feeding and resting areas after fledgling for four months. They started long distance migration in late October. A total of ten juvenile spoonbills successively migrated to nearby countries; seven to China, two to Taiwan and one to Japan. This is the first tracking data to find the migration behavior of Black-faced Spoonbill using this new tracking device. The survival of Black-faced Spoonbill depended on the protection of its critical wetland habitats in both of breeding and wintering ground.

#### **6904 Application of Conservation Physiology Tools to Evaluate Stopover Habitat Quality for Migrating Landbirds**

**Yushi Oguchi**<sup>1</sup>, Robert J. Smith<sup>2</sup>, Jen C. Owen<sup>1</sup>, <sup>1</sup>Michigan State University, East Lansing, MI, <sup>2</sup>The University of Scranton, Scranton, PA, Contact: oguchi85@gmail.com

Physiological markers related to health are important tools in evaluating stopover habitat quality for migrating birds. Stopover habitat is being altered by land-use change such as introductions of exotic shrubs. The nutritional differences in fruits of native and exotic shrubs may manifest as differences in habitat quality between shrublands dominated by these species. We hypothesized that fall migrating landbirds using exotic-dominated habitat in central Michigan, USA experience poorer health, with lower fat gain, baseline immunity, and antioxidant capacity relative to those in the native shrub-dominated habitat. We analyzed blood from two migrating species (gray catbird, *Dumetella carolinensis* and Swainson's thrush *Catharus ustulatus*) captured in native or exotic shrubland in the fall of 2012 and 2013 for triglycerides (fat gain index), five immune parameters, and antioxidant capacity. We also collected fecal samples and assayed fruits for antioxidant capacity and immunostimulatory carotenoids. We found no differences by habitat in any of the measures in Swainson's thrushes. In gray catbirds, triglycerides did not differ by habitat, but individuals in exotic shrubs showed lower levels in two immune parameters compared to conspecifics in native shrubs in 2013. Furthermore, antioxidant capacity of gray catbirds in exotic shrubs was lower relative to those in the native shrubs in both years. Fruit quality and consumption data suggest that these differences in health were largely driven by the relative consumption of the native spicebush (*Libdera benzoin*) fruits. We propose that conservation physiology is a powerful new tool in evaluating habitat quality, particularly in linking habitat attributes to individual health.

## **Session 70: Population Dynamics**

#### **7001 Fifty Years Since the Discovery of the Iriomote Cat: Current Status and Challenges for the Next Fifty Years**

**Masako Izawa**, Nozomi Nakanishi, University of the Ryukyus, Okinawa, Japan. Contact: izawa@sci.u-ryukyu.ac.jp

The Iriomote cat *Prionailurus bengalensis iriomotensis* was discovered in 1965 and recorded as a new species in 1967. This cat is endemic to Iriomotejima Island and is considered a subspecies of the leopard cat that is widely distributed in Asia at present. Although this cat is Endangered on the IUCN Red List, not many subspecies have been described. Its habitat is minimal for felids, and small population is restricted to a small island. Population estimates conducted over a 10-year period show stable populations, with no change in the size of a population comprising 100–130 individuals. Their primary habitat is coastal lowlands; however, recent surveys show wide distributions in inland

mountainous areas as well as evident breeding. Increasing human activities on the island have presented new challenges to maintaining the habitat of this wild cat. In this presentation, we aim to provide an overview of the present habitat of Iriomotejima Island and explain the major challenges for conservation efforts. We believe that the present and future challenges are related to traffic accidents and tourism, and are ever increasing and affecting the ecology of the wild cat. Tourism-related problems arise not only from the volume of tourists but also from the various forms of tourism. Additionally, it is the first factor that possibly alter the inland mountainous environment, which have remained unchanged to date, and could be the foremost in influencing the survival of the Iriomote wild cat.

### **7003 Population Changes of Timber Elephants of Myanmar during the Past Five Decades**

**Khyne U. Mar**, University of Sheffield, Sheffield, United Kingdom. Contact: emaximus2014@gmail.com

Elephants are vital to Myanmar's identity, culture, economy and ecology. Among Myanmar's captive Asian elephant (*Elephas maximus*) population ( $n \approx 5000$ ), over half are owned by the Government. Individual elephants possess a unique registration number where the details of its pedigree and life history are recorded from the day they are born or captured until death, of which their birth origins are referred to as wild-caught and captive-born. Utilizing the logbook biodata of the Government-owned working elephants, I attempt to document how time in captivity influences survival probabilities and reproductive potential in captive elephants. The study population contains 5,292 individually identified captive timber elephants, which were born or captured between 1952 and 2000. Life-table analysis and survival analyses were used to determine the long term sustainability of captive born and wild caught elephants and the patterns of age-specific reproduction and survival. Life-table analysis indicates that the captive-born section of the population is self-sustaining, but that the demographic rates seen in the wild-caught section is not sufficient to maintain a stable population. Survival analyses indicate that males have a higher mortality than females. In adults, wild-caught elephants suffered significantly higher mortality than captive-born elephants, and their mortality differed by capture methods. The reproductive fitness is lower in wild-caught females than captive-born females. This study will provide a better understanding of elephant life history both in this population and more broadly in terms of the life history strategies of long-lived mammals.

### **7004 Long-Term Survival and Reproduction Consequences of Birth Conditions in Asian Elephants**

**Hannah S. Mumby**<sup>1</sup>, Khyne U. Mar<sup>1</sup>, Virpi Lummaa<sup>1</sup>, <sup>1</sup>University of Sheffield, Sheffield, United Kingdom. Contact: h.mumby@sheffield.ac.uk

Elephants invest in producing few offspring over their long lifetimes, making the population management of this endangered species a challenge. Little is currently known regarding factors affecting individual variation in mortality and fertility, such as early developmental conditions. We use a large dataset ( $n = 1078$ ) of female working Asian elephants (*Elephas maximus*) from Myanmar to test these concepts. We analyze the effects of birth conditions, measured as concentration of stress hormones in reproductive-aged females, to categorize birth season into stressful vs. not-stressful periods. We show that the months in which adult females (potential mothers) have highest glucocorticoid concentrations and most intense workload are June to August; with a mean of 68.1ng/g feces compared to 45.6ng/g feces in the other months. Fewer births are recorded in these

months than in the rest of the year. In addition, elephants that are born in these months have lower chance of surviving to age 5. Female elephants born in these months exhibit faster reproductive senescence in adulthood (interaction between age and birth season,  $X^2_1 = 6.07$ ,  $P = 0.014$ ) and have lifetime reproductive success reduced by 15.9% in comparison to their counterparts born at other times of year. These findings have implications for our understanding of demography and conservation strategies in endangered Asian elephants.

#### **7005 Evaluation and Management Strategies for Ungulate Population in Jiangxi Matoushan Nature Reserve: Predicting the Prey-Base from Empirical Field Data**

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In order to implement the project on the reintroduction of the South-China tiger (*Panthera tigris amoyensis*), field surveys were conducted in Jiangxi Matoushan Nature Reserve in southern China. Twelve permanent transects were completed in three distinct functional zones from February to April 2012 and May to July 2013. A total of 112 ungulate signs were recorded on these transects. In addition, 20 camera traps were used to survey ungulates and predators in 2012, while the following year we extended the survey site by using 30 cameras. Overall 6,641 capture events in 2,930 camera days were obtained, presenting a variety of ungulate species: muntjak (*Muntiacus muntjak*), tufted deer (*Elaphodus cephalophus*), serow (*Capricornis sumatraensis*), and wild boar (*Sus scrofa*). Moreover, 6 quadrats were used for a vegetation surveys in different functional zones of the nature reserve. Population structure and composition of ungulates was compared in different functional zones using single factor of variance analysis in SPSS software. Significant differences in the distribution of ungulates were recognized between the core zone and experimental zone but not in other zones due to differences in habitat type and management practices of the nature reserve. Through ArcGIS analysis and Salford Predictive Modeler software we ran several predictive models to understand which areas are most suitable for ungulates. We conclude that muntjac and wild boar are mainly distributed in the experimental zone, while serow are more common in the core zone, while tufted deer are located evenly in the three functional zones. Finally, effective and feasible suggestions on management strategies and techniques for Matoushan Nature Reserve were recommended based on the results and analyses in this study.

## **Session 71: Wildlife Habitat Management –2**

#### **7101 Spatial Heterogeneity of Gut Microbiot Reveals Multiple Bacterial Communities with Distinct Characteristics**

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We analyzed bacterial communities of six distinct gut sites (the food bolus and mucus layer of the proximal small intestine, cecum and distal large intestine), using wild folivorous flying squirrels. We found significant spatial heterogeneity in composition, diversity, and species abundance

distributions (SADs) of gut microbiota, corresponding to physicochemical conditions. High diversity was detected in the mucus layer of small intestine and the food bolus of cecum, followed by the food bolus of large intestine and the mucus layer of cecum, and relatively low diversity in the food bolus of small intestine and the mucus layer of large intestine, likely due to disturbance and resource partitioning. The SADs showed succession-like patterns in the food bolus communities from the proximal to distal gut. Notably, each mucus layer community had a unique pattern different from the food bolus community of the same compartment, with distinct relative abundances of dominant species. In combination with data from other mammalian fecal samples, we concluded that gut microbiota were apparently dynamic in community structure, from low species richness with unequal abundances to high species richness with equal abundances; these findings were interpreted as strong habitat effects on bacterial communities.

### **7102 Comparison of the Nectar-Feeding Behavior of Pollination Partners on *Mucuna macrocarpa* (Fabaceae) Flowers among Three Islands**

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Cross-pollination of the evergreen vine *Mucuna macrocarpa* requires “explosive opening” to expose the stamens and pistil, which are covered by a hard carina. This process depends exclusively on animals (explosive openers). *Mucuna macrocarpa* is widely distributed from Southeast Asia to Japan, and the local fauna differs within its distribution. This study aimed to identify the openers on three islands (Kyushu and Okinawajima in Japan, and Taiwan) and to compare their nectar-feeding behavior. Field surveys were conducted from 2012 to 2014. Automatic video cameras were used to record flower visitors and their behavior. The nose tip of identified openers -used for explosive opening- was measured using specimens. Flower sizes at each study site were also measured. The main explosive openers in Kyushu, Okinawajima, and Taiwan were Japanese macaque, Ryukyu flying-fox, and red-bellied squirrel, respectively. Japanese martens and striped squirrels opened fewer flowers in Kyushu and Taiwan, respectively. With the exception of macaques, openers showed similar opening behavior. They hung from vines or grabbed inflorescences, fixed the flower direction by hand, and then inserted their nose between the banner and wings, and push upon the banner. Japanese macaques held flowers with one hand and opened them with the other. The nose tip of openers, other than macaques, was smaller than the space between the banner and wings of flowers. Rats species and Formosan macaques were observed to pick off flowers. These observations suggest that the requirements of successful openers are not only head shape and size but, more importantly, their feeding behavior.

### **7103 Managing Woody Encroachment in Arid Ecosystems: A Case for Small Colonial Herbivores**

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We tested the hypothesis that a small, colonial, burrowing rodent suppressed woody plant growth on its colonies. We used 4 black-tailed prairie dog (*Cynomys ludovicianus*) colonies in southeastern

Arizona, USA as our model system (3 of the 4 were inhabited by prairie dogs). We used the uninhabited colony as a control. We cut foliated branches from nearby mesquite trees (*Prosopis* spp.), and inserted the basal ends 10-15 cm into the ground on and around colonies. We measured height, basal diameter, and counted the number of stems on each branch, left them exposed to prairie dogs for 3 days, and quantified disturbance by remeasuring and recounting stems. We installed 4 transects of 20 saplings originating at the center of each colony that extended 100m off of each colony. We used ANOVA to compare the disturbance of saplings on colonies, on the edges of colonies, off of colonies, and at control sites. Saplings on colonies were disturbed significantly more often, and to a greater degree than those on colony edges, off of colonies, and at control sites. Our results suggest that prairie dogs may suppress woody plant growth on their colonies, and could potentially manage woody encroachment. Small, colonial herbivores occur in several other arid regions of the world, and may play a similar role in suppressing woody encroachment.

#### **7104 Effects of Deer Grazing on Vegetation and Ground-Dwelling Insects in a Larch Forest in Okutama, Western Tokyo**

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Sika deer (*Cervus nippon*) have experienced a rapid increase in the Japanese Archipelago. Although the effects of deer grazing have been widely studied, the indirect effects have received little attention. Using an eight-year-old deer enclosure in western Tokyo, we studied the direct effects on plants and the indirect effects on insects and microenvironments. Plant biomass was 14 times higher inside the enclosure than outside. Shrubs (e.g., *Aralia elata*, *Hydrangea paniculata*) and trees (e.g., *Symplocos sawafutagi*, *Clethra barbinervis*) were more abundant inside, whereas only unpalatable trees in poor condition grew outside (e.g., *Pterostyrax hispida* and *Cynanchum caudatum*). In the summer months, the maximum temperature was 8-10° C higher outside the enclosure and humidity was lower. Soil movement was 80 times more pronounced outside than inside. These results suggest that the abiotic environment became less stable for ground-dwelling insects. Carabid beetles were less abundant outside than inside, suggesting that deer grazing reduced plants and subsequently lowered habitat quality for these beetles. In contrast, carrion beetles, dung beetles and camel crickets were more abundant outside. The increase in these insects is attributed to the availability of deer feces and carcasses and is a direct effect of deer presence.

#### **7105 The Interaction of Prey Density and Landscape Vulnerability Shapes the Home Range Use Patterns of Amur Tigers**

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Theoretical and empirical research suggests that home range use patterns of carnivores are driven by the availability of their prey. Availability depends on prey density, dispersion, and accessibility. Thus, carnivores may select habitat where prey are particularly dense or habitat where prey are particularly vulnerable because of the configuration of landscape attributes. We assessed the

influence of prey availability and vulnerability, mapped separately for each of the primary prey species (sika deer, *Cervus nippon*; red deer, *C. elaphus*; wild boar, *Sus scrofa*), on the home range use patterns of Amur tigers (*Panthera tigris altaica*) in Far East Russia over 21 consecutive winters. For accessing availability, we fit negative binomial resource selection functions to the ungulate survey data to predict the relative intensity of use for each of the three primary prey species. The relative vulnerability of prey to tiger predation as a result of landscape structure was defined by fitting a kill site model as a function of landscape attributes alone. We found that home range use patterns were most affected by the interaction of red deer density and red deer vulnerability in the landscape, as well as wild boar density. Models employing parameters specific for preferred prey were more robust than models that summed values across all primary prey species. These results suggest that the home range use patterns of solitary Amur tigers are shaped by patterns of distribution and vulnerability of preferred prey, and emphasizes the importance of evaluating predation dynamics at the level of each prey species.

## Session 72: Population Census Techniques –2

### 7201 Counting Wild Boar: Are All Attempts in Vain? An Approach with Camera Traps 2012 - 2014

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All over Europe wild boar (*Sus scrofa*) population densities are increasing and spreading into agricultural and cultivated regions. As a result economic problems, like field damage and threat of disease outbreak rise. For effective management local density is an essential factor but is often hardly known. Often hunting statistics are taken as estimates, but are dependent on many additional factors like weather, hunters willingness etc. The wild boar is taking a special role among all other terrestrial mammals, due to its cautious behavior and learning aptitude, social behavior, and nocturnal activity. Thus, reliable estimates of this species' density are difficult to obtain. From 2012 to 2014 we conducted several investigations in two different regions with different habitat types (i.e., forest and agriculture dominated land) to estimate wild boar density in Lower Saxony, Germany. The pictures were added to the software "Wild Picture". Differences between the two regions as well as seasonal changes in density and habitat use were observed. The results indicate that camera traps represent a good approach to estimate wild boar density throughout the year, which has a direct benefit for management. Important information on age distribution and annual population growth can be taken into account. On the other hand using wildlife cameras require careful handling and also testing the abilities of the cameras before starting field work. Angle of view, angle of detection as well as the detection reliability are a critical points affecting the results and must be considered regarding when designing the study.



## 7202 Density Estimation of Japanese Black Bear Using Camera-Trap in Fukushima Prefecture

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For the management of Japanese black bear (*Ursus thibetanus*) population, some prefectures have respectively enacted an upper limit for annual captures Japanese black bear in Japan. This limit is determined on the basis of the estimated density. Therefore, some bear density survey methods have been studied to develop investigation techniques that offer highly accurate results at low cost. We attempted to estimate Japanese black bear population of the whole Fukushima prefecture using camera trapping results from our study area at the Ou Mountains. We set 40 camera traps in our study area, distinguished bears from their chest marks and calculated the density using a spatially explicit capture-recapture using Program Density. Our results showed the density estimate was at 0.49 bears per km<sup>2</sup> (95% CI = 0.29-0.81) in our study area. We estimated the hypothetical area of bear habitat in Fukushima prefecture-wide at 5,717km<sup>2</sup> based on the National survey on the Natural Environments vegetation map. We extrapolated the density into this area to estimate the bear population in Fukushima prefecture. The population estimate was at, bears (95% CI = 1654-4610), but confidence interval was larger than previous research. Although application of extrapolated results may under-or over-estimated bear density and population size, this research indicates that Japanese black bear density is relatively high in Fukushima prefecture.

## 7203 Comparison of Camera Trapping Random Encounter Model and Thermal Imaging Distance Sampling in Deer Density Estimation

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Understanding the dynamics of species' populations is essential, whether studying endangered or overabundant populations. Thermal imaging distance sampling has been commonly used to assess deer population size, however camera traps have increasingly been implemented in population monitoring and now, the newly proposed Random Encounter Model (REM) offers a chance for population estimation from camera traps without needing to identify individuals. To investigate the potential of camera traps in deer density estimation, the densities of three deer species (*Dama dama*, *Cervus nippon* and *Capreolus capreolus*) from several different forest blocks across the UK were modelled using both camera trapping REM and thermal imaging distance sampling. In total, 528 deer in 188 groups were observed using thermal imaging over 24 survey nights and simultaneously, 152 camera trap placements were set up across the sites, which accumulated in 561 independent photos taken over 1,510 camera nights. Estimated deer densities ranged from 9-75 deer per km<sup>2</sup>. A high detection rate was recorded by the camera traps and the two modelling approaches showed no significant difference between the abundance estimates ( $n = 8$ ,  $z = -0.48$ ,  $P = 0.32$ ). Because the development of accurate, convenient density estimate models are of particular interest to conservation ecology and game management alike, this study highlights the possibility of camera traps and the Random Encounter Model as an alternative deer density estimation approach.

## **7204 Wildlife Monitoring Network in Hokkaido**

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For conservation and management of wildlife, we need information about their status. Monitoring efforts are thus required. For most cases, however, monitoring efforts are often problem-based and species-specific; it is started only after a problem has become apparent. Because of the lack of efficient monitoring systems for wildlife in general, the recognition of a problem is often belated and when the effort begins, available data are not enough to deal with the problem effectively. To remedy the situation, I have developed techniques for monitoring wildlife in general with middle-to-large-sized species as a primary target. The techniques include camera-trapping tools, a survey method, and a data-processing system which includes data-mapping on Google Earth. Along with the technical developments, I also have built a wildlife monitoring network in Hokkaido in collaboration with various parties, including forest management and wildlife research organizations. The first monitoring started in 2006 and at present, monitoring surveys are conducted once or twice a year at 16 sites in Hokkaido. The framework of the network is as follows: our institute supports the monitoring surveys by providing necessary techniques and advice. In exchange, the data are shared. The data are managed and utilized locally by the organization that conducted the surveys. All the shared data are managed at our institute and utilized at larger scales. The results are open to the public at the following website: <http://cse.ffpri.affrc.go.jp/hiroh/wildlife-monitoring>. This monitoring system can constitute a useful information infrastructure for wildlife management.

## **Session 73: Human Dimensions**

### **7301 Sociological Approach to Human-Wildlife Conflict in a Predator Guild Composed of Snow Leopards, Grey Wolves and Dholes in the Pamirs of Northwestern China.**

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We conducted a sociological questionnaire survey of the herders from local communities in Taxkorgan Nature Reserve, located in the Pamirs of Northwestern China, to investigate conflicts between humans and the carnivore guild composed of grey wolves, dholes and critically endangered snow leopards. A total of 137 predator attacks were reported and 510 livestock (including sheep, goat, yak, cattle, donkey and cow) were killed. Grey wolves and wild dholes were responsible for most of the livestock losses (315 animals killed by grey wolves and 129 by dholes). Snow leopards did not show significant preference for any livestock type (ANOVA,  $P = 0.493$ ) meanwhile wolves and dholes did. The use of guard dogs didn't prevent carnivore attacks ( $P = 0.962$ ) but rearing livestock in pens at night did reduce depredation risk ( $P = 0.027$ ). No compensation policy has been employed in the study area so far but if it were to be developed in the future, most interviewed herders (55 out of 66) would want to receive the compensation in cash, and 9 herders in livestock; insurance was the least popular choice ( $n = 2$ ). Our study explored the human-predator conflict patterns in the Pamirs of Northwestern China and gave suggestions to mitigate livestock depredation. Policy planning for compensation schemes could also benefit from this research.

### **7302 Various Scale of Collaborative Wildlife Management: Local Resident and Wildlife**

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Human-wildlife conflicts have been escalating in Japan. To mitigate these conflicts, collaborative wildlife management by local residents is an effective damage management method and has been advocated. However, many villages are reluctant to conduct this method. Previous studies stated that the scale of wildlife management caused issues with securing new management plans. However, few studies have attempted to understand scale of collaborative wildlife management. In this paper, I focus on the scale of wildlife management conducted in each village to understand how to manage wildlife by local residents. I interviewed leaders of each village in order to determine the residents' networks involved in the management by semi-structured interviews from August 2010 to September 2014. The study sites were 16 village in Sano City, Tochigi Prefecture. The responses showed various wildlife management scales like neighborhood, village, and several villages. Based on the scale, contents and system of the wildlife management programs differed. The activity scale in each village was decided by village's other activities. In conclusion, to consider sustainable collaborative wildlife management, use of the role of each scale of activities will be important to consider. In addition the transfer of successful wildlife management activities across regions will be important.

### **7303 The Contribution of Biodiversity to the Creation of Contemporary Culture: Quantitative Analysis of Pokémon**

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The biodiversity of wildlife is said to have contributed to the maintenance of traditional culture and linguistic diversity. The conservation of biodiversity for the maintenance of unique cultures and the relationship between cultural and biological diversities are also discussed in terms of "biocultural diversity". The current day imitation of various wildlife species furthermore shows that wildlife biodiversity is recognized as a new resource in creating contemporary culture. This utilization is considered as a "new human dimension" that may affect the conservation of wildlife. Accordingly, the relationship between contemporary culture and wildlife biodiversity is likely to be an important factor in future wildlife management. However, there has been little attention paid to the role of biodiversity in contemporary culture compared to that in traditional culture and linguistic diversity. In particular, it is difficult to quantitatively analyze the contribution made by biodiversity. We therefore conducted a quantitative analysis of the creation of over 700 *Pokémon* characters and their organism motifs. We found that, on average, approximately 60% of *Pokémon* characters have been based on organisms, and that the proportion has increased in the past 18 years. The proportion of organisms identified under the genus level has also risen. This indicates that the creation of diverse characters is likely to be dependent on the biodiversity of usable wildlife motifs. These results suggest that creating diversity in contemporary culture requires biodiversity, and that the conservation of biodiversity is therefore important for maintaining contemporary culture.

## Session 74: Ecosystem Management, Community, Landscapes, Habitat Restoration

### 7401 Population Genetic Structure of the Winkled Frog, *Glandirana (Rana) rugosa*

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Dispersal patterns and geographic isolation associated with landscape structure have been considered major components in shaping the contemporary distribution and genetic diversity of terrestrial animals. Accordingly, insight could be gained into the historical processes of a taxon by analyzing its population genetic structure. We performed genetic analyses of the wrinkled frog, *Glandirana (Rana) rugosa* (Anura; Ranidae), native to East Asia, using mitochondrial and nuclear loci to reconstruct its complete evolutionary history and ultimately to provide a framework for future management efforts. The mitochondrial data revealed a marked level of spatial structuring in *G. rugosa* populations corresponding to the pattern of geographic distribution. First, the genetic differentiation between populations from Korea and Japan was substantial, indicating a long history of allopatric divergence between the two regional groups. Second, the Korean and Japanese populations were likely partitioned into two and five genetic clusters, respectively, and the genetic differences among clusters within regions were high enough to classify them as independent evolutionary significant units. To confirm the mitochondrial data, we examined the genetic diversity and patterns of gene flow of the species using up to seven microsatellite loci, and resolved the relationship of *G. rugosa* with related species and its phylogenetic placement within Ranidae.

### 7402 Conservation and Management Planning of the *Rana plancyi chosonica* Habitats in Central Park, Jangnam Plain, Sejong City, Republic of Korea

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The study site Jangnam Plain in Sejong City, Republic of Korea was the floodplain of the Geumgang River in the past. Jangnam Plain was developed to cultivate rice in the 1950s. Since 2005, Jangnam Plain was promoted to urban development with a plan to fill the rice paddy in order to create a Central Park. Due to the 2011 biotope survey by Chungnam Development Institute, Jangnam Plain was identified as the habitat for *Rana plancyi chosonica*, endangered wildlife (class II) designated by the Ministry of Environment. Local residents and environmental groups claimed the need to preserve the habitats of *Rana plancyi chosonica* community, so the development project was stopped. This study was performed to mediate between the development plan of Central Park in Sejong City and conservation of the *Rana plancyi chosonica*'s habitat. We investigated the location and population of *Rana plancyi chosonica* from May to July 2013. The home range area of that was 870,586 m<sup>2</sup> and the populations of that was 806 individuals. We suggest that the habitats of *Rana plancyi chosonica* communities should be preserved to encompass about 1.6 km<sup>2</sup> for 1,500 individuals of *Rana plancyi chosonica*. We suggested the principles of management in order to

preserve the habitats including the need to properly supply the water and to enforce organic farming in order to ensure the habitat of *Rana plancyi chosonica*.

**7403 Biodiversity Assessment of Factors Affecting the Management of Wetland Riverine System of National Chambal Sanctuary in Rajasthan, India**

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Chambal River is an important inland water source for irrigation in Eastern Rajasthan. Three major, 12 minor and hundreds of micro dams are constructed for development purposes. Many more proposed dams are threatening to kill the river ecosystem. The low river flow is seriously threatening the integrity of the river system and simultaneously the many threatened and critically endangered species. Many communities are dependent on the river for their survival. The survival of the species is depended on the minimum water flow of the river; populations of these river-dependent species can be used as indicators for measuring the health of the ecosystem. The gharial (*Gavialis gangeticus*) was once abundant in Chambal and other rivers is now highly endangered mainly because of land use changes, destruction of nesting sites, fishing nets and collection of eggs for consumption. Fresh water dolphin, (*Platanista gangetica*) once common, are now restricted to the lower stretches of the river. Smooth coated otters, fresh water turtles are key fresh water animals and are now restricted to a few pools. This study emphasized ecological monitoring of Chambal river basin with special reference to water requirements of key aquatic species, socio-economic conditions of villages along river, and ecosystem services in the development of a long term monitoring program for five years. The proposed study aims to assess the impact of the major irrigation, multipurpose projects on the water flow, water quality and populations of key species.

**7404 Analysis of Conflict between Wildlife Habitat Conservation and Potential Resource Development in the Muskwa-Kechika Management Area, British Columbia, Canada**

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The Muskwa-Kechika Management Area in British Columbia, Canada, maintains one of the most diverse large-mammal assemblages in North America. Our objective was to assess possible conflict between conservation of wildlife habitats and natural resource development. We created GIS layers of resource potential for oil and gas, minerals, forest products, and wind power from spatial data on topography, geology, resource inventory, and resource infrastructure; they were integrated into a cumulative resource potential layer and a Shannon diversity layer of resource potential (resource-diversity potential). Overlaps of highly suitable species-specific habitats with areas of high cumulative resource potential and with areas of high resource-diversity potential were used to determine the relative likelihood of habitat alterations that could have detrimental consequences. High-value habitats for moose (*Alces alces*), elk (*Cervus elaphus*), and wolves (*Canis lupus*) overlapped with areas of high cumulative resource potential and areas of high resource-diversity potential at high levels (21-43%) across seasons. High-value habitats for woodland caribou (*Rangifer tarandus*) overlapped with areas of high cumulative resource potential more in winter (23%) than in

the growing season (5%), whereas high-value habitats for mountain goats (*Oreamnos americanus*) overlapped with areas of high resource-diversity potential more in winter (43%) than in the growing season (19%). High-value habitat for grizzly bears (*Ursus arctos*) overlapped areas of high resource-diversity potential more in autumn (25%) than in spring (16%). High-conflict areas for each species were mapped across the landscape to help minimize future industrial alterations to habitats that could compromise the dynamics of this wildlife system.

#### **7405 Norm Localization in Domestic Practices: Implementation of the Convention on Biological Diversity in Japan**

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There has been an emerging international norm in favor of the protection of biodiversity. In many states governmental actions of natural resource management have been largely “environmentalized” since the 1990s. Japan has been an important contributor to this development; however it has been slow to implement its international obligations into domestic legislation. Recently some progress has been achieved given the pressure of domestic environmental movement. The Japanese Government enacted the 2008 Basic Act on Biodiversity and the hosting of the 10th meeting of the Conference of the Parties to the CBD (COP10) for the CBD in Oct.2010 has raised public and governmental awareness of the issue. This paper analyzes the norm localization process of the CBD in Japan through an investigation of three components of the socialization process: 1) state socialization (state actors including local government); 2) societal actors (non-governmental movements and interest groups, etc.); and 3) the market participants. The paper argues that the resultant cultural match and changes in behaviors through this localization process has not proceeded to the point that the Japanese government has fully implement and internalized the norm. There is not yet a robust policy and legal apparatus to preserve biodiversity under the convention in Japan. However, the steps taken so far create the prospect of building the new “green innovation” project in East Asia that could be comparable to Natura 2000. It also recommends additional steps that can be taken to further protect biodiversity in Japan.

## **Session 75: Marine Mammals –2**

#### **7501 Fractal and Sound Frequency Spectral Analyses of Humpback Whale Songs in the Western Waters of Okinawa Island, Japan**

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North Pacific humpback whales (*Megaptera novaeangliae*) migrate to their breeding areas in lower latitudes in winter, including the western waters of Okinawa Island, Japan where the bottlenecked population of humpbacks is increasing drastically in recent years. Male humpbacks emit unique calls known as “songs”, during their breeding season. Although the role of the songs is considered relating to the female mate selection and competition among males, the ecological role of the songs remains unclear. The aim of this study is to provide the novel information on the ecological role of

the songs from the observation of the complexity and peak frequency in the songs. The complexity and peak frequency in the total of twenty-eight independent song sessions that were recorded through January to March off the coast of Kerama and Ie Island from 1999 to 2013 were analyzed using two different kinds of methodologies: 1) the fractal dimensional method and 2) frequency spectral analysis method. Throughout 15 year periods, there are significant increase of the structural irregularity in high-frequency band in the songs ( $P < 0.01$ ), and the peak frequency tends to rise. These results indicate that the structural patterns and frequency band become diverse from year to year. This phenomenon may be possibly-caused of the population increment in this area due to the conceivable reasons such as the reproductions among the population and/or the ingressions from other breeding areas in these years. Qualitative evaluation for the complexity of the songs provides the critical information for understanding the ecological role of the songs.

### **7502 The Morphology of the Pelvic Bone and Femur of Bryde's and Sei Whale**

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Little is known on the morphology of the pelvic bone and femur of modern cetaceans. The present study morphologically examined the pelvic bone and femur among 25 Bryde's whales (*Balaenoptera edeni*) and 51 sei whales (*B. borealis*) collected through the JARPNII program in the western North Pacific. Through examination it was indicated that the pelvic bones of both species shared very similar shape as that the cranial part was elongated, mid-lateral part had a process protruding externally; the length was about 2% relative to the body length (mean: Bryde's whale, 1.95%; sei whale 1.96%); the bones were thicker and narrower in males than in females, and the mid-lateral process of the bone located more caudally in females than males (Mann-Whitney *U* test;  $P < 0.05$ ). For Bryde's whales, the cranial parts were sometimes missing and somewhat twisted in females. Most of sei whales (38/51) had large femurs and Bryde's whale (1/25) had small femur with no femur confirmed in others. Comparing the present result with published records, there is the sexual dimorphism in the shape that pelvic bones which were narrower in males than females in Bryde's and sei whales. Such morphological variations in the pelvic bone and femur are thought to be species or sub-species specific features.

### **7503 Inter- and Intra-Oceanic Morphological Differences in the Flipper White Patches of Common Minke Whales**

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Common minke whale *Balaenoptera acutorostrata* is distribute all around the world. From genetic studies, the North Pacific and the North Atlantic populations are divided at the subspecies level and also the existence of two stocks in the North Pacific is reported. On the other hand, little morphological evidence is available to support such stock separation. The present study examined the morphological variation in pattern of the white patch on the flipper to find out inter- and intra-

oceanic differences so as to clarify stock structure for improvement of stock management. The photographs of and around the flipper from the North Pacific ( $n = 240$ , collected from the JARPNII), southern hemisphere ( $n = 14$ , collected from the JARPA) and from the North Atlantic ( $n = 13$ , cited through some websites) were used for the analysis. The proportion of white patch area to the flipper area was relatively smaller in the North Pacific than in the North Atlantic. The contour of the boundary of the white patch was almost straight in the North Atlantic, whereas that of the North Pacific was the waved line. It was also indicated that the ratio of white patch area and the contour of the boundary were different within the North Pacific, which were closely related to genetically-based stock identification. This study revealed that there are clear morphological inter- as well as intra- oceanic differences on the flipper. It would be valuable information not only for taxonomy but also for the stock based management of this species.

#### **7504 Distribution of Pacific White-Sided Dolphin, Dall'S Porpoise and Harbor Porpoise around Hokkaido, Japan**

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We compared the environmental requirements and the niche overlap of Pacific white-sided dolphin, Dall's porpoise and harbor porpoise in an area of sympatry. Cetacean sighting surveys were conducted around eastern Hokkaido onboard T/S Ushio maru from July to October in 2009, 2011-2014. To estimate of niche overlap, suitable habitats were calculated using dolphin's presence locations and environmental factors (water depth, sea surface temperature and distance from the land) using Software Maxent. Secondly, niche similarity index (Schoener's D, 0: no overlap ~ 1: identical distribution) was calculated using suitable habitats map by Software ENM tools. The number of Pacific white-sided dolphins was 1996, Dall's porpoise was 1893 and harbor porpoise was 47. Pacific white-sided dolphins were around northeast Hokkaido, which was a shallow area where water depth was less than 100 m, whereas Dall's porpoise were off the southeast and northeast of Hokkaido, where water depth was deeper than the former. Harbor porpoises were in the entire coastal waters of the survey area, which was intermediate water depth of the preceding species. The niche overlap between Pacific white-sided dolphin and harbor porpoise was high (D: 0.637), however, interspecific competition probably was low because of diet differences. The former mainly feed on epipelagic fishes, while the latter feed on epipelagic and midwater fishes. The niche overlaps between Dall's porpoise and Pacific white-sided dolphin, Dall's and harbor porpoises were low (D: 0.196, 0.393). Dall's porpoises mainly feed on midwater fishes, so they were probably distributed in the areas of deeper water.



## Session 76: Ecology and Management of Primates

### **7601 Habitat Use of Bonobos for Ranging, Feeding and Night-Sleeping At Wamba, Democratic Republic of the Congo: For Linking Long-Term Behavioral Observations to Conservation Management**

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Understanding the habitat selection of endangered species is essential for effective conservation management. We examined annual habitat use of a group of bonobos (*Pan Paniscus*) in the Wamba field site within the Luo Scientific Reserve, northern Democratic Republic of the Congo. Using satellite imagery, we categorized the group's home range into three forest types: 1) primary forest (P/OS), 2) young secondary forest and agriculture (YS/Ag), and 3) swamp forest (Sw). We tracked the group for 1 year and compared usage of the three forest types for ranging, feeding, and night-sleeping. The group ranged and fed disproportionately more often in P/OS and less often in YS/Ag and Sw than expected based on habitat availability. Also, the group slept mostly in P/OS (94% of nights monitored). In June, when a fruit species selectively eaten by bonobos was generally abundant in Sw, the group mostly ranged and slept there. Bonobos fed on herbaceous plants most often in YS/Ag, but they also fed more on various types of food in P/OS and Sw. Fruit availability in P/OS had no significant effect on habitat selection, but the group fed in YS/Ag most often during the two months when fruits in P/OS were least abundant. Semi-open habitat with abundant herbaceous plants, such as YS/Ag, may provide fallback food for bonobos through a year. Sw can be a main habitat seasonally to complement P/OS. We highlighted the importance of minor-use habitats, such as inundated and human-modified areas, that may be underestimated by only counting nest locations.

### **7602 Diurnal Resting Site Selection and Daytime Feeding Behaviour of Wild Malayan Flying Lemur, *Galeopterus variegatus*, in Western Java, Indonesia**

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We studied diurnal resting tree selection and daytime feeding behavior of wild Malayan flying lemur (*Galeopterus variegatus*) in West Java, Indonesia between 2011 and 2013 to address their relationships with forest structure. The flying lemurs holding onto tree trunks were observed on 184 occasions. The flying lemurs were observed to use up to 33 different tree species as diurnal resting place. Fourteen out of 33 species were preferred for their densities, while three species were not preferred. No clear relationship between the degree of preference and tree density was found. At the landscape level, flying lemurs preferred taller trees and areas with relatively low tree coverage. Flying lemurs were observed feeding mainly on the young leaves of nine different tree species during the daytime. This study found that it is important to protect isolated tall trees for the flying lemurs, perhaps because it is advantageous for long-distance flying and/or predator avoidance.

Some of the diets were newly recorded, while several plants which were previously known as food items were not consumed in this study site.

### **7603 Ruminant-Like Primate, Proboscis Monkey in Borneo: Physiological Similarity and Difference from Functional Ruminants**

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Although foregut fermentation is often equated with rumination in the literature, functional ruminants (ruminants, camelids) differ fundamentally from non-ruminant foregut fermenters (*e.g.* macropods, hippos, peccaries). They combine foregut fermentation with a sorting mechanism that allows them to remasticate large particles and clear their foregut quickly of digested particles; thus, they do not only achieve high degrees of particle size reduction but also comparatively high food intakes. Regurgitation and remastication of stomach contents have been described sporadically in several non-ruminant, non-primate herbivores. However, this so-called “merycism” apparently does not occur as consistently as in ruminants. For primates, we described regurgitation and remastication in free-ranging individuals of the foregut-fermenting proboscis monkey (*Nasalis larvatus*). In addition, to test whether proboscis monkey has exceptional chewing efficiency among primates, as ruminants have among mammals, we compared fecal particle size in free ranging specimens with those of 12 other primate species. While we cannot exclude other reasons for the exceptional chewing efficiency in proboscis monkeys, our results represent circumstantial evidence for regular use of rumination in this species. Lastly, we discuss the similarity and difference between this ruminant-like primate and functional ruminants in terms of their digestive systems.

### **7604 Adaptation to a Snowy Environment: Biogeographical Patterns in the Diet of the Japanese Macaque, *Macaca fuscata*, and Their Environmental Determinants**

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In order to ascertain environmental determinants, we reviewed spatial patterns in the diets of Japanese macaques *Macaca fuscata* in relation to geographical and environmental variables. We collected data using food composition lists, main food composition lists, and percent feeding time percentage, from the entire range of this species (48 studies from 29 sites). We performed correlation analyses and compared mean percentage values of each dietary component and food type to ascertain spatial patterns over the range and between forest types. We then conducted model selection to identify the environmental determinants. Japanese macaque diets were mainly composed of fruits, seeds, and foliage throughout the entire range, but the percentage of other components varied (*e.g.*, populations inhabiting higher elevations mainly fed on bark and buds). Many of the dietary spatial patterns, however, were more correlated with environmental variables than with geographical variables. Mean temperature, snow characteristics, and the normalized difference vegetation index (NDVI) were significant environmental determinants of spatial variations

in diet. Spatial patterns in food diversity, however, were not detected, perhaps because instead of the animal matter that was eaten in southern Japan, bark or buds were eaten in northern Japan, and the species never became a specialist. There were no significant differences in these trends between the different methods. When studying biogeographical patterns in the feeding behavior of mammals, environmental rather than geographical variables should be investigated, since the former's effect is sometimes independent of the latter's. We should pay attention not only to temperature and primary productivity, but also to snow characteristics.

#### **7605 Anthropogenic Effects and Ecological Influences on the Terrestriality of Bornean Orangutans (*Pongo pygmaeus morio*) in Multi-Functional Landscapes**

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Forested habitat for orangutans (*Pongo pygmaeus morio*) in Kalimantan has been fragmented into smaller habitats of various size. These habitats are distributed within multi-use, human-dominated landscapes and include conservation forest, logging concessions, karst forests, forest plantations, reclamation areas post-mining, and oil palm plantations. Orangutans are typically arboreal and exhibit many morphological adaptations to arboreal locomotion, but our study shows that in degraded forest landscapes Bornean orangutan often travel on the ground. A study of terrestriality of the Bornean orangutan has important implication for understanding their behavioral adaptations and strategies for living in the human dominated landscape. The combination of methods used in this research include indirect survey techniques using nest surveys and camera trapping, combined with vegetative plots to assess habitat quality and forest cover. Our results indicate that terrestriality of the Bornean orangutan is influenced not only by the quality of forest habitat (e.g., forest structure and composition, canopy connectivity) but also by the age-sex classes of orangutans, the tree species that are planted in that landscape, fruit availability, the distance of the landscape to human villages, and the size of fragmented landscape.

### **Session 77: Wildlife Disease and Toxicology**

#### **7701 Genetic Diversity and Phylogeography of Asama Virus in the Japanese Shrew Mole (*Urotrichus talpoides*)**

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Recent discovery of genetically distinct hantaviruses, including Asama virus (ASAV) in the Japanese shrew mole (*Urotrichus talpoides*) from Mie Prefecture, challenges the long-held view that rodents are the principal reservoir hosts and raises the possibility that soricomorphs may have played an important role in the evolutionary history of hantaviruses. The existence of two distinct chromosomal races of *U. talpoides*, geographically separated by the Fuji and Kurobe rivers in central Honshu, provided an opportunity to study the genetic diversity and phylogeography of ASAV in Japan. Lung tissues of 35 Japanese shrew moles, captured in Ehime, Niigata, Gunma, Okayama and

Wakayama Prefectures between 2007 and 2014, were analyzed for ASAV RNA by RT-PCR using oligonucleotide primers based on sequences of known hantaviruses. ASAV RNAs were detected in Japanese shrew moles from Niigata, Gunma and Okayama Prefectures. Pair-wise alignment and comparison of entire S, M and partial L-segment sequences showed similarities of 78.3-80.4% and 86.6-90.0% against prototype ASAV strains at the nucleotide and amino acid levels, respectively. Phylogenetic analyses of the newly acquired sequences, generated by Bayesian methods, indicated topologies suggestive of geographic-specific clustering, similar to the phylogeography of soricid- and rodent-borne hantaviruses. Host mtDNA sequence analysis indicated two distinct lineages of Japanese shrew moles, congruent with the ASAV genetic diversity. The close genetic and phylogenetic relationship between ASAV strains and hantaviruses harbored by soricine shrews in Eurasia suggests a possible host-switching event prior to the migration of ancestral shrew moles to Japan, hundreds of thousands of years before present.

#### **7702 Management of Infectious Canine Hepatitis in Red Foxes (*Vulpes vulpes*) in Wildlife Rehabilitation Centers in the United Kingdom**

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Populations of red foxes (*Vulpes vulpes*) are rapidly adapting to man-made environments, and often come into direct or indirect contact with humans. Foxes are frequently presented to veterinarians and wildlife rehabilitation centers in Europe. Groupings of foxes are common in such settings and this can be problematic in terms of the spread of disease. The aim of this study was to investigate outbreaks of mortality due to infectious canine hepatitis at two wildlife rehabilitation centers in the United Kingdom, and to assess management factors which may have contributed to these outbreaks. Disease occurred mainly in juvenile foxes held in groups of three to eight animals in small enclosures. The foxes died after exhibiting clinical signs including neurological signs and jaundice for 1 to 2 days. Four red foxes submitted for postmortem examination had enlarged, congested livers. Histopathology revealed severe, diffuse, hepatocyte dissociation and necrosis. Intranuclear inclusion bodies were present in hepatocytes and in renal glomerular and tubular epithelial cells. Canine adenovirus type 1 was detected by the polymerase chain reaction in tissues and the identity of the virus was confirmed by sequencing. It is concluded that congregation of juvenile foxes in wildlife rehabilitation centers is a risk factor for outbreaks of fatal infectious canine hepatitis. Management strategies to reduce the risk of spread of disease in groups of captive, free-ranging canids include quarantine, disinfection of premises and vaccination. An understanding of the epidemiology of the disease in free-ranging populations of canids will help to guide management strategies in captive foxes.

### **7703 Response to Oxidative Stress of the Japanese Field Mouse Living in the Site Contaminated by Radioactive Substances**

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In 2011, a large amount of radioactive materials was released from the Fukushima Daiichi Nuclear Power Plant. In Fukushima, all of wild animals and plants are left behind a high radiation-dose area, and therefore they are still exposed to radiation. Radiation induces DNA mutation followed by DNA damage such as strand breakage by ionization and or oxidative stress. If such adverse effects of radiation occur in germ cells, unexpected mutations may accumulate in future generations through inheritance. The aim of this study is to clarify the DNA damage caused by radiation to the Japanese field mouse (*Apodemus speciosus*) which is widely distributed in the lowland forest of Japan. Mice were collected from a high radiation-dose site (Fukushima) and two lower radiation-dose sites (Toyama and Aomori) in 2012. The accumulation of 8-hydroxy-2'-deoxyguanosin (8-OHdG) which is a marker for oxidative stress and expression of DNA repair enzymes, 8-oxoguanine glycosylase (OGG1) and superoxide dismutase 1 (SOD1), in testis were determined. Furthermore, gene diversity for mtDNA and microsatellites were also performed. The mice collected from Fukushima showed higher accumulation of 8-OHdG and higher expression of OGG1 and SOD1 in testis than those from lower radiation-dose sites. However, there was no difference in gene diversity among different radiation-dose sites. These results suggest that germ cells of the Japanese field mice living in highly radiation-dose area induced oxidative stress but DNA damage was reduced by the expression of anti-oxidative or DNA repair enzymes. As for gene diversity, this species may potentially have high genetic diversity therefore further study using wider range of genetic regions is required.

### **7704 The Distribution and Time-Series Variations of Concentration of Radio-Cesium in the Body of Wild Boars and Sika Deer**

**Masaaki Koganezawa**<sup>1</sup>, Kei Okuda<sup>2</sup>, Yuuji Kodera<sup>3</sup>, Emiko Fukui<sup>3</sup>, <sup>1</sup>Utsunomiya University, Utsunomiya, Japan; <sup>2</sup>Fukushima University, Fukushima, Japan; <sup>3</sup>Utsunomiya University, Utsunomiya, Japan. Contact: masaakik@cc.utsunomiya-u.ac.jp

Because of the Fukushima Daiichi nuclear accident in March 2011, radio-cesium was released into a wide range of areas, and hence, wild animals were also contaminated by the radioactivity. However, sufficient knowledge has not been accumulated in terms of the distribution or time-series variations of the concentration of radio-cesium internal to the body of wild animals or whether differences exist or not in those among species and regions. In this research, the muscles, the organs, and the gastrointestinal contents were removed from the deer (*Cervus nippon*) captured in Nikko area and the wild boars (*Sus scrofa*) captured in Nakagawa area in Tochigi Prefecture, central Japan between 2011 and 2015, and the concentration of radio-cesium was measured. Then, comparisons were made with respect to the distribution and time-series variations of the concentration of radio-cesium internal to the body of these two species. The concentration of radio-cesium within the muscles of wild boars was also examined to find the regional differences in the time-series variations using the wild boars captured in Tochigi and Fukushima Prefectures between 2011 and 2014. The results of the research will be reported in this presentation.

## Session 78: Hunting as a Tool for Wildlife Conservation

### **7801 Management and Challenges of Ungulates in North America**

**Paul Krausman**, University of Montana, Missoula, MT, Contact: Paul.Krausman@umontana.edu

The North American Model of Wildlife Conservation had its genesis, in part, with the conservation of native ungulates. Thus, it is important to understand what these species are and how they have been and are, currently, managed. Ungulates are hooved quadrupeds that include those that are odd-toed (e.g. tapirs [*Tapirus bairdii*]) and even-toed (e.g. deer). Contemporary management of the ungulates evolved through three stages: exploitation, concern for survival and conservation through wise use. The success of conservation of ungulates has been attributed to the merger of biology, an understanding of habitat and the role of human dimensions. This triad of wildlife management has been effective. Most ungulate populations in North America have been restored; viable populations exist. Challenges to the conservation of large mammals remain, however, including increased human population growth, climate change and sources of funding.

### **7802 Hunting, Conservation, and Waterfowl Management in North America**

**Craig Miller**, University of Illinois, Champaign, IL, Contact: Craigm@illinois.edu

The North American Migratory Bird Treaty (NAMBT) between the United States, Canada, and Mexico was enacted in 1918 in response to rapidly declining populations of migratory birds as a result of commercial uses of feathers and whole birds. This treaty provides for protection of wintering and spring nesting habitats, population monitoring, and regulated hunting. Similar treaties also exist between the United States and Japan and the U.S.A. and Russia. One of the principal outcomes of this treaty was the establishment of waterfowl flyways in North America. However, during the 1980s waterfowl populations dropped to levels not seen since the commercial depredations of the late nineteenth century, and for some species populations reached record low levels. In response to these population declines the North American Waterfowl Management Plan (NAWMP) was adopted between the U.S.A., Canada, and Mexico. This plan, in conjunction with the NAMBT, embraces Adaptive Harvest Management (AHM) to ensure sustainable populations of waterfowl throughout North America. Through AHM hunting is closely regulated to maintain viable populations, and as such provides an important function as compensatory mortality by allowing for the take of surplus birds from breeding populations. In this manner, hunting is closely linked with conservation and sustainability of waterfowl throughout North America. This presentation will focus on the role hunting plays in conservation and maintaining sustainable waterfowl populations in North America.

### **7803 The Origins and Evolution of Regulated Sport Hunting in North America**

**John Organ**, U.S. Geological Survey, Reston, VA, Contact: jorgan@usgs.gov

The origins and evolution of regulated sport hunting in North America are a product of a combination of social, ecological, political, and geographic factors. One cannot fully appreciate or understand regulated hunting in the United States and Canada without knowledge of these factors and how they influenced wildlife and people. Many of these factors converged during the mid-19<sup>th</sup> century to have dramatic effect on people, wildlife, and hunting. Throughout subsequent history,

punctuated events affecting these factors caused dynamic changes that have ultimately resulted in the regulated hunting programs currently in place. The interrelationships among major factors in the 19<sup>th</sup> century including the Industrial Revolution, immigration and burgeoning urban populations, western military campaigns, transportation infrastructure development, social elites and the post-frontier Primitivist movement are described relative to the origins of regulated hunting. Twentieth century influences including the increasing role of government, the emergence of science in wildlife management, the Dust Bowl, post-World War II population expansion, and the environmental movement are analyzed in the context of how regulated hunting evolved from a recreational pursuit to an increasingly important management tool. A vision for the future of regulated sport hunting as a management tool for wildlife conservation, and as a positive cultural influence in society is offered.

#### **7804 Hunting as a Wildlife Management Tool in the United States: Current Controversies and Ethical Considerations.**

**Vanessa Lane**, Agriculture and Natural Resources, Tifton, GA, Contact: [vlane@abac.edu](mailto:vlane@abac.edu)

Hunting is an important part of wildlife conservation in the United States. In 2011, 13.7 million U.S. residents aged 16 years or older hunted, contributing over \$33.7 billion (U.S.) to the national economy. Although hunting has been used as a conservation and economic tool for over 100 years in the U.S., equipment and methods used have changed in effectiveness, quantity, quality, availability, and affordability. Many ethical controversies now exist regarding concepts of sportsmanship, fair chase, public versus private ownership of wildlife, and the use of hunting to manage wildlife populations. Public acceptance is critical for the long-term viability of hunting as a management tool, and varies greatly depending upon wildlife species, hunting methods used, location, and public demographics. I will discuss three current controversies in the United States, their ethical considerations, and how they may affect the future hunting as a conservation tool: 1) improved hunting technology and perceptions of fair chase, 2) high fencing, captive breeding, and the public versus private ownership of wildlife, and 3) the use of lethal versus nonlethal methods to manage wildlife populations.

#### **7805 Use of Hunting to Manage Urban Deer Populations in North America**

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Managing local overabundance of some wildlife species in urban/suburban areas and parks has become a challenge for many wildlife professionals throughout the world. Cervids are perhaps the most challenging overabundant species to manage because they can be either a valued game resource or a pest species, depending on the site-specific location and circumstances. Wildlife professionals must consider complex biological, ecological, sociopolitical, public, and legal issues when attempting to manage locally overabundant deer (i.e., “urban deer”) in urban/suburban areas and parks. For many decades, wildlife professionals in North America have had experience managing locally overabundant white-tailed deer (*Odocoileus virginianus*) populations in these situations, where hunting may not initially be considered as an appropriate management technique. Managing these overabundant deer populations through regulated public hunting often involves diverse, and sometimes controversial, debate among stakeholders. I will summarize several case studies where hunting programs have been used to manage urban deer populations in North America, and will discuss attributes and considerations that have been associated with successfully implemented

urban deer hunting programs. Specifically, I will describe program management objectives, important legal and agency policy issues, hunter selection procedures, weapons authorization or restriction, partnerships with non-governmental organizations, animal welfare considerations, and coordination with media. I will conclude with a discussion of future challenges, opportunities, and specific recommendations for the continued use of hunting to manage urban deer populations in North America.

#### **7806 Hunter Participation in Multi-Landowner Cooperatives: The Case of the Kinzua Quality Deer Cooperative**

**Zuri Kelley**<sup>1</sup>, Shawn Riley<sup>1</sup>, Susan Stout<sup>2</sup>, <sup>1</sup>Michigan State University, East Lansing, MI, <sup>2</sup>USDA Forest Service, Irvine, PA, Contact: kelleyzu@msu.edu

Harvesting of antlerless white-tailed deer (*Odocoileus virginianus*) is important mechanism for managing deer populations that achieve societal goals for the species. Hunting cooperatives, which bring together stakeholders to meet common conservation goals, have been an effective means to achieve desired harvests. The Kinzua Quality Deer Cooperative (KQDC) of northwestern Pennsylvania, USA is an on-going cooperative of forest landowners and managers, wildlife biologists, deer hunters, and local businesses initiated in 2000 to demonstrate how hunting can be used to meet ecosystem goals of multiple stakeholders. My study examined factors contributing to success of the KQDC to reduce deer densities and to assess what motivates hunters to voluntarily participate in antlerless deer hunting in areas with low deer densities such as the KQDC. To determine motivations and perceived constraints to hunting, as well as satisfaction derived from past hunting experience and future willingness to hunt on the KQDC, we surveyed 1,008 hunters who purchased supplemental antlerless deer permits under a “Deer Management Assistance Program” from 2007-2012. We identified a variety of motivations and constraints for deer hunting the KQDC. Yet, hunters were willing to continue hunting on the KQDC despite relatively low deer densities. Cooperative members exhibited characteristics such as effective communication, trust, and propensity to accomplish diverse objectives relative to a shared resource. Our findings suggest that a long-term success of cooperatives depends in part on hunters’ knowledge of and willingness to participate in conservation objectives established by managers.

#### **7807 Age-Specific Antler Size Distribution: An Effective Tool for Managing Cervid Populations**

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Some ungulate populations have been shown to be sensitive to impacts from selective harvest of trophy animals. Targeting a disproportionate number of males based on phenotypic characteristics may cause directional selection, where high-quality males are rare and low-quality males are abundant. The subsequent accumulation of low-quality males may lead to degradation of forage resources, leading to detrimental impacts on management goals. We describe a unique cervid management model based on phenotypic classification that is designed to minimize phenotypic exploitation effects, using white-tailed deer (*Odocoileus virginianus*) as the model species. Individuals are categorized based on their absolute deviation from average within an age-specific antler size distribution. Knowledge of typical antler growth rates allows the manager to generate



selective harvest criteria designed to differentially remove animals from the left side of the distribution earlier in life while protecting animals within the right side of the distribution.

### **7808 Effects of Selective Harvest on Phenotypic Traits in White-Tailed Deer**

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Selective harvest, or culling, is a strategy to increase antler size and manage population structure in cervids. However, the effects of culling on wild populations are not known. Culling will affect the standing crop via removal of individuals with undesirable antler traits. Over time, intensive culling may affect the genetic potential for antler development. The objective of this research was to determine effects of culling on phenotypic traits in male white-tailed deer (*Odocoileus virginianus*) from southern Texas, USA. Three study areas, one subject to intensive culling (14 km<sup>2</sup>), one to moderate culling (72 km<sup>2</sup>), and one as a control (20 km<sup>2</sup>), were used. The intensive treatment culled males at all age classes, while only males aged  $\geq 3.5$  years were subjected to culling in the moderate treatment. We used the helicopter net-gun method to capture deer during 2006 to 2014. We estimated age, and measured antler characteristics and body mass. Deer that did not meet culling criteria for their age class were sacrificed during 2006 to 2012. We captured 4,364 deer and culled 2,226 deer during the study. Culling affected the standing crop of males aged  $\geq 5.5$  years. However, we found no consistent treatment effect in young age cohorts, and thus no evidence the treatment affected genetic potential for antler growth. We observed variation in antler size among treatments for young age classes and a strong interaction between antler size and body mass, indicating environmental effects on phenotypic traits. This study will have important implications for harvest management strategies.

## **Session 79: Feral Cat Issues on Island Ecosystems**

### **7901 Evidence for the Effects of Feral Cats on Insular Wildlife**

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Various types of evidence have been promulgated as proof for the effects of feral cats on wildlife, typically including numerous studies on predation inferred from diet, mortality attributed to pathogens, and photographic or videographic documentation. The strength of these types of evidence is often short of conclusive. For example, studies of predation inferred from diet provide weak evidence for two reasons: 1) they cannot differentiate depredation from scavenging by feral cats, and; 2) they cannot address population-level effects on wildlife because it is rarely understood if mortality acts in compensatory or additive manner. Likewise, pathogens may cause mortality of individuals, but population-level effects of pathogens are rarely known. Photographic or videographic documentation provides direct 'smoking gun' evidence that may be useful for positive identification of depredation by cats, or prey designated as threatened or endangered species. However, the most direct and compelling evidence comes from examples where feral cats have

been entirely removed from islands. In many cases, several species of seabirds as well as other wildlife have recovered after the complete removal of cats. Where possible, the experimental removal of cats would provide the most conclusive proof of effects on wildlife populations. In other cases where cat removal is not feasible, modeling based on predation rates and life history parameters of species may be the only means of assessing population-level effects on wildlife. Understanding population-level effects of feral cats on wildlife will ultimately be necessary to resolve longstanding wildlife management issues.

#### **7902 Feral Cat Predation on Native Species in Amami-Oshima Island, Japan**

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It has been concerned that feral cats *Felis catus* have negative impact on endangered endemic mammals; such as Amami rabbit; *Pentalagus furnessi*, Ryukyu long tailed giant rat; *Diplphrix legata*, and Amami spiny rat; *Tokudaia osimensis* in Amami-Oshima Island where is one of the most biodiversity hot spot in southern Japan. A total of 175 preys were identified in 102 scats collected mainly in habitats of endangered endemic mammals in the island from 2009 to 2011. Among the prey items, mammals were contributed to 95% of frequent occurrence and 97 % of daily consumed biomass (DCB). Especially, endangered endemic mammals were provided 69% of the total DCB by cats (each was as follows, giant rats, 35%; spiny rats, 22%; and Amami rabbits, 12%). The black rat *Rattus rattus* which is abundant as a non-native mammal in the island was identified the second most consumed prey (29%) in feral cat diet. Mean DCB of a cat was estimated as 363.6 g  $\pm$  192.7 SD and maximum was 548g. According to the daily food requirement, we estimated that one cat needs to eat utmost of 1 rabbit, 1.1 giant rat, 5 spiny rats or 3.1 black rats per day. Average of 1.7 preys was predated by one cat/day was recognized. Therefore, this study indicated that feral cats are likely to be having a very significant predation impact on endemic mammals on the island. To ensure the long-term survival of these endemic mammals, urgent and active management of feral cat population should be considered.

#### **7903 Clear and Present Threat by Feral Cats to the World Largest Pelagic Bird Population in Mikura Island, Japan**

**Nariko Oka**, Yamashina Institute for Ornithology, Abiko City, Japan. Contact: oka@yamashina.or.jp

Introduced predators have caused drastic decreases or extinction of native vertebrates on islands. This is true on Mikura Island 220km south of Tokyo (20.6km<sup>2</sup> in area, 851m in altitude, covered with laurel forests and 300 islanders live). It has been a home for the world largest population of streaked shearwaters (*Calonectris leucomelas*). Since the last two decades of 20th century when villager`s life styles changed, feral cats have turned to increase and is estimated to number about 500 cats (24/km<sup>2</sup>) at present. For ten years from 2005 to 2014, 389 feral cats were captured to be sterilized with the average of 44 cats per year (ranging from 17 in 2013 to 104 in 2009), but were released there, as TNR (trap, neuter, release) has been welcomed to Japanese society because of Animal Rights advocates. The shearwaters were estimated to dramatically decrease from 1.7-3.5 millions in 1978 to 0.88 million in 2007. This decrease trend never stopped, down to 0.77 million in 2012. Feral cats (sterilized or unsterilized) may have long-longevity in the warm island with abundant prey

(shearwaters for nine months a year, Japanese wood pigeon and black rats year-round and others). Since 2014, we have introduced ID microchips for all cats captured, to estimate their longevity. In February 2015 we began to take feral cats away to foster parents in the main land and 14 kittens or young feral cats got foster parents. To save the nature ecosystem in the island, we need to find the best mixed way.

#### **7904 Current Status of Cat Managements for Wildlife Protection in the Ogasawara Islands, Japan**

**Tetsuro Sasaki**, Kazuo Horikoshi, Hajime Suzuki, Institute of Boninology, Tokyo, Japan. Contact: sasaki@ogasawara.or.jp

Ogasawara Islands, oceanic islands located about 1,000km south of Tokyo, were registered as a World Natural Heritage Site in 2011. In Chichijima (23.80km<sup>2</sup>, population 2,100) and Hahajima (20.21km<sup>2</sup>, population 450), feral cats have become serious threats to wildlife. Particularly, the red headed wood pigeon (*Columba janthina nitens*) was highly endangered, its population size was estimated 100 birds or less. In 2008, PHVA workshop on the pigeons was held in Chichijima, it was concluded that exclusion of feral cats from the protected area was the top action plan. For a management of pet cats in villages, Tokyo Veterinary Medical Association (TVMA) has voluntarily conducted their sterilization surgeries since 2008. Currently, infertility rate of pet cats in the Ogasawara Islands became 100%. In Chichijima, the feral cat capture program of the whole island by cage traps has been started from 2010. More than 200 cats have been captured and transported to animal hospitals of TVMA in Tokyo so far. The number of feral cats reduced up to about 10% of the initial size. As a conservation target, the pigeons showed a marked population increase since 2012. On the other hand, young pigeons started to appear in the village area, and were attacked by pet cats that partially reared outside. As a significant object remained in Chichijima, trap shy feral cats, have become highly difficult to be caught now. In Hahajima, the capture program is still limited in less than half area of the island.

#### **7905 Impacts of Feral Cats on Seabirds and Its Measures on Teuri Island, Hokkaido, Japan: Aiming for the Co-Existence of Seabirds, Humans, and Cats on the Island**

**Yasunori Takenaka**, Ministry of the Environment, Haboro, Hokkaido, Japan. Contact: yasunori\_takenaka@env.go.jp

Teuri Island in Hokkaido, Japan is 5.5 km<sup>2</sup> in size with ca. 350 people and a breeding colony site of one million seabirds of eight species, including endangered common guillemot (*Uria aagle*) and Spectacled guillemot (*Copphus carbo*). Feral cat population has been increasing and is 200-300 cats in the island. Their predation impacts have been influenced on the seabird nestlings and eggs, and disturbing the breeding colony, especially in recent years. Therefore, the Ministry of the Environment, the Hokkaido Government, the Haboro-Town, the Hokkaido Veterinary Medical Association, and some of animal protection NPOs were set up a conference and have been working together for aiming to establish "No feral cats exist in Teuri Island". In 2012, the Haboro-Town established regulations about registration of pet cats, and has been carrying out spay and neuter programs, and enlightenment activities of proper pet care for residents of the island. Since 2014, the conference has started a feral cat trapping campaign in the breeding colony site. Captured 42 feral cats were sterilized and microchipped, then tamed by staffs of the Hokkaido Seabird Center, animal

hospitals and NPOs, and 17 of them have found their new home. New homes of tamed cats have been searching at cat adoption events by NPOs. To remove all feral cats from Teuri Island, the conference has been implementing enlightenment activities in various places, building a management and a follow-up system to expand volunteers who can tame feral cats, and holding regular cat adoption events.

#### **7906 The Management of Feral Cats on Islands: Is Long-Term Management Ever an Option?**

**Sugoto Roy**, IUCN, Gland, Switzerland. Contact: [Sugoto.Roy@iucn.org](mailto:Sugoto.Roy@iucn.org)

The most favourable, finite option for invasive species management is eradication. However for eradication to be successful, a number of strict criteria need to be fulfilled. The most important criteria of these is that once eradicated, there is no possibility of natural re-invasion. It is not surprising therefore that many eradications are carried out on offshore islands because of their isolation and therefore defensible boundaries, and also because they are often biodiversity hotspots due to their high levels of endemism. Even on offshore islands however sometimes these criteria cannot be immediately fulfilled and the only option is long-term management until they can. This paper explores the value of long-term management using a case study from a Caribbean Island where an island wide trapping campaign was carried out together with a sterilization programme for the domestic cat population.

This study explores the feasibility and costs of undertaking a long-term feral cat management operation on a small island, and the strategies developed that could be used to make it more cost effective. The value of undertaking approach as a regional strategy are discussed.

#### **7907 Feral Cat Control for the Conservation of Endangered Native Species in Japan**

**Takashi Nagamine**, Conservation & Animalwelfare Trust Okinawa, Uruma, Japan. Contact: [nagamine@oki-wild.org](mailto:nagamine@oki-wild.org)

Approximately 10 million domestic cats *Felis catus* are kept as a pet and a lot of unowned cats are also inhabited everywhere in Japan. The negative impacts of feral cats on the wild animals have been becoming clear and big issues in the country. Especially, predation damages on wild mammals and birds, including endemic species on some islands has been becoming severe. In addition, there are issues of the disturbance in seabird colony sites and the spread risks of the infectious diseases from feral cats to native wild cats, *Prionailurus bengalensis* spp. Feral cat managements have been implemented in several islands of Japan. Feral cats have been removed from seabird colony sites on Teuri Island in Hokkaido, and Mikurajima and Ogasawara Islands in Tokyo. In Tsushima Island in Nagasaki and Iriomotejima Island in Okinawa, feral cats have been managed not to spread infectious diseases to the wild leopard cat populations. Feral cat populations have also been controlled to protect endemic endangered species on Amami-Oshima and Tokuno-shima Islands in Kagoshima and Okinawa, Iriomotejima, and Minami Daitojima Islands in Okinawa. Islands where feral cat managements have been succeeded and populations of endangered native species have been recovered have common measurements, which are 1) elimination of feral cats from endangered species habitats, 2) regulations of proper pet care for house cats are enacted by local governments, and 3) reproduction controls on both owned and unowned cats have been carried out. However there are many difficulties on implementation of cat management.

## Session 80: Wind Energy and Bats: Toward Appropriate Assessment and Monitoring

### 8001 Outline of the Policy of the Environmental Impact Assessment on Wind Power Plant in Japan: Current Status and Background

**Dai Fukui**, The University of Tokyo, Tokyo, Japan. Contact: fukuidai@uf.a.u-tokyo.ac.jp

While the wind power generation has advantages such as shifting to a low carbon society, there are growing concerns about negative impacts on ecosystems. To reduce such impacts, appropriate EIA (Environmental Impact Assessment) is necessary.

In Japan, a system of EIA was first introduced in 1972 for public works. In 1984, a standardized rule of "Implementation of Environmental Impact Assessment" was set up through a Cabinet decision. Subsequently, in 1993, the "Basic Environment Law" was enacted, and promotion of EIA was stipulated. Consequently, corresponding to the framework of the new environmental policy as well as referring to EIA systems in other countries, the "Environmental Impact Assessment Law" was enacted in June 1997. However, at that moment, installation of wind power plants was not subject to the EIA Law. Although some of the local governments enact local EIA ordinances, in many cases, only the voluntary EIAs have been conducted based on "NEDO manual" and the sufficient measures have not been necessarily taken.

About ten years after enforcement of the EIA law, the Revised EIA Law that incorporates EIA procedure into the planning stage and into reporting and announcing results of the measures for protecting the environment was enacted. Because of possible negative impacts on natural environment, installation of wind power plants was added to the projects which are subject to the Revised EIA Law in October 2012.

In this talk, background of the Japanese EIA and current EIA procedure for wind power plants are reviewed.

### 8002 Case Study of Birds Affected by Wind-Turbine Installations in Japan

**Tatsuya Ura**, Wild Bird Society of Japan, Tokyo, Japan. Contact: ura@wbsj.org

The increasing use of wind power in Japan raises various concerns. To date, 341 carcasses of birds that collided with wind turbines have been documented from 21 literatures, of which 102 were found incidentally by passers-by. Among these cases, 43 carcasses were of the endangered White-tailed Eagle *Haliaeetus albicilla* (found in Hokkaido) and 48 were of the common Black Kite *Milvus migrans*. This suggests that the wind turbines in Hokkaido may have been installed within the core coastal habitat of the White-tailed Eagle. On the other hand, the Black Kite population may have been affected because it commonly flies at the same height as the wind turbine rotors. Furthermore, habitat loss has occurred at Taikoyama in Kyoto Prefecture and Aoyama-kogen in Mie prefecture. This involves birds shifting their habitats away from the wind turbine premises. In both cases, the numbers of individual birds and species and the breeding territories of the birds are decreasing especially near wind farms. Two cases of wall effect, which involves a change in the migratory flight path of birds due to the presence of wind turbines, are known. One case involves the Honey-buzzard *Pernis ptilorhynchus* in the Sadamisaki Peninsula of Ehime Prefecture, while the other involves cranes in Ikitsukijima, Nagasaki Prefecture. To reduce the impact of wind turbines on birds, monitoring should be mandated by means of EIA laws, and zoning should be introduced as in Europe.

This would contribute both to the dissemination of wind power and to the conservation of the birds habitat.

**8003 Collisions of White-Tailed Eagles (*Haliaeetus albicilla*) with Wind Turbines and Development of a Bird Fatality Estimation Model in Hokkaido, Japan**

**Saiko Shiraki**, Tokyo University of Agriculture, Abashiri, Hokkaido, Japan. Contact: s3shirak@bioindustry.nodai.ac.jp

White-tailed eagle (WTE) is designated as one of the national endangered species, and the Ministry of Environment in Japan has implemented a protection program. The collision with wind turbines is currently the primary cause of WTE's deaths in Japan. Although the confirmed mortality of WTEs killed by wind turbines to date is 42, this number is just "the tip of the iceberg." An accurate calculation of bird collision fatalities is important not only to assess the impact on the bird population but also to evaluate the appropriateness of the predicted fatalities in the planning stages of future wind facilities. Therefore fatality estimation with some corrections of biases, which affects the number of bird carcasses found under wind turbines at the operating wind facilities, is required. Consequently, we are trying to develop an equation model to estimate fatalities of birds with some corrections to fit the study site characteristics in Hokkaido (Kitano & Shiraki 2013). The construction of this kind of model would be useful not only for more accurate fatality estimations but also to improve our understandings of the various biases in field data. In this presentation, I will talk on the status and characteristics of the collisions of WTEs with wind turbines in Hokkaido and subsequently introduce our bird fatality equation model.

**8004 A Review of Bat Fatalities from the Wind Energy Industry in Japan**

**Kuniko Kawai**, Tokai University, Sapporo, Japan. Contact: kkawaigm@gmail.com

It is both ironic and unfortunate that a green energy source such as wind power can have significant negative impacts on wildlife. The effects of moving turbine blades on birds and bats have been studied and managed intensely for more than a decade in North America and Europe. With an increasing number of turbines being built in Japan, observations of associated bird fatalities are also increasing. Given the relatively high rates of mortality reported elsewhere, there are also growing concerns about the effects of wind farms on Japanese bat populations. The potential impacts on bats have received relatively little attention to date, and research on the risks to different species has not been undertaken. Quantitative monitoring and the implementation of specific mitigation measures for bats are practiced rarely by the industry, and the standard industry guidelines for proponents lack sufficient detail. However, there is great potential to draw upon the experiences of other countries, especially those in Europe that have similar bat species. I present a review of the available pre- and post-construction surveys for bats in Japanese wind farm projects, with details on when and where bat fatalities are documented on post-construction surveys. In addition, I highlight the opportunities for monitoring and scientific research in Japan based on specific examples.

### **8005 Germany's "Energiewende" and Its Impact on Protected Wildlife Species**

**Voigt Christian**, Leibniz Institute for Zoo and Wildlife Research, Berlin, Germany. Contact: voigt@izw-berlin.de

Germany decided against the continuation of nuclear and conventional power production and for the promotion of renewable energy with a strong emphasis on wind power. Currently, energy derived from wind power makes up about 34% of the national renewable electricity production, yet the political aim is to further increase wind power production by about 30% until 2020. Consequently, large numbers of wind power facilities are erected in Germany, yet with unforeseen consequences for wildlife, particularly for endangered and protected bats. Presumably, more than 250,000 bats are killed annually due to interactions with German wind turbines and total losses may account for more than two million killed bats over the past 10 years, if mitigation measures were not practiced. More than 70% of killed bats are migrants, because major migratory routes cross Germany. Consequently, Germany's environmental policy is key to the conservation of migratory bats in Europe. Prospective increases in wind power will lead to the installation of larger wind turbines with potentially devastating consequences for bats. Mitigation measures that reduce bat fatality rates at wind turbines inefficiently may jeopardize national and international conservation goals and may cause Germany's environmental policy to collide with E.U. (Habitats Directive) and UN legislation (UN convention for the protection of migratory species).

### **8006 Patterns of Bat Fatality at Wind Energy Facilities in the United States**

**Hein Cris**, Bat Conservation International, Forest Grove, OR, Contact: chein@batcon.org

In the United States, potentially hundreds of thousands of bats are killed by wind turbines each year. Information gathered from post-construction fatality monitoring has provided valuable information regarding species composition, spatial and temporal patterns, and specific weather conditions during which fatalities typically occur (e.g., warm nights with low wind speeds). In addition, recent evidence from thermal imaging cameras indicates that tree-bats are attracted to turbines. However, the actual attraction factor(s) and scale of attraction are still unknown. Moreover, we still do not understand the population impact of wind development on bats. Despite these data gaps, opportunities exist to minimize or, where possible, prevent fatalities. In this presentation, I will discuss our current understanding of bat fatalities at wind energy facilities in the United States, address the challenges and data gaps remaining, and offer potential solutions to resolve this issue.

## **Session 81: Conservation GIS for Multisectorial Collaboration**

### **8101 Multisectorial Collaboration and Information Sharing: An Example from the Identification of Key Biodiversity Areas**

**Yoji Natori**, Conservation International Japan, Tokyo, Japan. Contact: ynatori@conservation.org

Collaboration among multiple sectors, and sharing of information and resources, is vital in planning and implementing biodiversity conservation. Key Biodiversity Areas (KBAs) are the places with biodiversity of global importance, selected based on its vulnerability and irreplaceability. Using these criteria, priority conservation areas have been selected in Japan. This NGO initiative used species distribution data from a government program, the National Survey on the Natural Environment, as

well as literature. The assessment considered distributions of 217 species of mammal, bird, reptile, amphibian, freshwater and brackish water fish and odonate, which were categorized as threatened under IUCN Red List or, under special circumstances, Japan's national red list. Vegetation map and existing protected areas were also considered in delineating the KBA boundaries. Data were combined using GIS to identify 228 KBAs covering 68,000 km<sup>2</sup>, half of which is not protected. KBAs are intended to be used for landscape level conservation by involving stakeholders from various levels and sectors. This identification initiative has revealed challenges of multi-sectoral collaboration, too, including updating IUCN Red List with national-level assessment, sharing species distribution data outside of objective for which the data were obtained in the first place, and updating the KBA list to incorporate site-level changes.

### **8102 Effective Sharing of Environmental Survey Data with Conservation Actors**

**Shintaro Abe**, Biodiversity Center of Japan, Fujiyoshida, Japan. Contact: SHINTARO\_ABE@env.go.jp

Biodiversity Center of Japan is an institute established to manage and distribute information on biodiversity from throughout Japan. The Center itself implements monitoring on flora and fauna, as well as collects and stores the acquired data, existing documents and specimens. These resources are partly open to public through internet and exhibition rooms, in order for awareness raising and education on biodiversity conservation. Such information can be effectively managed and interpreted with GIS. On the Biodiversity Center website, the results from various National Survey on the Natural Environment, and the boundary data for national parks and national wildlife sanctuaries, are available in kml and shape format. For any research and conservation on biodiversity, availability of such geographical information is critical. Effective approach for sharing and utilization of biodiversity data is discussed.

### **8103 Cloud GIS Brings the Mapping Platform**

**Masayo Tsuchida**, Esri Japan Corporation, Tokyo, Japan. Contact: masayo\_tsuchida@esrij.com

Cloud GIS has been developed in various field. Cloud GIS gives you everything you need to create interactive web maps and share with users and local community. Sharing information is much easier than using Desktop GIS. Nowadays GIS can use any type of platforms such as desktops, browsers, smartphones and tablets. GIS gives you visualize, question, analyze, and interrupt data to understand relationships, patterns, and trends. It used to approach to various geographical problem solving. This system is also possible to utilize for a situation such as conservation of the biodiversity esteemed in recent years. Although Asia is an area that includes the Southeast Asia where is a hot spot of biodiversity in the world, have had various issues. GIS is one of the strong tools to understand what is happening and what will happen in geographic space. GIS is a type of language that improves communications. How does GIS deal the issues and solve the problem? Introducing case studies including.



## **8104 Natural Environment Survey and Biodiversity Conservation by Gap Analysis in Hokkaido, Japan**

**Masami Kaneko**, Rakuno Gakuen University, Ebetsu, Japan. Contact: kaneko@rakuno.ac.jp

Gap analysis is a powerful tool in planning conservation areas. By superimposing distribution maps of important species, existing protected areas, their potential habitat and/or potential threats, the 'gaps' in conservation effort (places of high biodiversity but little protection) can be visualized. It could be applied to any ecosystem types. As an initiative to utilize such information and analysis tool, 'Conservation GIS-consortium Japan (CGIS Japan)' has been established. This information platform is collaboratively organized by Conservation International Japan, ESRI Japan, EnVision Conservation Office, and Rakuno Gakuen University. It aims at developing database, provision of information through GIS and internet, and policy advocacy for biodiversity conservation in Japan and in the world. By improving the quality of dataset available for the public, and improving the knowledge and skills among the users, existing GIS data can be utilized more effectively. For conservation of local environment, it is important that government sectors, research institutes and conservation actors share information and work in collaboration. This symposium shows some examples of such collaborative work.

## **Session 82: Conservation and Restoration of Large Cats in the Russian Far East and Korea**

### **8201 The Principles of Restoration of Big Carnivorous Mammals' Populations and Reintroduction of Amur Tiger and Other Big Cats in Russia**

**Viatcheslav Rozhnov**, Sergey Naidenko, Ekaterina Blidchenko, Anna Yachmennikova, Pavel Sorokin, Jose Antonio Hernandez-Blanco, Mariya Chistopolova, A.N.Severtsov Institute of Ecology and Evolution, Moscow, Russian Federation. Contact: rozhnov.v@gmail.com

Numbers of the most species of large carnivores decreases in the wild due the loss of habitats, poaching and population fragmentation. Wildlife conservation needs restoration of populations/groups in different parts of the range but the experience in reintroduction methods is very poor. Few successful projects were dealing with reintroduction of small/medium carnivores (black-footed ferret, Iberian lynx) or translocation of adult animal (Bengal tiger). Large carnivores populations in captivity may have higher genetic diversity than in the wild and may be used as a source for reintroduction programs. For the first time we developed methods for the reintroduction of large cats. The main requirements to the reintroduced animals are natural hunting and social behavior, fear of humans. The methods were tested for Amur tiger. Tiger cubs-orphan (4-5 months of age) were collected in the wild after their mothers' death and placed in rehabilitation center. Cubs lived there for 1,2 years, without contacts with the humans and got training on ungulate hunting (at least 8-12 successful attempts). After this cubs collared with satellite transmitters were released in the wild. Due 2013-2014 six tiger cubs were released to the wild. Five of them are still alive and sixth tiger was captured back for zoo breeding project. Tiger cubs showed intensive exploratory behavior (especially males) and hunted successfully on wildboars, red and roe deer, moose, bear, wolf. This unique perspective experience planned to be used for other large cats reintroduction (Persian and Far-Eastern leopard). This study was supported by Russian Geographical Society.

## **8202 Bringing Back the Big Cats: Potential Restoration of Tigers and Leopards in Korean Peninsula, a Former Range of the Species in Asia**

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In Korea, the relationship between humans and large cats, tigers and leopards, was relatively peaceful during most of last 5000 years. Although large cats were occasionally hunted for retaliation of human attack or simply for their high value, human and large cats maintained fear for each other, and respected each others' territories. During this time, Koreans did not attempt to exterminate the large cats from Korean peninsula. This delicate balance between large cats and human started to break down with the establishment of the Chosun dynasty, about 500 years ago. The nation developed systematic policies, such as organizing special military personnel to hunt tigers and leopards. This was the beginning of the end for large cats. Continuous hunting policies kept the tiger and leopard populations low in until late in the Chosun dynasty. It was during the Japanese colonial era (1910-1945) that the population of large cats finally declined to near extermination on the Korean peninsula.

Is the restoration of large cats in Korean peninsula possible in the future? We think there is hope if we act now. Three issues related to potential restoration of large cats in Korea will be discussed: 1) Why is it necessary to restore big cats in Korea? This issue requires involvement of specialists from various aspects including humanities, sociology and ecology. 2) Public sentiments toward big cats and their restoration in South Korea and the potential human-large cat conflicts. 3) Suitability of potential habitats for tigers and leopards in Korea.

## **8203 Trans-Border Movements of Large Carnivores in the Far East of Russia**

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Technical constructions on borders may be considered as a barrier for the large carnivores. We collared 5 wild Amur tigers, 2 brown and 2 Asiatic bears with GPS-collars in 2010-11 at the border region to study spatial movements. Data allowed to find out that one female Amur tiger and one male brown bear had crossed Russian-Chinese border. The tiger spent almost all time at the Russia, crossing the border 5 times during 8 months, staying at the China no longer than one day. The bear also spent most of the time in Russia, crossing the border 11 times during 8 months, staying in China from several hours to 11 days. In spring 2014 five 2-year-old orphan tiger cubs (3 males, 2 females) with GPS-collars were released in the wild. Two males crossed Russian-Chinese border. One male swam across Amur River in October. He stayed in China for 63 days until he crossed the river back over the ice. In China he used space of 15010 km<sup>2</sup>. Two hours after the return he again crossed the river over the ice, but stayed in China only 22 hours. The other male also crossed Russian-Chinese border by water. 11 November he rounded border constructions on Bolshoy Ussuriysky Island by Amur River. He stayed in China for 33 days and used space of 1229 km<sup>2</sup>. He returned in Russia rounding border constructions on the island, but by Ussuri River. The obtained data give valuable information about existence of the trans-border populations of large carnivores.

#### **8204 The Integrated Study and Approaches to Amur Leopard Conservation in Protected Areas**

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Amur leopard is one of the nine living leopard subspecies, which occupies the northern part of the species' range. This subspecies had been completely extirpated across the Korean Peninsula, which it once fully inhabited. Currently, there are only 50 individuals left in the Russian Far East, and no more than 10 individuals are found in Northeast China.

With the purpose of conserving this critically endangered subspecies the National park "Land of the Leopard" the protected area of federal importance was established in 2012. Together with buffer zone and the oldest Russian nature reserve "Kedrovaya pad" it represents the largest protected area in Amur leopard range. The total area of all protected areas mentioned above constitutes 2900 square kilometers, which is 80% of the total area of the Amur leopard range in Russia.

As part of the conservation and restoration of Amur leopard population within protected areas the five key activities are implemented: patrolling and prevention of protection status violations; scientific research; environmental education; educational tourism; development of international cooperation.

#### **8205 The Role of Russian Protected Areas in Conservation of Amur Tiger**

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Amur tiger is one of the biggest felids in the world and the northernmost subspecies and the only tiger that lives in snow. In the beginning of 20th century there were about 1000 Amur tigers in Russia. But due to intensive hunting, by 1940, less than 50 remained. Since 1970 full-range surveys of Amur tigers have been conducted every 9-10 years. Based on data from the last survey (2005) there were 430-500 Amur tigers in the Russian Far East. Historical Amur tiger range included extensive portions of the Russian Far East, northeast China and much of the Korean peninsula. Today the only viable tiger population remains in the southern Russian Far East, mainly in Primorskiy and Khabarovskiy Provinces. The current range of Amur tigers includes approximately 180,000 km<sup>2</sup>. Nearly 10% of Amur tiger range is protected, including 9 federally protected areas: The largest tiger reserve is Sikhote-Alin Reserve, at 4,000 km<sup>2</sup>. Why are PAs important for tiger conservation? Prey densities are higher inside protected areas than in adjacent forest lands. Both tiger densities and reproduction rates are higher inside protected areas than outside. Human impacts are minimal inside protected areas. So, PAs are "source sites" for tigers. What we do in PAs for tiger conservation: Strict law enforcement within PAs; habitat protection; Long-term monitoring and research; Working with local people (ecological education); Training the next generation of conservationists.

## Session 83: Strategy and Tactics for Deer Management in Wetlands

### 8301 Deer Management to Conserve Wetland Birds in the UK

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The RSPB is Europe's largest conservation charity managing reserves across the UK totalling over 150,700ha. The UK faces an explosion in populations of native and introduced deer in the absence of natural predators or widespread deer management effort.

Wetlands in the UK are squeezed by a range of modern pressures, yet home to an important range of species. Most are protected by UK and international designations yet on a number of reserves, deer are damaging habitats, indirectly effecting priority bird species. Two wetland reserves the RSPB manages, Leighton Moss in Lancashire and Minsmere in Suffolk are suffering wetland habitat damage by native Red Deer (*Cervus elaphus*).

A number of priority bird species including Bittern (*Botaurus stellaris*) Bearded Tit (*Panurus biarmicus*) and Marsh Harrier (*Circus aeruginosus*) are almost exclusively linked with reedbed habitat. Red Deer are inhibiting the growth of reedbed vegetation by trampling and grazing pressure, modifying habitats towards open grassland. This in turn is reducing habitat quality for reedbed species on our reserves.

We have employed traditional monitoring methodologies combined with drone technology to count deer within dense wetland habitat along with assessing damage and habitat quality. Working with partners and neighbours we have introduced targeted culling on both sites, employing best practice and exemplar methods of lethal control and extraction to avoid further damage or disturbance to important species and habitats. All venison is sold via licensed game dealers for the human food chain, largely funding the cost of deer management on our reserves.

### 8302 Changes in Density and Habitat Selection of Sika Deer during Winter in Kushiro-Shitsugen National Park

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The Kushiro Marsh is the largest remaining marshland in Japan, is designated as Kushiro-Shitsugen National Park, and provides essential habitats for various wildlife species. Sika deer (*Cervus nippon*) population within Kushiro Marsh has become overabundant, resulting in a change in plant communities and an increase in deer trails by trampling within the marsh. Moreover, the high deer density increases deer-train collisions and damage of agriculture and forestry around the marsh. Therefore, deer management in and near the national park is needed for conservation of wetland ecosystem and prevention of the damage. However information about density and habitat selection of sika deer is scarce in the national park. Thus, we examined density and habitat selection of sika deer during winter in the national park by aerial surveys on February, 2012 and 2015. The estimated density in 2015 was 7.8 deer/km<sup>2</sup>, and was about 2.5 times higher than that in 1994 from previous study. Confidence intervals of Manly's selection index (Manly et al. 2002) for broad-leaved forests calculated by aerial surveys in 2012 ranged above 1. This suggests that deer selected broad-leaved forests during winter in 2012 in the national park. We will analyze habitat selection of sika deer in

2015, and would like to discuss how to implement effective management of sika deer from a result of changes in density and habitat selection in the national park.

### **8303 Changes in Dynamics and Population of Red-Crowned Cranes and Sika Deer**

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Red-crowned crane: RCC (*Grus japonensis*) is a resident bird and was widely distributed throughout in Hokkaido in Japan until the mid-19th century. The population was significantly decreased in the late 19th century due to excessive hunting, commercial trade, and heavily impacts of habitat destruction. However, recent population of crane recovered to over 1,200 because of supplementary feeding in winter. Periodical census of RCC has been implemented twice a year, in December and January since 1952. The census only reports sum total population and has not ever analyzed to review abundance, spatial distribution pattern, or impacts of artificial feeding. We assume that artificial feeding both positive and negative impacts on RCC and changed its distribution range in the study area. Sika deer (*Cervus nippon*) also increased rapidly at the 1980's in the eastern area of Hokkaido. The habitats of these two species overlap in many parts of Kushiro Shitsugen Marsh and its surrounding areas. We scanned and converted over 8,000 paper-based information sheets with 2,800 present/absent data of RCC periodic survey for last 10 years to analyze geospatially with GIS and deer population data. Our research is still in progress to determine the impacts of feeding and deer abundance on cranes, but we prove that deer management can be consistent with crane conservation.

### **8304 GPS Telemetry Tracking of Sika Deer in Several Wetlands of Hokkaido in Cooperation among Relevant Organizations**

**Yasuyuki Tachiki**<sup>1</sup>, Koichi Waseda<sup>1</sup>, Daisuke Fukui<sup>1</sup>, Takunari Murai<sup>1</sup>, Hiroyuki Uno<sup>2</sup>, Yoshihiro Inatomi<sup>2</sup>, Mayumi Ueno<sup>3</sup>, Satoshi Terauchi<sup>4</sup>, Satoshi Abe<sup>5</sup>, Sayaka Fujii<sup>6</sup>, Issei Nakata<sup>4</sup>, Isami Takahashi<sup>7</sup>, Satoshi Matsumoto<sup>8</sup>, Takumi Matsumoto<sup>8</sup>, Tetsuya Ito<sup>9</sup>, Masakazu Nakaya<sup>10</sup>, Aisa Ishiroroshi<sup>11</sup>, Toshihiro Shimazaki<sup>12</sup>, Mizuna Sato<sup>13</sup>, Ryoto Yoshida<sup>13</sup>, Hino Takafumi<sup>13</sup>, Tsuyoshi Yoshida<sup>13</sup>, Rika Akamatsu<sup>1</sup>, <sup>1</sup>EnVision Conservation Office, Sapporo, Japan; <sup>2</sup>Institute of Environmental Sciences, Hokkaido Research Organization, Sapporo, Japan; <sup>3</sup>Institute of Environmental Sciences, Hokkaido Research Organization, Kushiro, Japan; <sup>4</sup>Ministry of the Environment, Kushiro, Japan; <sup>5</sup>Ministry of the Environment, Sapporo, Japan; <sup>6</sup>Ministry of the Environment, Aomori, Japan; <sup>7</sup>JA Hamanaka, Hamanaka, Japan; <sup>8</sup>Hamanaka deer management conferences, Hamanaka, Japan; <sup>9</sup>Hamanaka town, Hamanaka, Japan; <sup>10</sup>Betsukai town, Betsukai, Japan; <sup>11</sup>Notsuke Nature Center, Betsukai, Japan; <sup>12</sup>Sarobetsu eco-network, Toyotomi, Japan; <sup>13</sup>Rakuno Gakuen University, Ebetsu, Japan. Contact: tachiki@env.gr.jp

In Hokkaido, there are more than 100 marshlands (more than 80% of total marshland area in Japan) and it is considered that these wetlands are regional biodiversity hotspots. On the other hand, recently, these areas have some conservation troubles because high density of sika deer (*Cervus nippon*) inhabits these wetlands. Kushiro Marsh, which is the largest marshland in Japan, is used by deer for all season. Deer population has become overabundant in Sarobetsu marshland (the 2nd largest), causing the damage of a coastal forest which is a special protection area in the national

park. The vegetation in Kiritappu marshland (the 3rd largest) has been degraded by deer grazing. It is an important first step to clarify the behavior of deer when managers consider the strategy of deer management. Unfortunately, there are few cases to conduct GPS telemetry tracking surveys because the tracking is expensive and the budget for wildlife management is usually limited. However, we have been able to attach 62 GPS collars to deer at the above-mentioned three wetlands for the past 2 years in cooperation with the Ministry of the Environment, municipalities, local councils, Japan Agricultural Cooperatives, universities, and Non-profit Organizations. In our presentation, we show that the GPS collar data will be a powerful tool not only to provide scientific information but also to mitigate the sectionalism such as government or land boundary. In addition, we discuss the importance of cooperation with various organizations from the stage of field researches, in order to manage deer in wetlands.

## Session 85: Exotic Macaques in Japan: Current Situation and Management Goals

### 8501 Overview of the Exotic Macaque Problem in Japan

**Kei Shirai**, Wildlife Management Office, Inc., Machida, Japan. Contact: shirai@wmo.co.jp

Taiwanese macaques (*Macaca cyclopis*) and rhesus macaques (*M. mulatta*), legally designated as invasive alien species, have been introduced at several sites in Japan. Their population size, frequency of hybridization with Japanese macaques (*M. fuscata*), and the progress of countermeasures differ between sites. Shimokita Peninsula: Taiwanese macaques were kept as free-ranging pets since 1971. The Japanese macaque population on the peninsula is a natural monument, and countermeasures were not taken until the prefectural ordinance were established. Eradication was successful in 2004. Izu-ohshima Island: Taiwanese macaques escaped from a zoo in the 1940s. Although hybridization doesn't occur because Japanese macaques are absent, crop raiding causes serious problems, and the invasive macaques may have influences on the native ecosystem. Consideration of which aim given priority is important. Kii Peninsula: Taiwanese macaques escaped from a zoo at the edge of the peninsula ca. 1954. Wakayama Prefecture Government has removed 366 individuals since 2002. This alien population may have been eradicated in 2013, and final monitoring is currently underway. The influence caused by males' dispersion on the Japanese macaque population of the peninsula is of concern, but remains unknown. Bousou Peninsula: Rhesus macaques and rhesus-Japanese hybrids have lived since the 1960s. Chiba Prefecture Government has removed over 1700 individuals since 2005, but hundreds remain. Emigration of males have been occurring, and hybrid individuals have been reproduced in the neighboring Japanese macaque population. Currently, researchers and Ministry of Environment have begun to develop low-cost and conventional methods for discrimination between Japanese macaques and hybrids.

### 8502 Hybridization with Exotic Macaques in Japan: Overview from Genetic Monitoring

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Adverse effects on the ecosystem by invasive macaques have drawn special attention in Japan because of hybridization with indigenous Japanese macaques (*Macaca fuscata*). Among five localities corroborated so far, Taiwanese macaques (*M. cyclopis*) are involved in four cases and

rhesus macaques (*M. mulatta*) are in one case. They all originate from imported groups used for tourism in early to mid 20th century that were then accidentally or intentionally let loose later. We have confirmed three cases of large-scale hybridization in mainland Honshu, where two are with Taiwanese macaques and one is with rhesus macaques. The degree of hybridization is variable among these cases. Conspicuously, unidirectional hybridization, only from indigenous to exotic species, has been observed in the cases of Taiwanese macaques. To the contrary, bidirectional hybridization has been confirmed in the case of rhesus macaques in the Bousou Peninsula, Chiba Prefecture. Results of genetic monitoring indicate expansion of hybridization in the peninsula. The Japanese government recently revised the "Invasive Alien Species Act" which addresses the impacts caused by hybridization more than before. Under this condition, preventive measures are urgently required in the Bousou Peninsula to prevent expansion of the hybrid zone between the two species. It is important in the current management program to improve monitoring methods to identify hybrids and evaluate the degrees of hybridization based on morphological and molecular traits.

### **8503 Morphological Cues to Determine Hybridization Rate between Exotic and Japanese Macaques**

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Many species of macaques, i.e., long-tail (*Macaca fascicularis*), rhesus (*M. mulatta*, Mm), and Taiwanese macaques (*M. cyclopis*, Mc) have been introduced to Japan. A part of those populations were released to the wild. Those exotic macaques have adapted to the environment and increased population. As macaques have the population structure of male dispersal and female philopatry, males are exchanged between exotic and indigenous Japanese macaque (*M. fuscata*, Mf) troops to produce hybrids which produce offspring of different degree of hybridization. While government projects to eradicate exotic macaques, pure Mf should be excluded from eradication. Thus, methods for quick determination of hybrids is required. Morphological and pelage characters are visual cues for determination. Relative tail length (standardized by crown-rump length) of Mf, Mc and Mm are, 15%, 80%, and 30-45%, respectively. Mcs have darker pelage than Mfs. Mms are distinct from Mfs by their bi-partite pelage color pattern (contrast), grayish upper-half and light orange lower-half body. Mms have shorter face (snout projection) than Mfs. In these traits, hybrids exhibit intermediate state between parents. For hybrids of Mc and Mf, tail length can be used to Mf-back-cross F3 (Mc participates 1/8 of genome), though it is the limit for Mm-Mf hybrids. Then pelage and face would be evaluated. Developmental change in these traits should be considered for discrimination, for example, immature have relatively longer tails than adults of the same genetic background. Morphology of local Mf, and good still photo is indispensable for determination.

### **8504 Management Goal of Exotic Macaque Problem in Japan**

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Continual hybridization between native Japanese and exotic rhesus macaques in the Bousou Peninsula is the most challenging exotic macaque problem in Japan. The situation is attributable to the slow response of the government after its initial acknowledgment that feral rhesus macaques

were in fact present in Bousou. No further delay can be tolerated. Countermeasures should prioritize the minimization of Japanese macaque genetic contamination. It is essential to rapidly remove individuals exhibiting clear morphological characteristics of either rhesus macaques or hybrids. Next, all remaining hybrids must be removed by careful genetic screening of individual groups of Japanese macaques. Higher operational priorities must be allocated to groups at greater risk of introgression. A more challenging but necessary task is to identify several groups of intact Japanese macaques via precise genetic analysis, and to prevent hybridization by enclosing these animals. The preservation of Japanese macaque genes in vitro is also required; this constitutes insurance against management failure. Furthermore, it is essential to monitor male rhesus monkeys and hybrids that seek to emigrate to neighboring endemic populations and to completely remove such individuals. However, detailed goals must be carefully defined based on the present extent of genetic introgression, the feasibility of the planned approach, and public consensus. An adaptive management approach and reliable governmental financial support are essential if we are to accomplish our mission.

### **8505 Who Is the Real Culprit behind Macaque Hybridization in Thailand?**

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Thailand has six species of macaques; long-tailed (*Macaca fascicularis*), rhesus (*M. mulatta*), Assamese (*M. assamensis*), stump-tailed (*M. arctoides*), northern pig-tailed (*M. leonina*) and southern pig-tailed (*M. nemestrina*) macaques. Because those macaques are neither national animal (as seen for elephants) nor nearly extinct, their conservation received least concern. Most of macaques inhabit temple grounds where harming or killing animals is prohibited. Besides, 94% of Thai people are Buddhists which are prone to make merit by offering foods to animals living in temple areas. This subsequently causes overpopulation of animals and leads to human-macaque conflict across country. The population control program has been eagerly set by the Department of National Parks, Wildlife and Plant Conservation by the end of 2014. Although many methods have been introduced, such as contraception by vasectomy or hormone implantation and translocation, culling is not the option in Thailand. Regarding our macaque survey and research for more than 20 years, hybridizations between those six macaque species were recorded throughout Thailand. Most of macaque hybrids are mainly caused by human-made, e.g., pet-release, translocation, habitat disturbance which forced the two species sharing the same habitat, and intention to produce the hybrid by locals. However, the macaque hybridization in Thailand is not a focal point among Thai people. Thus, acts to turn people interest into this issue are needed.

## **Session 86: Disease Ecology**

### **8601 What Is Disease Ecology?**

**Shannon LaDeau**, The Cary Institute, Millbrook, NY, Contact: ladeaus@caryinstitute.org

Disease ecology as an explicit focus of ecological research is relatively recent, with a sixty-fold increase in literature citations between 1990 and 2014. Disease has more often been considered as a disturbance rather than an inherent part of ecosystems. This talk will introduce the ecological



principles of disease systems and highlight case studies that have motivated and shaped the disciplinary focus. The fundamental principles of disease ecology derive from classical theory in population and community ecology. The dynamics of any particular disease system are defined by the interactions among the organisms involved in disease transmission, which are themselves influenced by abiotic and biotic constraints on population growth rates. The number of newly recognized diseases affecting humans, domestic animals and wildlife have increased in recent decades and many of these 'emerge' when spill-over events between species occur. Thus, while traditional disease biology or epidemiological studies strive to understand the patterns of outbreak in a single species of interest, it is increasingly evident that management strategies often demand more comprehensive understanding of the ecological interactions across wildlife, human, domestic animal and potential vector populations.

### **8602 Emerging Infectious Diseases of Wildlife: A Critical Perspective**

**Daniel Tompkins**, Landcare Reserach Manaaki Whenua, Dunedine, New Zealand. Contact: tompkinsd@landcareresearch.co.nz

Be they impacting people, agriculture or wildlife, emerging infectious diseases are acknowledged to be occurring at an increased rate globally. Management to successfully mitigate these threats requires identifying and understanding their drivers. However, it is recognised that many reports of currently and recently emerging disease causing agents may have insufficient supporting evidence to substantiate their status as such. In such cases, frequently limited resources for research and management may be misallocated with respect to where they could make the most valuable impact. In addition, the 'noise' generated by spurious cases may obscure accurate assessments of emergence drivers, and thus be misleading to considerations of suitable and effective management actions to decrease risk of emergence. I present a critical review of the vertebrate wildlife emerging infectious disease literature from 2000 onwards, identifying those agents for which there is sufficient evidence of emergence, and using them to objectively identify and rank in terms of importance the causes and drivers of current and recent disease emergence in vertebrate wildlife. Exposure to domestic sources of infection and human-assisted exposure to wild sources were identified as the two main drivers of emergence across host taxa; the domestic source was primary for fish while the wild source was primary for other taxa. There was generally insufficient evidence for major roles of other hypothesised drivers of emergence.

### **8603 Niche Selection by Microbes: *Babesia* and *Ehrlichiae* Exhibit Host Preference among Rodents Sharing Ecosystems in Hokkaido, Japan**

**Mohamed Moustafa**<sup>1</sup>, Kyle Taylor<sup>2</sup>, Ryo Nakao<sup>3</sup>, Mariko Sashika<sup>1</sup>, Michito Shimozuru<sup>1</sup>, Toshio Tsubota<sup>1</sup>, <sup>1</sup>Graduate School of Veterinary Medicine, Hokkaido University, Sapporo, Japan; <sup>2</sup>University of Florida, Gainesville, FL, <sup>3</sup>Hokkaido University, Sapporo, Japan. Contact: hatepara@yahoo.com

The study of tick-borne pathogens (TBPs) in wildlife is extremely important, not only because more than 70% of human emerging infectious diseases (EIDs) have their origin in wildlife, but also because vector-borne diseases might have been responsible for almost 30% of EID events in the last decades. In this study, we examined the presence of genetic material from zoonotic *Babesia* and *Ehrlichia* spp. among 252 rodents collected in Hokkaido, Japan from 2010 through 2011: 138 *Apodemus speciosus*, 45 *Apodemus argenteus*, 42 *Myodes rufocanus* and 27 *Myodes rutilus*. Blood DNA samples were

examined by multiplex PCR and Reverse Line Blot (RLB) hybridization for 5 *Babesia* and 9 *Ehrlichia* species. Five pathogens were detected: *Babesia microti* (18.6%), *Candidatus Neoehrlichia mikurensis* (16.3%), *Ehrlichia muris* (2%), *Ehrlichia chaffeensis* (2.8%) and an *Anaplasma* sp. related to *Anaplasma phagocytophilum* (2.4%). In comparison to its prevalence in the other species, *B. microti* and *E. chaffeensis* showed higher affinity for *M. rufocanus* with a prevalence of 54.8% and 9.5% ( $P < 0.01$  each), respectively. However, *C. N. mikurensis* showed the highest prevalence in *A. speciosus* (23.2%,  $P < 0.01$ ). Out of 21 co-infections detected in this study, 13 were detected in *A. speciosus* and 5 in *M. rufocanus*. Eleven cases of co-infection were between *B. microti* and *C. N. mikurensis*, 8 of them observed in *A. speciosus*, while the other 2 occurred in *M. rufocanus*.

#### **8604 What Migratory Birds Brought Avian Influenza Virus into Japan?**

**Manabu Onuma**<sup>1</sup>, Sachiko Moriguchi<sup>2</sup>, Koichi Goka<sup>1</sup>, <sup>1</sup>National Institute for Environmental Studies, Tsukuba, Japan; <sup>2</sup>Niigata University, Niigata, Japan. Contact: monuma@nies.go.jp

When the infectious cases of highly pathogenic avian influenza virus (HPAIV, the virus is classified into influenza virus type A) occurred in Japan in 2004, for the first time in 79 years, it was noted that migratory birds could bring the virus into Japan. Therefore, NIES have started the monitoring of avian influenza virus in migratory birds faces since 2007 funded by the Ministry of the Environment (MOE). Faecal samples of the birds were collected from 52 locations. The virus RNA were extracted from the faecal samples by EZ1 Virus Mini Kit v2.0(QIAGEN) or MagMAX AI/ND Viral RNA Isolation kit(Ambion). And then, LAMP method (Eiken Chemical) was applied to detect the virus RNA. When positive cases were observed, DNA was extracted from the positive faecal samples. The extracted DNA was used to confirm the virus carrier bird species using DNA barcoding. In addition, the environment of avian influenza virus positive locations were characterized by winter temperature, precipitation, duck population size, habitat abundance, size of urban areas, poultry density and so on to create a potential risk map of avian influenza. The result showed that Northern Pintail (*Anas acuta*) and Mallard (*Anas platyrhynchos*) were common carrier birds. And dabbling duck population, size of urban area, diving duck population, and altitude were related to the occurrences of avian influenza positive cases.

#### **8605 Genetic Structure of *Sarcoptes scabiei* Populations from Raccoon Dogs and Domestic Dogs in Gifu Prefecture, Japan: The Necessity of Ecological Perspectives for the Interpretation of Data**

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Sarcoptic mange is a contagious skin disease in mammals and is caused by *Sarcoptes scabiei*. This disease affects many mammals, including raccoon dogs (*Nyctereutes procyonoides*) and domestic dogs (*Canis lupus familiaris*), in Japan. Although the possibility of transmission between these Canidae species has been suspected, no evidence of “*Sarcoptes* mite flow” has been obtained. In the present study, we analyzed the genetic relationship between *S. scabiei* obtained from raccoon dogs and domestic dogs using 9 microsatellite markers. We collected 130 *S. scabiei* isolates from 22 raccoon dogs and 5 domestic dogs from 2007 to 2014 in Gifu Prefecture, Japan, and elucidated the

genetic structure of these mites using a Bayesian model-based algorithm provided by STRUCTURE software (Pritchard *et al.*, 2001). The mites were separated into two groups at the uppermost hierarchical level, with the mites obtained from raccoon dogs and domestic dogs clustered together in each group. This result strongly suggests the transmission of sarcoptic mange between raccoon dogs and domestic dogs in Gifu Prefecture. However, the interpretation of the coexistence of the two mite groups is difficult due to the lack of ecological data on hosts and mites. In this presentation, we propose some hypotheses on this phenomenon from the perspectives of the host and mite and the interaction between them.

#### **8606 Tuberculosis in Asian Elephants (*Elephas maximus*) of Nepal**

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Tuberculosis (TB) in elephants is a re-emerging disease primarily caused by *Mycobacterium tuberculosis*. TB testing was done using DPP VetTB Assay (Chembio Inc., USA) in 147 captive elephants of Nepal. The result showed that about 25% elephants were suspected to be infected with TB. Trunk discharge sample was collected from nine elephants which were strongly positive on DPP VetTB Assay and samples were cultured in L-J media. The culture results showed that there was no growth of *Mycobacterium tuberculosis* complex in all the samples. *Mycobacterium tuberculosis* was isolated from lung tissues of three captive elephants in Nepal. Bacterial species was determined as *M. tuberculosis* by a multiplex PCR and confirmed by *gyrB* sequencing. Spoligotyping, TbD1 detection and multi-locus variable number of tandem repeat analysis (MLVA) results suggested that three isolates belonged to a specific lineage of Indo-Oceanic clade, EAI5 SIT138. One of the elephant isolates had a new synonymous single nucleotide polymorphism (SNP) T231C in the *gyrA* sequence, and same SNP was also found in human isolates in Nepal. MLVA results and the transfer history of these three elephants suggested that two of them might be infected with *M. tuberculosis* from the same source. Elephants might have contracted tuberculosis most probably from their handlers.

#### **8607 Planning of Korean National Institute of Wildlife Health (KNIWH)**

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Constructing a national and international system for management of wildlife health and disease is considered as an important and urgent task worldwide. Disease and parasites are increasingly recognized as critical cause for debilitation of wildlife and ecosystem while potentially reducing biological diversity. Additionally, diseases that emerge from wildlife can pose serious and negative impacts on the health of human and livestock. Ministry of Environment, Korea is pursuing establishment of Korean National Institute of Wildlife Health (KNIWH) in effort to set up nation-wide system for monitoring, managing and studying wildlife diseases. Project for planning KNIWH was carried out by Seoul National University in 2014, with financial support of Ministry of Environment. According to the plan, the vision of KNIWH is 'future world of healthy and harmonious ecosystem, animals and human'. Its mission is 'monitoring and surveillance of wildlife disease', and 'scientific research, communication, cooperation for protecting the health of wildlife, ecosystem and human'.

Four main tasks of KNIWH are 1) wildlife disease surveillance and monitoring, 2) wildlife disease prevention and response/ management, 3) research and development of techniques to resolve problems related to health and disease of wildlife and ecosystem, 4) education, promotion and international networking. Disease ecology will be one of main areas of our research. KNIWH is planning to open by 2018 and basic design for construction is currently under way. We hope that KNIWH provides positive influence on areas such as ecosystem conservation, public health, industry and economics, science and education in Korea. Further, we hope that it can contribute to the improvement of international wildlife health and disease management system in East Asia.

## Session 87: Ecology and Management of Small Mammals

### 8701 Landscape Change Affecting Small Mammals in California Inferred by Readily Available Means

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In this study, simple method to infer habitat suitability for the terrestrial organism is explored. Small mammal is used here, but it possess potential to be applied for various other faunas and/or floras. Google Earth and its satellite images have been used in science, like discoveries of the world largest beaver dam in Canada, Kamil Crater in Sahara Desert, and new rain forest in Mozambique. Google Earth has been providing the past satellite images of a given location since 2009. This feature allows one to study the change in landscape at a given location through time. Rapid urbanization in southern California has resulted in great amount of habitat loss for the organisms in the area. Among the small mammals that inhabit the area, much of the attention has been given to kangaroo rats, *Dipodomys*. This is noted by the number of species on the threatened animal list. But information regarding their sister taxa, pocket mice (both *Chaetodipus* and *Perognathus*) has been limited. Populations of California pocket mice (*Chaetodipus californicus*) were live captured in the foothills of Los Angeles and San Bernardino Mountains in 2000. Landscape images were compared in 2014. Habitat loss was noted. This method will not replace the necessity of on-site assessment. But, it is a promising option when considering the simplicity, quickness and availability at no cost.

### 8702 Rodent Fauna of Sulawesi Island: Diversity, New Discoveries and Distributions

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Sulawesi, the largest island in the Wallacea biodiversity hotspot, is known to contain a highly diverse, unbalanced fauna, typical of large, oceanic islands. Among terrestrial small mammals, the rodent fauna of Sulawesi is entirely endemic and contains a wide range of morphological and apparently ecological diversity. The purpose of this study is to update information on the diversity, distributions and discoveries of new genera and species from Sulawesi island. New information is the product of recent small mammal inventories conducted since 2010. Prior to the initiation of our surveys, 51 species from 18 genera of rodents were known, many from only one or two localities. During our surveys, we recorded 31 species in 15 genera, including several we treat as new species and/or

genera. Our results demonstrate that rodent fauna in Sulawesi is dramatically undersampled, supported by discoveries of new genera, including a molarless rat (*Paucidentomys vermidax*), the Sulawesi water rat (*Waiomys mamasae*), and others that we have yet to formally describe. We also show that many species' ranges are undersampled by documenting a variety of known species from new locations and expanded elevational ranges.

### **8703 The Effects of Food and Parasitism on the Survival and Reproduction of the Taiwan Field Mouse**

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Resource and natural enemy are two of the key driving forces behind life history evolution and population dynamics. However, their relative importance to a wild population has rarely been investigated using manipulative experiments. In this study, I used a manipulative field experiment to test the effects of food supplementation and parasite removal on the survival and reproduction of the Taiwan field mouse (*Apodemus semotus*). The study was conducted from May through September 2013 in a mixed deciduous-conifer forest. Supplemental seeds were allocated to 24 food stations at the study site such that the mice whose home ranges overlapped the food stations would have access to the seeds. During the same time period, I randomly assigned either parasite removal (via anthelmintics) or control (water) to individual mice. The food supplementation and parasite removal created a total of 4 treatment groups: food-supplemented mice with reduced parasitism, food-supplemented mice without reduced parasitism, non-supplemented mice with reduced parasitism, and non-supplemented mice without reduced parasitism. I tracked survival and reproduction of individual mice using capture-mark-recapture method. The survival and reproductive activities generally increased with food supplementation but not parasite removal. For reproducing females, however, the benefit of food supplementation was particularly obvious when they had reduced parasitism. I concluded that food resource plays a more important role than parasitism in the survival and reproduction of this wild rodent. Nevertheless, the females' life history may be sensitive to combined effects of food and parasitism.

### **8704 Habitat Selection of Wahlberg's Epauletted Fruit Bat in an Agriculture/Reserve Matrix**

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Conversion of natural landscapes to commercial agricultural production is implicated in the decline of biological diversity and the ecosystem services it provides. Northeast Swaziland has experienced rapid conversion of lowveld savannah to sugarcane plantation starting in 1979, but also contains the largest reserve network in the country. This has resulted in a reserve-agriculture landscape matrix. Thus the area presents a microcosm to investigate the impact of landscape conversion on African wildlife. Old World fruit bats provide important ecosystem services such as pollination and seed dispersal, yet they remain poorly studied. We investigated home range and habitat selection of Wahlberg's epauletted fruit bat (*Epomophorus wahlbergi*). A total of 20 adult female and 20 adult male fruit bats were radio collared and tracked during the dry season from mid-May 2014 to mid-November 2014. Commuting and foraging fruit bats showed strong preference for riparian areas in

both reserve and agricultural settings. Additionally many fruit bats used riparian zones in reserve and agricultural settings for day roost sites. Our data indicate that maintenance of agricultural landscape heterogeneity facilitates continued use by fruit bats and therefore maintains seed dispersal services. Preservation of forested riparian strips appears to be especially important. Long range movement of up 34km straight line one-way distance in a night were noted suggesting that seed dispersal over long distances is possible.

#### **8705 Diet of the Banahao Forest Mouse and Oriental House Rat: Implications for Mt. Banahaw San Cristobal Protected Landscape, Luzon Island, Philippines**

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The diet of the endemic Banahao forest mouse (*Apomys banahao*) and non-native Oriental house rat (*Rattus tanezumi*) from two locations of the Mt. Banahaw San Cristobal Protected Landscape were compared. This was done to infer the possible negative impacts of the non-native species on native and endemic wildlife species in Mt. Banahaw. Information gained can be used to design conservation strategies for endemic species. *A. banahao* was recorded in the mossy forest of Mt. Banahaw de Lucban and from secondary lowland forest, lower montane forest and up to upper montane forest in Mt. Banahaw de Tayabas. *R. tanezumi*, on the other hand, was recorded from agricultural areas to secondary lowland forest in Mt. Banahaw de Lucban and agricultural area to reforestation area in Mt Banahaw de Tayabas. The guts of the specimens were excised, washed, sorted and the contents analyzed. The diet of the endemic species *A. banahao*, was predominantly arthropods while the diet of the non-native *R. tanezumi* consisted mainly of plant or digested matter. This suggests that there is no competition in food and resources between the two species. However, *R. tanezumi* may negatively impact other endemic, sympatric rodent species through competition and transmission of diseases. Strict implementation of management zones is recommended to prevent encroachment of vegetable and rice croplands on forest habitat leading to the eventual spread of commensal rodents.

#### **8706 Differences in Status and Trend among Isolated Populations of a Montane Mammal Reflect Adaptive Capacity and Aspects of Climate**

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Climate varies across many intersecting environmental gradients of landscapes, as does the magnitude of contemporary climate change already observed. Amidst such change, a species' populations that differ in evolutionary history, climatic context, and adaptive capacity may respond differently to climate, and through different mechanisms. We performed surveys for American pikas (*Ochotona princeps*), a 125- to 200-g poorly-dispersing lagomorph that lives in talus and analogous habitats with cool, moist climate, at >1200 locations in five geographic regions of western North America during summers 2011-2014. We sought to assess which environmental factors best predicted pika distribution and distributional change (if any), in each region. Surveys used paired-observer line transects with distance sampling to quantify pika detectability and number of

individuals detected per transect. Contrary to our predictions, both status (e.g., talus-patch occupancy, density) and trend (e.g., extent of local extirpations, upslope retractions, and encounter of only old sign) of pikas varied strongly across regions. Populations faring better exhibited greater behavioral and dietary plasticity, and apparently higher overall adaptive capacity. Logistic-regression models (for each region) competing in an information-theoretic framework, as well as spatially hierarchical species distribution models, suggested that the species was limited by different factors in different regions. For example, measures of water balance were especially important in the hydrographic Great Basin. These results not only improve our understanding of status and trend of high-elevation species' distribution and trend, but also can inform decisions regarding allocation of conservation effort and management actions. More-mechanistic understanding of species responses and their adaptive capacity can affect: assessment of species' conservation status, harvest seasons, genetic engineering, managed relocations, and associated policy.

### **8707 Structural Thresholds and Landscape Resistance for Natal Dispersal Movements in an Endangered Forest Obligate**

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How animals perceive habitat and make movement decisions during natal dispersal is important to understand landscape features that limit connectivity, and to enable prediction of how landscape changes may influence population dynamics. Improved understanding of movement thresholds is critical to implement habitat management plans for threatened and isolated animal populations and restore habitat connectivity. Herein we examine forest structural thresholds associated with natal dispersal movements in an endangered forest obligate, the Mt. Graham red squirrel (*Tamiasciurus hudsonicus grahamensis*), isolated on a single mountain in southeastern Arizona, USA. From 2010-2013, we radio collared 94 juvenile red squirrels, and quantified 8 LiDAR-derived forest structural characteristics and burn severity from past wildfire at 10,800 lifetime animal locations. We calculated thresholds for use and created probability of use surfaces to identify areas likely used or avoided by juveniles. Finally, we calculated least-cost paths and landscape resistance surfaces to identify likely natal dispersal corridors and movement barriers. Important structural features differ between used and available locations. Elevation, canopy cover, mean tree height, standard deviation in tree height, live basal area, and total basal area are significantly greater whereas slope, and burn severity significantly lower at used locations compared to available. Mt. Graham red squirrel natal dispersal is sex biased, with distances significantly greater than reported for other red squirrel populations. Expanded dispersal movements, combined with 45% (14,160 ha) loss of forest above 2,135 m highlights the urgent need to identify areas currently promoting movement and manage for increased landscape connectivity in future forest management plans.

**8708 Reverse Sexual Dimorphism, Behavioral Phenotypes, and Female Reproductive Success: What Can We Learn From a Fossorial, Forest Obligate in a Fragmented Landscape?**

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Climate and anthropogenic forest change create numerous conservation challenges. Understanding the impact of such change on female fitness measures, such as maternity home range size or litter size, can influence potential conservation strategies. Behavioral phenotypes, a set of repeatable behaviors in an individual that are the result of its genotype interacting with the environment, may affect reproductive success. We described behavioral phenotypes (activity/exploratory and sociality) of a small mammal with reverse sexual dimorphism (females are larger than males), cliff chipmunks (*Tamias dorsalis*), a common fossorial granivore, in the Pinalenios Mountains, Arizona, USA and examined if 1) age, sex, mass, and reproductive condition affect behavioral differences and 2) behavioral phenotype affect nursing female home range size or litter size. During June-September, 2014, we performed behavioral tests and tracked nursing females using radio-telemetry. We used a principal components analysis and generalized linear models to assess both objectives. We found that mass, age, and sex influenced activity/exploratory behavior, whereas reproductive condition, age, and mass influenced sociality. Our results indicate that reverse sexual dimorphism may explain differences in behavioral phenotypes; however, individual behavioral differences are not related to female reproductive success (home range size, litter size). Sexual dimorphism and behavioral phenotypes may not affect female reproductive success in this system, however behavioral phenotypes could affect population fitness through other mechanisms. Understanding the effect of behavioral phenotypes on reproductive and population fitness allows managers to develop better conservation and management plans in landscapes affected by climate and anthropogenic fragmentation.

**8709 Economic and Environmental Benefits from Refining Control Methods for Introduced European Rabbits in New Zealand**

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European rabbit (*Oryctolagus cuniculus*) numbers have recently increased dramatically in some parts of New Zealand as the effects of rabbit haemorrhagic disease virus wane. Rabbits are negatively impacting stocking rates and environmental values, and threatening the economic viability of farms in rabbit prone areas. Aerial poisoning using 1080 or pindone is currently the only practical method available to farmers for controlling rabbits at high densities. However, this method is expensive and can cost up to \$NZ140 per hectare for 1080, and even more for pindone. High costs result primarily from the high bait sowing rates used and the best-practice requirement to broadcast bait as uniformly as possible to obtain complete coverage of the treated area. We trialed a reduced bait sowing method (strip sowing) to determine if the high per hectare cost and use of toxin could be reduced without a loss of efficacy (c.f. best practice broadcast). We found no statistical difference in the percent rabbits killed between the two treatments, with an average kill of 94.0% for broadcasting and 92.8% for strip sowing. We then modelled predicted rabbit population responses based on the observed percentage kills obtained from each treatment. Based on these results, we



estimated the per hectare per annum costs of rabbit control for each treatment over a 15-year farm management plan.

### **8710 Changes in Latrine-Based Communication in European Rabbits along a Rural-to-Urban Gradient**

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European rabbits (*Oryctolagus cuniculus*) exchange information via the deposition of excreta in latrines, and depending on the intended receiver(s), latrines are either formed in central areas (within-group communication) or at the periphery of home ranges, i.e., at territorial boundaries (between-group communication). The relative importance of core vs. peripheral marking behavior depends, amongst other factors, on population densities and group sizes. In Europe, rural rabbit populations are currently on decline, while at the same time can reach high densities in urban and suburban areas, but tend to form much smaller groups. We determined latrine sizes, latrine densities, and latrine utilization frequencies relative to their distance to the nearest burrow in wild ranging rabbit populations along a rural-to-urban gradient in and around Frankfurt a.M. (Germany). The proportion of latrines established in close proximity to the burrow was highest for rural sites compared to urban and suburban ones. At rural sites, we found the largest latrines and those containing the most fecal pellets close to the burrow, suggesting that core marking prevailed. By contrast, latrine densities and utilization frequencies increased with increasing distance from the burrow in urban and suburban populations, suggesting a higher importance of peripheral marking. We argue that increased peripheral marking in urban populations reflects an increased importance of communication between (rather than within) groups, and this seems to be a consequence of higher population densities, smaller group sizes, and relaxed predation pressure in urban populations.

# Poster Sessions

[001-030]

## 001 Metabolomic Study of Gut Compartments of Folivorous Giant Flying Squirrels

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Folivorous mammals, which consume mature leaves, can extract energy from leaf cellulose, with the aid from microbes inhabiting in their guts. Two giant flying squirrels in Taiwan, red flying squirrel (*Petaurista philippensis grandis*) and white-faced flying squirrel (*P. alborufus lena*) that have enlarged caeca (where microbial fermentation happens) are typical folivorous mammals. Metabolites are the products of metabolism and reflect the physiological status and the gastrointestinal chemical environment of an animal. We analyzed untargeted gut metabolic substance of the flying squirrels by liquid chromatography-mass spectrometry (LC-MS). Specifically, we compared flying squirrel with laboratory rats to reveal the difference between wild folivores (flying squirrel) and domesticated laboratory rats, especially to highlight the uniqueness of hindgut metabolome of the flying squirrels. We found that metabolite composition corresponded to gut anatomical structures with metabolite groups revealed by principle component analysis (PCA) coupled with K-means cluster analysis. Variations of metabolite composition also were correlated with digestive time. In addition, pentose phosphate pathway (PPP) might be a highly expressed pathway in flying squirrels' hindguts and related to biosynthesis of certain essential nutrients (e.g., fatty acids that were not included in leaves). Our study established a direct link of element cycles within forest ecosystem through co-metabolic biochemical reactions facilitated by the gut microbiota residing in host mammals. In this light, future wildlife management is expected to take the gut microbiota into consideration.

## 002 The Use of Camera Traps for Ungulate Estimation

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Camera trapping has been widely used to estimate animal density. Implementation of this method is efficient for population studies of species with recognizable individuals, such as some large carnivores. The aim of our study was to estimate population density of two forest ungulates: long-tailed goral (*Nemorhaedus caudatus*) and sika deer (*Cervus nippon*). This investigation was carried in Lazovsky State Nature Reserve (43° N, 134° E) located in the south-eastern Sikhote-Alin Mountains. For sika deer we used a method of estimating animal density using camera traps without the need for individual recognition. For long-tailed goral, along with this method, we also used mark-recapture models since gorals may be recognize by unique horn features. Individual recognition of sika deer is possible by spots during summer season only. During 2012-2013, 22 camera traps (Bushnell Trophy Cam) were set in 3.4 km<sup>2</sup> of goral habitat for a total effort of 9454 trap/nights and 1992 independent photographs of gorals. Among goral, 54 individuals were recognized (15.9 per km<sup>2</sup>) but 20% of the pictures were insufficient quality to allowed identification especially night

pictures. Different mark-recapture models are presented. During 2014, 13 camera traps were set in sika deer habitat on 8 km transect resulting in a total of 1347 trap/nights and 425 photographs of sika deer. Using the formula we calculated sika deer density 13.2 individuals per km<sup>2</sup> that was 50% higher than the density obtained by aerial surveys. The study has shown that it is possible to estimate density of goral and sika deer by camera trapping.

### **003 Tracking of Sika Deer Migration by New Type Global Positioning System Collar**

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GPS (Global Positioning Systems) collars use advanced technology and are widely used to track wildlife; however, researchers have not been able to obtain the location data in a timely manner with conventional GPS collars. Downloading by using a GSM line is possible, but it can't be used frequently. We have developed new a GPS collar that solves the problem. The new GPS collar calculates SS (spread spectrum communication) data from GPS satellite data, then send the data to receiving station by 142 MHz digital communications. We can now locate deer position in real time and frequently as well. In 2014 and 2015, we have evaluated the ability of new type GPS collar on 5 free-ranging sika deer (*Cervus nippon*) to study their forest migration in Gunma Prefecture. Our results suggest the new GPS collar was confirmed to be instant, accurate and practical.

### **004 Application of Nonlinear Time Series Analysis to Wild Animal's Photoplethysmogram for Detecting Cutaneous Blood Circulation Characteristics**

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The microcirculation of the skin is a rather complex dynamic system which is important for skin metabolism and temperature regulation and plays an important role in the organism's defense system. Photoplethysmography is a simple and low-cost optical technique that can be used to detect pulsatile changes in the dermal vasculature. The photoplethysmogram is widely used in medical settings or human health care, as well as in veterinary medicine. However due to difficulties in measuring signal from animals, obtained physiological parameters are not reliable. The current study sought to investigate the properties of photoplethysmographic signals obtained from small mammals by methods of nonlinear time series analysis to find reliable indexes reflecting physiological changes in blood circulation under various external conditions. Photoplethysmogram would be a useful tool to investigate the biological state of animals in combination with remote sensing system.

### **005 Using Real-Time Telemetry Systems the GPS-TX, for the Construction of Japanese Macaque Damage Control Scheme in Gunma Prefecture**

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We examined current crop damage by Japanese macaques (*Macaca fuscata*) and evaluated the real-time tracking methods (GPS-TX system) that are employed. Japanese macaques have caused serious damage to agricultural products, and their activities around human settlements have impacted human life in a variety of ways. In Japan, various countermeasures against crop damage by wildlife, and a program for the popularization of these countermeasures have been discussed. One very important method for reducing crop damage is to ward off the Japanese macaques. In order to track the Japanese macaques in real-time we developed the GPS-TX. The GPS-TX enabled us to reach animals in real time, making it easier to locate the target animals. Now pursuers can directly observe their behaviors and foraging.

#### **006 Effects of Ambient Air Temperature on Daily Energy Intake in Captive Japanese Water Shrews**

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Japanese Water Shrew, *Chimarrogale platycephala*, is semi-aquatic, endemic, and endangered Soricidae in Japan. Little is known regarding general ecology and physiology of this species. We recorded body mass and daily energy intake of captive five shrews over a year to obtain general physiological information about metabolism. While in captivity, the five shrews maintained almost constant body masses, despite variation in their daily energy intake (those were fed ad lib). The intake of the shrews decreased significantly as the ambient air temperature increased up to 22-25 degree of Celsius, although the intake was almost constant above the temperatures. These results indicate that lower critical temperature of thermoneutral zone of this species are approximately 22-25 degree of Celsius, and below those temperature the daily energy expenditure of the shrews decreases as temperature increases probably because of the suppression of thermoregulation costs. Even under same temperature, the energy intake of the shrews increased when those swam or bathed in water tank, indicating that thermoregulation costs increase when the fur is wet. Furthermore, coprophagia (eating of own feces) of the shrews was observed always after they fed on crickets, a behavior that may enhance assimilation of the crickets. This could be due to the difficulty in digesting chitin a substance abundant in crickets.

#### **007 Capture of Sika Deer in Northern Japan Using Cable Restraint Devices**

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In recent decades, overabundant sika deer (*Cervus nippon*) populations have caused severe damage to agriculture and forestry in Hokkaido, Japan. To reduce this damage, the deer population has been aggressively controlled by hunting and nuisance culling. Additionally, the deer are increasingly being captured using traps, because they tend to infest agricultural fields after sunset, when the use of

guns is prohibited. We investigated the efficiency of cable restraint devices to capture sika deer, and tested the use of baited traps to improve trapping efficiency. The loops in our traps had a minimum diameter of 12 cm, as required by law. We set non-baited traps on deer trails in forests and agricultural fields. During 1443 trap-nights from 1 April 2010 to 20 March 2011, we captured 39 deer (0.027 capture efficiency), and the only non-target species caught was a single red fox (*Vulpes vulpes schrencki*). Of these 39 deer, 64% were captured within ten days of setting the trap. From 3 October to 1 December 2011, we set baited traps for a total of 54 trap-nights, and captured 4 deer. Although the capture efficiency of the baited traps (0.044) was better than that of the non-baited traps, the difference was not significant. These results suggest that cable restraint devices are an efficient method for capturing sika deer that infest agricultural fields, and that baiting may improve trapping efficiency.

#### **008 Environmental and Social Impact Assessment on Patheingyi River in the Development of Socio-Economic Condition of Local Inhabitants**

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Myanmar is an agriculture country, whose main product is rice. The Ayeyarwady Delta region is the most productive place, where lots of rice mills are running along Patheingyi River, the main river of this region which flows directly into the sea. We surveyed the socio-economic conditions of this focus area in order to evaluate the best ways to maintain the ecosystem and educate the local population. We did this by creating new environmental sustainability issues that depended on the weak points as well as good points and comparing with international criteria on environmental issues. Focusing on the upstream and downstream of the Patheingyi River including its river level and the nearby villages along the course of the River, all are intended for broad community support and commercial development of natural resources protecting the right of environment as well as local inhabitant's livelihood to be sustainable equilibrium. According to WHO environmental standards and international standards on EIA (Environmental Impact Assessment) as well as SIA (Social Impact Assessment), these criteria will be systematically verified along the course of Patheingyi River and nearby villages. It will be observed by applying ESI (Environmental Sustainability Index) in the project area. For example, in a village, Nyung Kai, there are many rice mills and the side products are easily throwing into the river, and the water turbidity was increased and the color was changed. Such situation must damage wildlife resources and sustainability of the freshwater ecosystem. Thus, for policy making and evaluation of ESI, it is essential to focus on water quality analysis in this river in detail and to document the current status of the water pollution.

#### **009 State Wildlife Grants: A Funding Mechanism to Conserve Declining Species in the United States**

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For over 75 years, the Wildlife Restoration Act has provided a dedicated source of funding that supports the North American Model of Wildlife Conservation. In 1950, the Sport Fish Restoration Act was passed, providing complementary funding to support sport fish populations and provide recreational opportunities to anglers. These two grant programs create the foundation of the U.S. Fish and Wildlife Service's Wildlife and Sport Fish Restoration (WSFR) Program. Although responsible for the distribution of over \$16B USD to the States and territories, the two primary grant programs

restricted eligibility to birds, mammals, and sport fish. State wildlife agencies often lacked a stable or significant funding mechanism for other declining species. Many agencies lacked the ability to focus on ineligible species (e.g. invertebrates, amphibians, reptiles, nongame fishes) and less emphasis was placed on species not traditionally hunted or fished. In 2001, Congress funded a new grant program, State Wildlife Grants (SWG). Unlike dedicated grant programs managed by WSFR, SWG would rely on annual funding by Congress. With the help of continued support from partners, the State Wildlife Grant program has received Congressional appropriation annually, FY2001-2015, reaching a total of about one billion dollars. The SWG program is unique to WSFR in that it is intended to focus on species in conservation need through comprehensive conservation planning. To date, the conservation success stories supported by SWG are numerous, affecting species from mussels to warblers. The presented poster will focus on the significance of this funding mechanism, from its creation to its accomplishments.

#### **010 The Conservation Status and Prospect of Leopard Cats in Taiwan**

**Yu-Hsiu Lin<sup>1</sup>**, Kuan-Fu Lin<sup>1</sup>, I-Han Chien<sup>1</sup>, Kuei-Shien Lin<sup>1</sup>, Fang-Tse Chan<sup>1</sup>, Jian-Nan Liu<sup>2</sup>, <sup>1</sup>Endemic Species Research Institute, Nantou County, Taiwan; <sup>2</sup>National Chiayi University, Chiayi County, Taiwan. Contact: chemics.tw@gmail.com

In Taiwan, leopard cats (*Prionailurus bengalensis chinensis*) are on the list of protected species, and belong to category I, meaning endangered. Unfortunately, the distribution and population size remain unclear. The study reviews survey data, rescue cases, and road-kill information to analyze the threats and distribution status. The reason behind this is that Taiwan is a high density population island, and most lowlands were destroyed or occupied by human beings. Many conflicts have happened so it is quite difficult to promote conservation actions. We conduct this project in Jiji and Zhongliao Townships, Nantou County, in central Taiwan with community-based approach to promote leopard cat conservation. These two townships cover an area of 196.4 km<sup>2</sup> with a human population of 27,322. The two towns are surrounded by scattered secondary growth forest, orchards, and betel nut (*Areca catechu* L.) plantations. The area seems to be the hotspot of leopard cat distribution in Nantou County. Except long-term monitoring of camera traps, we establish a farmer-animal conflict reporting system and promote environment-friendly crop cultivation. Our goal is to enhance public awareness of leopard cat conservation, and establish a model area that can be used to promote conservation for leopard cats.

#### **011 Overview of Environmental and Wildlife Education Program at Chiba University, Japan: Review of Reports Submitted by Japanese and International Students**

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Learning about environmental problems including human-wildlife conflicts with international students could enrich understanding of the theme from global perspectives for Japanese students. The author conducted a study to understand the effects of the course entitled "Facilitating nature conservation in our society" taught in English at Chiba University, Japan. Every class included lectures and group discussion. The author taught this course for one semester (a total of 15 classes) in which a total of 12 students attended (7 from Japan, 2 from the US, one each from Australia, Finland, and Thailand). Reports submitted by students every week were reviewed to understand

what students learned from the class and group discussion with other students from various countries. Analysis revealed that through discussing with the students from different countries and/or who have different points of view, the students broadened their views on the topic. For example, Japanese students learned that having guns and joining hunting activities are common in the US and Finland, comparing to Japan, and reflected on those cases to think why human-wildlife conflicts became big issues in rural landscape of their own countries. An American student learned how her perceptions on wildlife were different from those of the Japanese students which she concluded that her points of view regarding wildlife have been molded by her cultural background. The students learned how the wildlife conflicts are common all over the world, and how learning about cases and strategies around the world is important to cope with the issues in their own countries.

### **012 History of Japanese Serow (*Capricornis crispus*) Management**

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Japanese serow is monogamous territorial browser, endemic to Honshu, Shikoku and Kyushu islands. This species is legally protected by two laws: the Law for Protection of Cultural Properties (LPCP) as a 'Special Natural Monument Species (SNMS)' and the Wildlife Protection and Hunting Law (WPHL) as a 'nongame species'. Poaching was a major threat to serow population until the middle of the 20th century. Groups of poachers were eliminated through the anti-poaching campaigns in 1959. Then the serow population began to increase and reached 100,000 around 1980. With the recovery of the serow population, damage to forest and agricultural products drastically increased and conflict between serow conservation and primary industries became a social problem. In 1979, the Government decided to change the management policy. The essential points of management translate to; 1) To designate serow habitat as the Special Natural Monument instead of designating the species as the SNMS in LPCP. 2) To allow pest control of serow in case of necessity. However, the establishment of serow reserves are incomplete due to limited support of land owners. Therefore, serow still remains as the SNMS. In 1999, the WPHL was amended and management planning system was established. This system still regulates the serow culling. With the development of the management systems and turn down of forestry since the 1980s, the conflict between conservation and primary industries calmed down. On the other hand, increasing sika deer population is becoming a cause of decline in serow population through interspecific competition.

### **013 Seasonal Movement and Diving Patterns of the Kuril Harbor Seals in Eastern Hokkaido**

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The number of Kuril harbor seals (*Phoca vitulina stejnegeri*) in eastern Hokkaido has increased by about five times in comparison to the number of seals in the 1970s. Similarly, the number of the Kuril harbor seals in Daikoku Island, Akkeshi which is the biggest haul-out site in eastern Hokkaido has also increased. According to the increasing number of the seals, damage to the fisheries has increased as well an expansion in the area of damage has been observed. In this study, eight seals which were captured from 2010 to 2013 in the eastern Hokkaido were attached Argos transmitters (Mk10-AF: WILDLIFE COMPUTERS). From the tracking data, we examined the seasonal movements

and diving patterns of the Kuril harbor seals around Daikoku Island, Akkeshi. In spring, range of movement was about 40 km, on the other hand, in summer it became narrower. Many lower and shorter dives, during which the diving time was less than 10 minutes and the diving depth was 0-50 m were seen in spring. These diving depths were the same depth as the fishing net; therefore, we considered that the feeding area and fishery area overlap in spring, which led to conflict in these areas.

#### **014 Catch History of Steller Sea Lions in Japanese Waters: A Review**

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The Asian stock of Steller sea lions (*Eumetopias jubatus jubatus*, SSLs) migrate to Hokkaido Island, Japan during winter. The hunting of SSLs in Hokkaido during the period from the 1960s to the 1990s was considered to a reason for the decrease in the population in the Kuril Islands. Then, after the 1990s, the SSLs have commenced rebounding, recently exceeding the pre-1960 level. As the result of the recovery, coastal fishery around Hokkaido has been suffered from damages due to SSLs. Hunting (culling) is one of measures to mitigate the damages. It is vitally necessary to evaluate the effect of hunting for the management of SSL population in Japan. In this study, we reviewed the catch history of SSLs in Japan since the 1910s using published and archive records, in the purpose of constructing a demographic model. By 1945, commercial hunting was conducted at the middle Kuril Islands. During this period, the abundance was not well known; however, the number of wintering SSLs along the Hokkaido coast has been reduced. In the early 1960s, the culling was initiated at the southern and eastern section of Hokkaido, then extended to the northern section in the late 1960s. In the late 1970s, culling at the southern section diminished; then it transferred to the eastern section in the mid-1980s. The rise and fall in SSL hunting are considered to reflect the decadal variation in coastal distribution of SSLs around Hokkaido. These data will be utilized to construct a numeric model to evaluate the effect of culling on population dynamics of SSLs around Hokkaido Island.

#### **015 Using DNA Barcoding for Fecal Analysis of Eurasian Otter (*Lutra lutra*) to Identify Their Prey**

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We implemented the DNA barcoding approach as an analysis tool for otter feces. The resolution provided by the DNA barcoding approach in fecal analysis is adequate to identify the prey to genus and species level and is effective in determining the actual diet. In addition, we examined the otter feces using a microscope, and identification was based on the visual inspection of teeth from fish and bones from frogs, reptiles, birds and mammals at the highest taxonomic level. Twenty-four randomly selected spraints from 15 sites were utilized in the analysis. The DNA barcoding approach; however, identified 18 amphibians, 2 reptiles, 2 mammals, and 49 fishes from the spraints to the genus or species level. Visual inspection on the other hand identified 72 fishes, 10 insects, 12 amphibians, 1 mammal, 2 macro-invertebrates and 8 undefined samples. Fishes were an important



prey item for otter both quantitatively and qualitatively. In addition, frogs were substantial prey, because the frogs were abundant in the season. The percentage of identification from DNA barcoding was 67.6 %. Comparing to visual inspection, the proportion of fishes was decreased and macro-invertebrates were not identified. In the species level, the prey of otters were mostly benthic fishes and easily catchable as the previous studies revealed. However, the fauna was different from that of surveyed sites.

#### **016 Impact by American Mink and Its Management in Japan**

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American mink, *Neovison vison* is an invasive species distributed in the Nagano, Fukushima and Hokkaido Prefectures in Japan; however, the impact of serious agricultural damages caused by American mink is not known. Local governments are reluctant to manage the species and its ecological are limited. In order to better understand the impact on the regional ecosystem by mink, we conducted population size estimations and studied the food habits of the mink in Abukuma river system of Fukushima and the Kushiro river system of Hokkaido. Individual number of mink was estimated along Abukuma at 2.7 to 4.8 per km, which showed that population density of the mink in this region was extremely high. The mink preyed on frogs frequently through at the year. Disappearance of mature frogs in winter reduces the reproduction function of the frog, which may lead to reduction or disappearance of their population. In addition, endemic species of Japanese mustelids was captured in these survey was few, it is suggested that the mink is depriving the habitats of these animals.

#### **017 Site Related Development in Testes of Male Bryde's Whales, from Viewpoints of Evaluation of Sampling the Testis Tissue in the Stock Management Purpose**

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The sexual maturing process in the testes tissues of the North Pacific Bryde's whale were histologically investigated because of their importance from viewpoints of appropriate stock management based on biological evidence. Testes tissue samples were collected from the testes of 12 individuals, collected under the Japanese scientific permit whale research program (JARPN II) in the western North Pacific 2011-12, which were assumed to be in puberty, in the maturing process from immature to mature. The tissues were obtained from 15 different representative sites equally allocated within the testis (heavier side), and histologically examined with the HE-stained processes. The testicular histological sections were observed under an optical microscope (x10-40). Observation was randomly chosen 25 seminiferous tubules within the sections by following three standards; i) diameter of tubule, ii) ratio of open lumen to 25 tubules, iii) number of germ cells at each four stage of the spermatogenesis. It was revealed that the seminiferous tubules diameter were the largest at the center of the anterior site. The ratio of the open lumen presence and the number of germ cells also tended to be higher in tissues at the anterior than the posterior site. The spermatogenesis started from the center at the anterior site of the testes, and gradually expanded to the posterior.

These results indicated that the sexual maturing process does develop from the anterior to the posterior site rather than synchrony throughout testes tissues among male Bryde's whales, which might give some biases in the traditional sampling manner that collected only tissues from the center of the testes.

#### **018 Foraging Trips of Juvenile Steller Sea Lions during Early Summer in Russian-Japanese Waters**

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Steller sea lions (SSLs, *Eumetopias jubatus*) in the Asian stock breed on rookeries in Russian waters in summer and conduct winter migrations to Hokkaido, Japan. For young SSLs in Alaska, it has been suggested that the ontogeny of foraging behavior requires time before the appropriate diving behavior and knowledge of prey locations is fully developed. To investigate the ontogeny of foraging behavior of juvenile SSLs in Russian-Japanese waters, we deployed satellite tags (SRDL, SMRU) on three juvenile SSLs (Nos.1 and 2: yearlings, No.3: 2-year-old), incidentally by-caught in a fixed fishing net and released at Sarufutsu, northern part of Hokkaido in June 2014. They were tracked for 36, 43, and 29 days, respectively. All juveniles utilized non-breeding haul-out sites; No.1 mainly utilized Kuznetsov Point, western coast of Sakhalin, whereas Nos.2 and 3 utilized only Opasnosti Rocks in Soya Strait between Hokkaido and Sakhalin. Each individual conducted round trips (n=3, 8, and 4) to different areas; Nos.1 and 3 around the Okhotsk Sea coast of Hokkaido and No.2 around Aniva Bay. Trip distance and mean dive depth tended to be different among them, and No.3, the largest juvenile, showed the shortest trip distance ( $170.2 \pm 19.3$  km) and shallowest dive depth ( $25.0 \pm 0.9$  m) compared with the others (No.1:  $222.2 \pm 130.1$  km,  $55.8 \pm 2.3$  m, and No.2:  $205.3 \pm 36.4$  km,  $49.7 \pm 1.4$  m). Previous studies revealed that diving abilities of pinnipeds develop with body mass; therefore, No.3 may be able to reduce energy consumption during shallow dives. Also, only No.3 regularly departed the haul-out at night. These results may suggest that foraging behavior of juveniles with experience is more efficient than yearlings.

#### **019 The Different Feeding Strategies of Each Behavior Pattern on the Spotted Seals in Bakkai**

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Recently, the numbers of spotted seals (*Phoca largha*) in the Sea of Japan, Hokkaido has been increasing rapidly and extended their haul-out area size and have been staying for longer terms than in the past. However, there are no reports on the utilization of feeding grounds and haul-out sites of

spotted seals in the Sea of Japan. In this study, we aimed to examine the relationship between location of feeding grounds and frequencies of hauling-out, and considered the foraging strategies for each behavior pattern of the spotted seals coming to Bakkai as a new haul-out site in the Sea of Japan, Hokkaido. By the population count it indicated that the seals began to migrate to Bakkai in November, the number of seals most increased from December to January, and the seals went to back to summer habitat in May. Additionally, from the results of tracking study using satellite-tags (from 2009 to 2013, n = 25), it suggested that the seals around Bakkai came from the Tatar Strait or the Okhotsk Sea. Also, six foraging patterns and haul-out sites were confirmed, and it was suggested that the seals used wider areas of the Japan Sea, Hokkaido for foraging in winter. Furthermore, we concluded that there are various foraging strategies depending on distance between haul-out sites and foraging areas.

#### **020 Development of Polymorphism Analysis System of Major Histocompatibility Complex (MHC) Genomic Region in Dolphins**

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Cetaceans are important marine mammals used for biological, ecological, evolutionary and genetic research, which still require a detailed characterization of their Major Histocompatibility Complex (MHC) polymorphic region that is composed of a cluster of MHC and their linked genes involved functionally with the adaptive and innate immune systems. In this study, in order to better understand the degree and types of polymorphisms and genetic differences of the cetacean MHC regions among individuals and populations, we developed in total ten DNA markers such as eight microsatellite (MS) markers, MHC -DQB and MHC-DRB markers using a 2.1 Mb genomic sequence of false killer whale MHC region. Polymorphism analysis using 22 dolphins (18 bottlenose dolphins, two Risso's dolphins and two hybrids between them) that are composed of four independent families, revealed five to 14 alleles for the ten DNA markers. The observed heterozygosity and polymorphic information content (PIC) of the DNA markers using 22 dolphins excluding offspring ranged from 0.636 to 0.909 and 0.557 to 0.907, respectively. All dolphins were genotyped without discrepancy in each family. Also 26 MHC haplotypes were estimated from the genotype data, and of them three mother-offspring combinations were thought to be recombinant haplotypes. Therefore, the DNA markers we developed in this study will be useful genetic tool for population genetics and conservation genetics of captive and wild dolphins.

#### **022 Stable Isotope Analysis of Three Odontocetes, Harbour Porpoise, Dall's Porpoise, and Pacific White-Sided Dolphin around Hokkaido, Japan**

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Harbor porpoise, Dall's porpoise and Pacific white-sided dolphin are most common small odontocetes around Hokkaido and sometimes they co-occur in same area. In this study, the stable isotope ratios of these odontocetes around Hokkaido were analyzed. Carbon and nitrogen stable isotope ratios were measured in the muscle of 68 stranded or by-caught odontocetes. They included 35 harbor porpoises, 19 Pacific white-sided dolphins and 14 Dall's porpoises. The value of  $\delta^{13}\text{C}$

(mean  $\pm$  SD) of harbor porpoise, Dall's porpoise and Pacific white-sided dolphin was  $-18.6 \pm 0.78$  ‰,  $-19.4 \pm 0.69$  ‰ and  $-18.1 \pm 0.42$  ‰, respectively.  $\delta^{13}\text{C}$  of Dall's porpoise was significantly different from the other two species and it suggested that Dall's porpoise used pelagic areas and the other two species used coastal areas. The value of  $\delta^{15}\text{N}$  of harbor porpoise, Dall's porpoise and Pacific white-sided dolphin was  $13.3 \pm 1.06$  ‰,  $13.4 \pm 0.98$  ‰ and  $12.3 \pm 0.59$  ‰, respectively.  $\delta^{15}\text{N}$  of Pacific white-sided dolphin was significantly different from the other two species which implied that Pacific white-sided dolphin fed on lower trophic level of prey than the other two species. The high standard deviations for  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  in harbor porpoise suggested that harbor porpoise used wider range habitats than the other two species. It was found that three odontocetes have different feeding habitats around Hokkaido and it is the survival strategy for them to avoid being in competition.

### **023 Population Genetics of Krill Harbor Seal Over Their Breeding Grounds in Hokkaido, Japan**

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Past study based on mitochondrial DNA sequence indicated that there are two distinct populations, Erimo and east Hokkaido, for krill harbor seal, *Phoca vitulina stejnegeri* inhabit Hokkaido, Japan. However, this species is highly philopatric and the movement range in this area is restricted to 40km. Since all haul-out sites in Hokkaido are 20km to 50km apart, there could be more than two populations of this animal. In this study, population genetics of krill harbor seal was re-investigated by using different DNA region, and sampling area and type compared to the previous study. Samples were taken from the animal which were caught accidentally in the salmon set-net or captured for research purpose. Then, they were sorted and picked by the body length. Sampling took place at four sites; three main breeding sites in Hokkaido: Erimo, Akkeshi and Hamanaka, and a place within 20km range from Northern Islands' breeding ground: Nosappu. Statistical method includes relationship among haplotypes using Network and genetic divergence between each population using AMOVA. As a result, 720 nucleotide sequence of mtDNA D-loop regions were read and 16 new haplotypes were found. The frequencies of haplotypes were different for each site and statistical results showed there were two major populations, Erimo and east Hokkaido. Also these haplotypes may have experienced different history of divergence. Furthermore, Hokkaido population has low genetic diversity compared to Atlantic and east Pacific population suggested the krill harbor seals may have experienced bottleneck and founder effect.

### **024 Comparison of the Growth Curves in the Region and the Age of Harbor Seals**

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Harbor seals (*Phoca vitulina stejnegeri*) are two groups in Hokkaido; one is Erimo group and the other is the eastern Hokkaido group. Since the seals settle at same haul-out site for all seasons and there is 150 km apart from Erimo to the eastern Hokkaido, it has reported that gene flow is nothing between the two groups. Due to the recent increase in number of seals, it is suggested that nutritional status of individuals has been worse in recent years. Therefore, it has a possibility that

the growth differences in each area and sex have been existed. We therefore examined that we fitted the growth curves and revealed the presence of the differences. 513 samples were collected from 2002 to 2014 (258 males and 255 females) and estimated age, then three growth curves from age and body length were fitted. As a result, AIC of the growth curve of the Von Bertalanffy model was the lowest on excluding males of Erimo and the logistic model on males of Erimo. The male growth were bigger than females of Erimo, while on eastern Hokkaido, there were no difference on sex. On male, the growth of eastern Hokkaido was bigger than Erimo, no difference on female. Furthermore, the male growth in the 1980s was bigger than the 2000s, while female; the growth in the 1980s was bigger than only the 2000s on Erimo. It was considered that there existed the density effect, because increase in number was higher Erimo than the eastern Hokkaido.

## **025 Stability of Social Behavior during Reproductive Season in Aquatic and Semiaquatic Mammals**

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Aquatic and semiaquatic mammals underwent different evolutionary processes in adaptation to underwater life. As they have wide home range and spent most of the lifetime in the water, little is known about their social behavior during reproductive season. To investigate the stability of the mating pair of the pinnipeds and the cetaceans, we collected behavior and genetic data from spotted seals (*Phoca largha*), pacific white-sided dolphins (*Lagenorhynchus obliquidens*) and bottlenose dolphins (*Tursiops truncatus*) in aquariums. We found that mating pairs of the spotted seals had been maintained for at least four years and a male monopolized several females at least two reproductive seasons. However, the pairs have changed in subsequent reproductive seasons, suggesting the instability of pair-bond formation. All substitutions were non-synonymous: genetic data showed that the bottlenose dolphin differed from other species in the gene encoding of the arginine vasopressin 1A receptor (*avpr1A*). The result indicates that different types of selection occurred in the gene that controls social behavior in this lineage.

## **026 The Behavior Characteristics of Spotted Seals from Autumn to Spring in Each Sex and Age Class on Rebun Island, Hokkaido, Japan**

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Recently, on Rebun Island of Hokkaido, an increase in the numbers of spotted seals (*Phoca largha*) and the haul-out sites was confirmed. Seals came to stay year-round on Rebun. Furthermore, it was suggested that seals use different haul-out sites seasonally impacting the population count. To determine seasonal behavior characteristics, eight seals (four adults and four sub-adults) on Rebun Island were equipped with satellite transmitters and we analyzed their movement from autumn to spring. We clarified the differences of movement sites, hauled-out and dive frequencies, maximum depth and dive duration for each seal seasonally. These seasonal and area differences of each seal were tested statistically using the Kruskal-Wallis test, after that, conducted multiple comparison using the Steel-Dwass test. It was found that all adult seals traveled back and forth between Rebun

and the Tatar Strait, and they mainly stayed at the Tatar Strait from late winter to early spring. Furthermore, the hauled-out frequencies of the adult female seal increased in winter, which suggests that it might breed in the Tatar Strait. Additionally, it was found that seals repeated longer and deeper diving in winter at the Tatar Strait than another seasons and sites.

#### **027 Historical Decrease of the Dugong Population and Its Management Vision around the Ryukyu Archipelago, Japan**

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The population size of the dugong (*Dugong dugon*) around Okinawa Island was reported to be around dozens in 1998 and 3-5 individuals at present. Historically the Ryukyu Kingdom had managed the dugong population in Yaeyama Islands. Dynamite hunting had started around 1893-94, nearly 300 individuals were hunted around Yaeyama Islands. Because of such overhunting, the population decreased dramatically until the early 1910s. Around Yaeyama Islands located between the Philippines and the continent, healthy seagrass meadows are still distributed. In the present study, we made biological investigations on dedicated skulls of the dugong in Nanazou Utaki on Aragusuku Shimoji Island, which is a sacred place for the local community. As a result of morphological analysis on body length and the exchange situation of maxillary molars, 56-91 individuals with a wide range of life stages were identified. Molecular phylogenetic analysis of mitochondrial DNA showed that the population was composed of at least four maternal lineages around Okinawa. In addition, in the survey in the Philippines, we found the presence of the dugong and a wide range of food resources to maintain dugong populations. In order to restore the dugong distribution in Japan, it is necessary to recover the populations in northern part of the Philippines, which are expected to disperse to Yaeyama Islands, and to establish the dugong conservation center for the purpose of ex-situ conservation in Iriomote Island, similar to the Sado Japanese Crested Ibis Conservation Center.

#### **028 Morphological Difference in the Skull of Killer Whales (*Orcinus orca*) between Waters around Japan and Iceland**

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Previous studies have shown that sympatric Killer whale (*Orcinus orca*) sub-populations known as “ecotypes” are distinguished on the basis of behaviors, external morphology and prey preference. Although skeletal characteristics are important to examine taxonomical differences, only limited information of sexual and geographical differences are reported for killer whales. Sixty-four skull measurements of 23 adults from 19 specimens from the western North Pacific Ocean, Japan and 4 individuals from North Atlantic Ocean, Iceland were statistically analyzed to identify the existence of the geographic difference between the skulls of killer whales in both areas, using the two-sample t-tests, linear discriminant analyses and supervised methods (Tree-based Method and random Forest). From these analyses, clear geographic differences were found in the points of the greatest pre-

orbital width, the greatest width of right post-temporal fossa, the greatest zygomatic width and the thickness of lacrimal bone which includes the top of frontal (right-side) ( $p < 0.01$ ). The maximum classification success rate estimated from the linear discriminant analyses and the supervised methods were in the range 91% and 100% between those two localities. Since the critical values used for classifying the geographical variations and sexual variations are different in each classification method, it would be fair to say the results as the geographic variation between those areas. Such morphological differentiations are thought to be relevant to differences in the feeding apparatus, sound-producing apparatus and vision apparatus. These results indicate that the geographical difference shows in the skulls are possible related to their ecotype variations.

### **029 Ancient DNA Analysis of the Japanese Sea Lion for Study of the Evolutionary Position**

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The Japanese sea lion *Zalophus japonicus* was found around the Japanese islands until the last decades, but it is currently thought to be extinct. The evolutionary status of the Japanese sea lion has not been fully studied until now. While the final report of sighting was in 1970s, there are many bone remains of sea lions excavated from archaeological sites in Japan. Ancient DNA analysis using the remains will be able to provide useful information to further understanding the phylogenetic position of this sea lion. In the present study, we extracted total DNA from the bone remains (humerus and skull), which were excavated from archaeological sites on Hokkaido, Japan, and which were morphologically classified as the sea lion. Then, using the DNA extract, partial fragments of mitochondrial DNA (mtDNA) were amplified with polymerase chain reaction (PCR). The nucleotide sequences of successfully amplified PCR products were directly determined using an autosequencer, and compared with homologous sequences of genus *Zalophus* including the California sea lion *Z. californianus* and the Galapagos sea lion *Z. wolfebaeki*, and other pinnipeds, registered in the nucleotide sequence databases. Most of sequences obtained in the present study had high homologies with those of *Z. japonicus*, and they formed a single cluster in phylogenetic trees. In addition, the comparison of genetic distances between *Zalophus* species showed that the Japanese sea lion has been well differentiated from other species likely at the species level, not subspecies level.

### **030 Emigration of Indo-Pacific Bottlenose Dolphins around Mikura Island, Japan**

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Indo-Pacific bottlenose dolphin (*Tursiops aduncus*) inhabit tropical and temperate coastal areas from the Pacific Ocean to the Indian Ocean. In Japanese waters they inhabit the coast area of south Hokuriku from the Kyushu region, known as around Mikura Island, Ogasawara Islands, and Amakusa-Shimoshima Island. Long-term identification surveys revealed that there are resident populations around these islands. Our results showed that 41 individuals emigrated from Mikura Island to other areas between 1994 and 2014. We analyzed the data relating these emigrations and the number of adult female, subadult female, juvenile female, adult male, subadult male, and juvenile male were

14, 1, 1, 15, 8 and 2, respectively. And three individuals out of 14 adult female were accompanied by juvenile. Six emigrants returned to Mikura Island, and three emigrants remained there until 2014. Groups of emigrants observed at each destination consisted of 1 to 5 members, but the members repeatedly merged and separated. The most common destination area was Toshima Island, which is the part of Izu Islands Chain. The farthest destination was Tanabe, Wakayama prefecture, more than 200 km away from Mikura Island. In this study, we summarized basic information about emigrants. The reason why some dolphins leave their habitat will be revealed by studying on social relationships and habitat use of emigrants near future.

## [031-060]

### **031 Population Genetic Analyses of Microsatellites and Major Histocompatibility Complex (MHC) Genes in the Endangered Red-Crowned Crane on Hokkaido, Japan**

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Major histocompatibility complex (MHC) genes in vertebrates relate to immune responses and are one of the most variable regions in the genome. Although neutral genetic markers such as microsatellites could be used to infer genetic variations, their application in evaluating adaptive potentials is restricted. Hence population genetic analysis of adaptive loci, such as the MHC genes, is critical for conservation studies of wildlife. In the present study, we performed comparative analysis of genetic diversity between microsatellites and the MHC genes on the red-crowned crane (*Grus japonensis*), which is highly endangered in Hokkaido. Especially, the crane population in Japan decreased due to the expansion of industrial and agricultural developments, and faced extinction at the end of the 19th century. The crane population on Hokkaido has steadily grown since 1950s owing to conservation efforts such as artificial feeding in winter and protecting wetland, and its population size was recovered to over 1,300 birds until the present day. Our microsatellite analysis showed that the experience of bottleneck could have decreased the genetic diversity of the crane population, and little genetic differentiations are found among subpopulations. In addition, we investigated genotypes of the MHC genes (class IA and IIB loci) on about 150 individuals collected from 2006 to 2014. We then discuss the population genetic structure of the functional genes to assess the population status and to define the conservation methods of the red-crowned crane population, compared with that of neutral microsatellites.

### **032 Nest-Site Characteristics of Three Sympatric Forest Raptors in the Tokachi Plain, Northern Japan**

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We investigated nest-site characteristics of three sympatric forest raptors, Common buzzards (*Buteo buteo*), Northern goshawks (*Accipiter gentilis*) and Eurasian sparrowhawks (*A. nisus*) in agricultural areas of the Tokachi Plain, northern Japan. Surveys were carried out to locate active nests and nest site features were then recorded from 2007 to 2011. Nest trees and nesting forest stands (0.1 ha



plots centered on the nest tree) were measured as nest-site characteristics of raptors. Buzzards bred at 33 sites at least one time during the study period; this value for goshawks was 34 and for sparrowhawks, 48. Nesting forests of sparrowhawks were different from those of Buzzards and goshawks. Japanese larch (*Larix leptolepis*) were most frequently used by buzzards and goshawks as nest trees, whereas evergreen conifer trees were preferred sparrowhawks. Nesting forest structures of buzzards and goshawks were similar mature forests, while sparrowhawks nested in younger forests. However, nesting forest age were similar among three species, buzzards, goshawks, and sparrowhawks were  $45.7 \pm 6.2$  (range: 37-59),  $45.1 \pm 5.7$  years (range: 31-60), and  $37.8 \pm 8.1$  (range: 21-60), respectively. The seral stages (i.e. forest ages) of nesting stands differed: buzzards and goshawks nested in mature forests, whereas sparrowhawks preferred younger forests. Our results suggest that conservation of nesting forests of raptors is therefore likely to be possible through appropriate management of planted forests.

### **033 Fluctuation in Nutrient Supplying Service Provided by Black-Tailed Gulls to near Shore Kelp Aquaculture with Annual Change of Breeding Colony Size**

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Seabirds input large amount of offshore-derived nutrients as a fecal into the near shore aquatic ecosystems at the breeding colony. Those nutrient supplying service provided by seabirds strongly affect biodiversity and biomass in those ecosystems. Since in general colony size of seabirds varied annually in response to changes in the prey availability, those nutrient supplying service may also vary annually. In this study, first we measured colony size of Black-tailed Gulls, *Larus crassirostris*, over 12 years on Rishiri Island, northern Japan, and examined the effects of the annual stock abundance of Japanese Sand Lance, *Ammodytes personatus*, a dominant prey of the gulls, on the colony size. Then we estimated the annual amounts of nitrogen supplied by the gulls into near shore area based on the colony size. Further, we examined the effects of the annual variation in the nitrogen supplying service on the productivity of near shore aquaculture of kelp, *Saccharina japonica*. Colony size of the gulls largely varied annually, and those increased significantly with annual sand lance stock abundance. The annual amounts of nitrogen supplied by the gulls were estimated from 560 to 4,050 kg in dry-weight. Annual production of the kelp increased significantly with the annual amount of supplied nitrogen in the shore near the gull colony, but this increase was not found in the shore far from the colony. Our results indicate that population dynamics of seabirds can fluctuate human food production in the coastal area.

### **034 Food Habit of the Endangered Okinawa Rail**

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The Okinawa rail, *Gallirallus okinawae*, is endemic to the northern part of Okinawajima Island in the Ryukyu Archipelago, Japan. This species is ranked as “Endangered” in the IUCN Red List because its numbers have been reduced by introduced carnivore species, traffic accidents, and habitat destruction. Although measures taken against introduced species have improved the situation in recent years, the incidence of traffic accidents has continued to increase. Therefore, further action is needed for effective conservation of the rail. The ecological data necessary for such conservation is, however, still lacking. For example, little knowledge on the rail’s food habit has been gained from ad libitum observations. This study accordingly aimed to clarify the quantitative food habit of the Okinawa rail by analyzing stomach contents. Stomach samples were collected from individuals killed either in car accidents or by predators from March 2008 to August 2014. Stomach contents were maintained in 70% ethanol. We identified species in the stomach contents as far as possible and measured the wet weight of each food item. Various taxa, including Oligochaeta, Gastropoda, Chilopoda, Diplopoda, Malacostraca, Arachnida, Insecta, Amphibia, and Reptilia were found. Among these, land snails were observed with high frequency throughout the year. In addition to animals, more than 50 types of seed, categorized according to shape, were recorded. These results indicate that the Okinawa rail is an opportunistic forager and that land snails are an important food source because of their high availability and ease of capture.

### **035 Ground Use Pattern of the Okinawa Woodpecker and the Amami Woodpecker in Subtropical Island Forest on Ryukyu Archipelago, Japan**

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The Okinawa woodpecker (OW) *Dendrocopos noguchii* and the Amami woodpecker (AW) *D. owstoni* are endemic, respectively, to Okinawa Island and Amami Island located in Ryukyu archipelago, Japan. The OW had been classified as the only species in genus *Sapheopipo*, but the recent molecular phylogenetic study showed that it belonged to genus *Dendrocopos*. The AW is a newly classified species; it was once classified as the largest and the darkest plumage subspecies of White-backed woodpecker *D. leucotos owstoni*. The phylogenetical and biogeographical estimated age of speciation is the early Pleistocene for OW and the last glacial period for AW. From the study of feeding items for the nestlings, the OW has a unique ground foraging habit unusual for arboreal *Dendrocopos* woodpeckers. Because of the difficulty of directly observing woodpeckers in the dense undergrowth of subtropical rain forests, we employed sensor cameras to compare their ground-use patterns to clarify the difference of adaptation for ground foraging. The frequency of male OWs directly perched on the ground was the highest (57.1%, n = 154) and significantly higher than female OWs (19.2%, n = 52). On the other hand, AW rarely perched directly on the ground. The percentages were for male AWs (4.5%, n = 66) and for female AWs (0.0%, n = 34). For the conservation of these woodpeckers, it is necessary to preserve old subtropical rain forests for their nesting and foraging. Furthermore, for the unique ground foraging OW, it is also important to maintain a safe foraging environment on the ground.

### **037 Energy Requirement of Middendorff's Bean Geese and Carrying Capacity in Fukushima Lagoon and the Surrounding Paddy Fields**

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Fukushima lagoon, which is located in Niigata Prefecture, Japan, is an important overwintering site for many migratory wildfowl species. Middendorff's bean goose, *Anser fabalis middendorffii*, which is one of migratory wildfowl designated as a near-threatened species by the Ministry of Environment, migrates to the lagoon every winter. And, more than 70 % of the geese migrates to Japan in winter overwinters in Fukushima lagoon. They mainly use the lagoon as roost and paddy fields around the lagoon as foraging sites. Therefore, paddy fields have been considered as an important overwintering habitat for this species. In recent years, however, paddy environment around the lagoon was remarkably changed by the expansion of the lagoon and farmland consolidation in paddy fields, which might pressure overwintering geese population. Loss and deterioration of foraging site could cause poorer energy intake, decrease survival rate, and eventually lead to reduce overwintering population size. To maintain the population size of bean geese in Fukushima lagoon, it is necessary to understand the amount of resources in which ensure energy requirement of geese during overwintering. In this study, we first clarify its food items and diet contribution of each food using DNA barcoding and stable isotope analyses. Then, we compare between energy requirements of geese during wintering and the total amount of energy estimated by both the biomass and the caloric content of food items available within foraging area. Finally, we discuss management scenarios to conserve the geese population overwintering in Fukushima lagoon.

### **038 Effects of a Deer-Proof Fence in a High-Deer-Density Area on the Recovery of Bird Communities in Oku-Nikko, Japan**

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The various adverse effects of increased deer population density have expanded to vegetation in Japan in recent years. In the face of deer problems, deer-proof fences have been installed in an effort to recover the vegetation within the fences in many regions. However, when deer-proof fences are installed in places that deer already inhabit in high density, it is reported that the vegetation assembled inside the fences differs from that assembled before the deer population increased. Therefore, because bird communities are strongly related to vegetation, the communities built within the fences can also be considered to differ from those before the deer population increased. In this research, in order to determine the characteristics of bird communities assembled within deer-proof fences, a bird community survey and a vegetation survey were conducted; eight survey plots were set up in each area with high and low deer densities and eight plots were also set up on each occasion at the time a fenced area was created and in the eighth year after the area was created within *Quercus crispula* forests in the Oku-Nikko, central Japan. Then, change factors in bird communities were examined using TWINSpan and canonical discriminant analysis. The results showed that the culm density of dwarf bamboo (*Sasa nipponica*), the numbers of shrub species and living shrubs, and the number of living sub-canopy trees inside the fences were unchanged even

after eight years elapsed since the deer-proof fences were installed, and no remarkable change was observed in bird community. From the above, the possibility was suggested that the installation of deer-proof fences in this research is not contributing to the recovery of bird communities.

### **039 Using Quantitative PCR to Examine Oil Exposure in Free Living Birds**

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In 2010, the BP Deepwater Horizon oil rig exploded in the Gulf of Mexico, resulting in approximately 4.9 million barrels of oil invading waters off the coast of Louisiana. Despite attempts to stop the oil from reaching shore, approximately 1,700 km of coastline was covered (45% of which invaded salt marshes, mainly in Louisiana). Many terrestrial animal species depend on these coastal marshes for food, reproduction, and habitat. One such species is the Seaside Sparrow (*Ammodramus maritimus*), a small endemic songbird that is a common year-round resident. Due to its large population size and its close association with the marsh, this species serves as a valuable indicator of how oil contamination in coastal marshes may affect terrestrial vertebrates, and possibly humans. To determine the effect of the BP Deepwater Horizon oil spill on Seaside Sparrows, we are seeking first to determine the magnitude and duration of oil exposure. To that end, we are quantifying the presence of CYP1A mRNA in individual sparrow liver samples collected over four years from unoiled, lightly oiled, and oiled sites, using real-time quantitative PCR (qPCR). This gene is expressed during the metabolism of polycyclic aromatic hydrocarbons (PAH) found in crude oil, thus its expression provides a reliable bioindicator of oil exposure. Here, we review our methods and present data obtained from a series of quality control steps that were performed to ensure the accuracy of qPCR. Once complete, our data may serve as a mechanistic link between oil exposure and potential phenotypic or fitness effects.

### **040 Developing 11 Microsatellite Markers Using Next Generation Sequencer for Endangered Golden Eagle**

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Japanese golden eagle (*Aquila chrysaetos japonica*) is one of the most endangered species. There are many ecological studies, but only a few genetic studies. Developing species specific genetic markers is important to genetic conservation study, because markers are necessary for precise individual identification, parent-child relationship and kinship study. We tried to establish new microsatellite markers using next generation sequencer. DNA was extracted from a blood sample of a golden eagle bred in Akita Omoriyama Zoo. Sequencing was conducted using next generation sequencer ion torrent. 5,222,991 reads were obtained. Mean length was 269bp and total bases became 1.4GB. 2,424 fragments were selected for following condition; more than seven repeats of two to four base unit sequence by Msatcommander. We designed 48 microsatellite markers with PRIMER3, and 11 markers were selected as the suitable genetic markers for noninvasive samples. The number of

alleles, observed and expected heterozygosities, probability of identity of each markers and mean inbreeding coefficient ( $F$ ) were calculated using 31 DNA samples (including wild Iwate population) extracted from feathers, pellets and egg membrane.  $F$  became 0.127, so there is a possibility that Iwate population had experienced inbreeding.

#### **041 Increasing Numbers: The Relation between Food Availability and Population Size in Zoo-Living Wild Corvids (Carrion Crows; Hooded Crows; Large-Billed Crows)**

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There have been a number of studies on population expansion among crows in urban areas worldwide. It has been presumed that surplus food from human food scraps (i.e. garbage) is the major driver of such expansion. Although this presumption seems plausible, to date, it has not been subject to verification through the use of comparative studies. Our study aims to evaluate whether the number of crows (*Corvus corone*, *Corvus cornix*, *Corvus macrorhynchos*) in four zoos relates to food availability, the mode of animal enclosure management, and nest tree availability. The zoo study sites were located in Edinburgh, Scotland, Vienna, Austria, Debrecen, Hungary, and Sapporo, Japan. These areas are similar in size and settings, such as presence of animal enclosures, human eating-places and open areas. The major difference between the zoos was the food availability; that is, how and where the zoo animal food was provided, and the extent to which it was available to crows. The surveys were conducted using unified behavioral observation methods, from April to August 2014, to see whether food availability was indeed the determinant factor for the number of crows found in the zoos. There was a positive correlation between food availability and the number of crows found in the zoos. Additionally, we found a larger number of corvid nests in the zoos where zoo animal food was more accessible to crows. We discuss the implication of these findings in relation to conservation and animal management practices.

#### **042 Avifauna under High Density Sika-Deer Forest on Nakanoshima Island, in Hokkaido**

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Nakanoshima Island located in Lake Toya. Deer population on the island grew from 3 introduced deer and peaked to 299 in 1984. Population had crashed but it recovered and population fluctuated around 130 to 480 deer thereafter. After first crash, dwarf bamboos (*Sasa senanensis* and *S. kurilensis*) the majority of understory plants had been eliminated. The aim of this study is to clarify the characteristic of avifauna in a forest with a high density of sika deer. Four 2-km line transects for the bird census were established in a deciduous broad-leaved forest, two on the island and two on the outside of the lake. Bird censuses were conducted 5 times for each routes in the breeding season. Some bird species that nest on the ground or in understory, such as *Cettia diphone* were common on outside routes, and rare on the island, but two ground nest bird (*Urosphena squameiceps* and *Phylloscopus coronatus*) were common in both on the outside and island. Two unpalatable plants species (*Senecio cannabifolius* and *Pachysandra terminalis*) flourished after deer irruption. The

aforementioned two bird species might nest in unpalatable vegetation. Dwarf bamboos were perennation plant and its height were 1.0-1.5 m. The height of *S. cannabifolius* is 1.0-1.5 m but it is therophyte plant and its height were around 0.2 m in late April. The height of *P. terminalis* is 0.1-0.2 m whole year. These two bird species arrive to the island from wintering ground in late April they might spend a days in the habitat where grass height is low during arrival to start breeding.

#### **043 Diet Analysis Using DNA Barcoding from Feces of the Japanese Crested Ibis, for the Habitat Management of Reintroduced Species**

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The Japanese crested ibis became extinct in 1981. Since 2008, the ministry of environment in Japan has reintroduced the ibises onto Sado Island, and in addition, various nature restoration tactics have been implemented for supporting the population of the released ibises. After the release of ibis, we have investigated the prey items and the foraging efficiency of ibis on restored paddy fields; however, according to direct observation of foraging behavior, ca. 80 % of prey species were too small to identify. Poor information on diet menu of ibis means that restoration tactics on Sado Island might be not necessarily appropriate for ibis. DNA barcoding is an approach to clarify food items by analyzing a DNA sequence collected from undigested food in feces, which is also recognized as a powerful tool for the rapid and unambiguous identification of species compared with traditional diet analysis such as the morphological identification of stomach-content and the direct observation of foraging behavior. Furthermore, this method is suitable for small animals and endangered animals because it keeps their stress from capture and treatment to a minimum. In this study, we aim to propose an effective nature restoration scenario based on foraging information of the Japanese crested ibis. First, the food items of ibis were clarified through a year using DNA barcoding from feces. Then, we calculated the foraging efficiency from their foraging behavior, DNA barcoding, caloric content of prey, and finally, we discussed an effective paddy management in which is able to raise foraging efficiency of ibis.

#### **044 Color Ringed Cormorants in Latvia**

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Despite of the fact that Greater Cormorant research started more than five years ago, in 2013 and 2014 the first ever bird ringing of Greater Cormorants was performed in Latvia to get information about migration routes and wintering grounds of coastal and inland breeding birds. During 2014, the regularly investigated colonies total of 173 Greater Cormorants were ringed with color rings (171 fledglings and 2 adult birds). Blue color rings with white inscription were used on the left leg and metal rings on the right leg. During long term research more than eight colonies were surveyed every year. Because of Latvia's geographical location and specialties just few of them are suitable for ringing. Only in several colonies nests are accessible, most of them are located in dry trees >15 m up. The main ringing place for coastal Cormorants is the biggest colony in Latvia (~1500 bp), located in Kemeru National Park restricted area on islet at Kanieris lake. Main inland colony (~600 bp) on Akmenssala (Stone islet) is located at Lubans lake >160 km from Gulf of Riga. We received sighting reports from six countries. Furthest report came from lake St-Cyr, France. There are no significant

differences found between inland and coastal birds in their migration routes and wintering areas so far.

#### **045 Ferruginous Hawk Demography in an Area of Intense Energy Extraction Activity**

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The recent rapid expansion of oil and gas extraction activities (e.g., well drilling, pipeline construction, road building) on the Great Plains (USA) has occurred with little understanding of the effects of such activity on wildlife populations. Over two years, we monitored the demography of breeding Ferruginous Hawks (*Buteo regalis*) in two areas of western North Dakota that are undergoing different intensities of energy extraction activities. Northwestern North Dakota is the heart of the Bakken Shale, where oil and gas extraction activities have been intense in recent years. In contrast, southwestern North Dakota has experienced only limited oil and gas extraction. We found similar numbers of Ferruginous Hawks nesting in the two areas, with comparable fledging success. However, nest site re-use was significantly lower (13% vs 80%) in the intensive extraction area, and much lower than reports from other parts of the Great Plains (average 78%). Thus, while energy extraction activity had no apparent impacts on immediate reproductive success of Ferruginous Hawks, long-term population declines may be expected in such areas given the exceptionally low nest site re-use that we observed in this study.

#### **046 Nationwide Decline of Early-Successional Bird Species in Japan: The Effects of Woody Vegetation Encroachment on the Temporal Changes in Riparian Bird Distributions**

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Many species that depend on early-successional habitats are declining worldwide due to suppression of natural disturbance. In the floodplains, woody vegetation encroachment after constructions of river structures (e.g. dams) has led to loss of unvegetated gravel bars as well as the decrease of species that depend on them (gravel bar-nesting birds). Although existing studies conducted in some dam-regulated rivers supported this, it is still unclear whether the decline in abundance of gravel bar-nesting birds would be detected at a nationwide scale. In this study, we clarified whether woody vegetation encroachment affects population changes in gravel bar-nesting birds at a nationwide scale. We used a national census of 109 rivers across the country conducted by Japanese government to calculate the geometric mean of bird population changes between 1996-2000 and 2001-2005. The bird abundance in rivers where vegetation has encroached was decreased more rapidly than those in rivers where vegetation has remained unchanged. Additionally, high priority areas for conservation of gravel bar-nesting birds were identified based on the bird distributions. Our results imply that national strategy would be needed to deal with woody vegetation encroachment and conserve riverine biodiversity.

#### 047 Species Status and Current Distribution of the Korean *Hynobius* Salamanders

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The genus *Hynobius* is one of the Asian salamander groups in Hynobiidae. Korean *Hynobius* salamanders are composed of three known species (*H. leechii*, *H. quelpaertensis*, and *H. yangi*) and three candidate species (HC1, HC2, and HC3). However, their conserved external characteristics make hard to identify the species by sight. Therefore genetic approaches are vital for species identification. Mitochondrial cytochrome *c* oxidase subunit I (CO1) is a proper marker for species identification and for statement of undescribed species. Consequently, we analyzed the CO1 gene for the Korean *Hynobius* species to confirm the species identification and richness. The results from the partial 1,464 bp sequence analysis of CO1 gene revealed that four cryptic *Hynobius* groups exist in Korean peninsula, of which three coincide with the results of Baek et al., 2011 (HC1, HC2, and HC3) and one from Uiryeong County is newly discovered (HC4). The sequence divergence between HC4 and other *Hynobius* groups in Korean peninsula is relatively higher than those observed in ordinary levels between other *Hynobius* species. The controversial issues of threshold values between intra and interspecific divergence were not observed in Korean *Hynobius* salamanders. Furthermore, the genetic results from mtDNA (a total 805 specimens) were used to make the distribution map for Korean *Hynobius* salamanders. The results suggest that the southern part of Korean peninsula is a hotspot for the diversification of the Korean *Hynobius* salamanders.

#### 048 Amphibian Species Richness in Dry Dipterocarp Reforestation Areas in Central Thailand

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In central Thailand, most area has been used for human settlement, agricultural purposes and industrial areas. As a result, most of the natural forest has been severely degraded. At Chulalongkorn University Forest in central Thailand, part of the 562.2-hectare area consists of the degraded dry deciduous forest. Currently, several restoration measures have been implemented including increase in water catchment and reforestation with dipterocarp saplings. In this research, we aims to examine how reforestation influence the amphibian community. Dipterocarp reforestation areas of the CU Forest at different stages were chosen as the study sites including 3-4 years old plantation, 2-year old plantation, and 1-year old plantation. Amphibians were monitored by visual encounter surveys during October 2013 to September 2014. The field surveys showed that 7 species were found in these areas namely *Kaloula pulchra*, *Microhyla fissipes*, *Microhyla pulchra*, *Micryletta inornata*, *Polypedates leucomystax*, *Fejervarya limnocharis* and *Occidozyga lima*. These 7 species were all found at the old reforestation plot with 3-4 year plantation. While at the new reforestation plot with 2-year plantation, there were only 5 species with no evidence of *Polypedates leucomystax* and *Occidozyga lima*. The least number of amphibian species were found at the new reforestation plot with 1-year plantation where only *Microhyla fissipes* and *Fejervarya limnocharis* were found. Our species inventory indicated that higher number of species were observed in the older plantation than in the younger plots. Overall results suggest that some of this amphibian species are sensitive to ecological change and could be used as an indicator species of reforestation success.



#### 049 Difference in Bone Mineral Density between Wild and Farmed Adult Rice Field Frogs

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Rice field frog *Hoplobatrachus rugulosus* is one of the most important alternative protein sources in Thailand. The increasing demand on rice field frog meat causes a great impact on the declining population in natural habitats. Wild rice field frogs have been recognized as a more tempting source of meat than those grown in farms. The hypothesis lies upon a higher quality of leg bones and muscles in the wild frogs than that of the farmed frogs. In this regard, this study aims to investigate the difference in bone mineral density (BMD) of adult rice field frogs grown in farm and natural habitats. Frog femur BMD was analyzed by a peripheral quantitative computed tomography at 3 reference sites, including femoral epiphysis, metaphysis and diaphysis. The BMD values of femoral epiphysis, metaphysis and diaphysis of the wild frogs were  $503.33 \pm 29.30$ ,  $413.10 \pm 16.33$  and  $983.49 \pm 35.46$  g/cm<sup>3</sup>, respectively. Additionally, the BMD values of femoral epiphysis, metaphysis, and diaphysis of the farmed frogs were  $226.92 \pm 7.12$ ,  $240.48 \pm 7.25$  and  $924.25 \pm 15.73$  g/cm<sup>3</sup>, respectively. Consequently, the BMD values of femoral epiphysis and metaphysis of the wild frogs were significantly higher than the farmed frogs. However, the BMD of femoral diaphysis of the wild frogs was slightly, but not significantly, higher than the farmed frogs. These results can be applied to improve meat quality of the farmed frogs so that it may be comparable to that of the wild frogs. As a result, it might increase the demand on the farmed frogs and subsequently prevent the decline of natural frog populations.

#### 050 What If Red Swamp Crayfishes Are Not Available? What Do Bullfrogs Feed on in Japan?

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Bullfrogs (*Lithobates catesbeianus*) were introduced to aquaculture in Japan and red swamp crayfishes (*Procambarus clarkii*) were introduced as prey of bullfrogs. Both bullfrogs and red swamp crayfishes are invaded in many aquatic ecosystems of Japan. However, both invasive species population are only limited to small aquatic landscapes of Hokkaido, the northernmost island of Japan. Additionally, study on bullfrogs is not available in Hokkaido. In this study, we examined the stomach contents of bullfrogs in the Onuma Quasi-National Park in south Hokkaido where red swamp crayfishes do not inhabit. We collected bullfrogs in summers of 2012, 2013, and 2014, and analyzed 470 stomach contents. We calculated the percentage of the index of relative importance (IRI) to determine the main prey species of bullfrogs. Bullfrogs mainly preyed on terrestrial invertebrates including ground beetles, spiders, centipedes, sow bugs and grasshoppers. Bullfrogs also showed cannibalistic behavior in our study area. However, we could not determine any significant ecological impacts on aquatic biodiversity of the study area. Invasion dynamics of bullfrogs are still unknown. Thereby, we should strongly need to compare the diet composition of bullfrogs of other areas especially in cool-temperate environments. In addition, we must identify cost-effective way of reduction of bullfrogs and carefully discuss socio-biological driving forces to eradicate this potential invasive species of Hokkaido's biodiversity.

### 051 Monitoring Long-Term Trends Spawning Frog Yokohama Nature Sanctuary

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The purpose of this study is to record the variation in populations of amphibians Montane brown frog (*Rana ornativentris*) that lives in Yokohama Nature Sanctuary which is a green space that was preserved in the big city of Yokohama. Every year from January to April, we have measured the number of eggs of *R. ornativentris* to estimate the abundance of adult frog population. We have surveyed for 8 years from 2007 and have confirmed every year the spawning of *R. ornativentris*. Decreasing trend of egg number has been found. Since this survey began, forest and grassland in the environment surrounding the waterside is not changed much. Throughout the study period, extreme changes in precipitation and temperature in the region has not been seen. Declining of egg population was caused by the change in habitat. Two considered. The first cause the deterioration of spawning environment due to the decrease of water level. The second was caused by predation of adult by Raccoon (*Procyon lotor*). There needs to be some future environmental conservation measures in the region.

### 052 Ecology and Conservation of the Dhofar and Arabian Toad in the United Arab Emirates

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The Arabian Toad (*Duttaphrynus arabicus*) and the Dhofar Toad (*Duttaphrynus dhufarensis*) in the UAE have been mapped and some recent observations presented. The Arabian Toad is more widely distributed in more mesic habitats and benefits from the increase in artificially irrigated habitats. The Dhofar Toad is able to live in drier areas but its distribution suggests it may be outcompeted by the Arabian Toad in wetter areas with greater availability of surface water. Also presented are two scenarios of anticipated climate change and how these species would cope in a hyper-arid climate which itself is a challenge to amphibian survival.

### 053 Impacts of Alien Frog on Invertebrates Living on Ground Surface in Hokkaido, Japan

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Understanding the food habits and impacts of introduced species is crucial in managing them to protect native ecosystems effectively. In Hokkaido, Japan, there are some alien frogs such as *Pelophylax nigromaculatus*. In this study, we examined the food habits of an alien frog, *P. nigromaculatus* and its effect on the native ecosystem through their predation. In 2005, 140 frogs of *P. nigromaculatus* were captured and stomach contents were examined. We found 662 prey items of 38 types. Main prey items were lepidopteran larvae, Gerridae, Araneae, Isopoda and Carabidae. We sampled ground surface invertebrates at 15 plots using five traps set up at interval of 5 m in August, 2010. At each plot, frog density was measured by counting adult and juvenile frogs by walking around for approximately 15 min. We conducted multiple regression analysis to examine the relationship between density of *P. nigromaculatus* and ground invertebrates using total volume and number of invertebrates as objective variables and density of frogs as explanatory variable. Our

results of pitfall traps showed that the density of ground invertebrates such as Araneae, Isopoda and Carabidae were lower in higher density of *P. nigromaculatus*. This suggests that the invasion of *P. nigromaculatus* affects populations of ground invertebrates through frog predation.

#### **054 Predator Cannibalism Can Intensify Negative Impacts on Heterospecific Prey: Experimental Study Using an Amphibian Predator-Prey System**

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Traditionally, predator cannibalism has been considered to weaken predatory effects on heterospecific prey by reducing the size of the predator population. However, we predict that predator cannibalism, by promoting rapid growth of the cannibals, can also intensify predation pressure on heterospecific prey, because large predators have large resource requirements and may utilize a wider variety of prey species. To test this hypothesis, we conducted an experiment in which cannibalism of Hokkaido salamander larvae (*Hynobius retardatus*) was controlled by manipulating the salamander's hatch timing (i.e., we used populations with large or small variation in the timing of hatching), and explored the resultant impacts on the abundance, behavior, morphology, and life history of the salamander's large heterospecific prey, Hokkaido brown frog tadpoles (*Rana pirica*). Cannibalism was rare in salamander populations having small hatch-timing variation, but was frequent in those having large hatch-timing variation. Thus, giant salamander cannibals occurred as a result of intense cannibalism. We clearly showed that giant salamanders exerted strong predation pressure on frog tadpoles, which induced large behavioral and morphological defenses in the tadpoles and caused them to metamorphose late at large size. Hence, predator cannibalism arising from large variation in the timing of hatching can strengthen predatory effects on heterospecific prey and can have impacts on various traits of both predator and prey. Because animals commonly broaden their diet as they grow, such negative impacts of predator cannibalism on the heterospecific prey may be common in interactions between predators and prey species of similar size.

#### **055 Beaver Facilitation in the Conservation of Boreal Anuran Communities**

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A rapid loss of species and habitats is occurring globally. Amphibians and wetlands are important components of this overall decline. Wetlands in the boreal region are frequently constructed by the damming activities of an ecosystem engineer, the beaver (*Castor* sp.). We investigated the anuran fauna in ten 'beaver ponds', ten 'non-beaver ponds' and eight temporary ponds in Finland. We conducted anuran chorus surveys to identify all three native species of Finland (the common toad *Bufo bufo*, the common frog *Rana temporaria* and the moor frog *Rana arvalis*) using the NAAMP protocol. We calculated detection probability, abundance index and species richness from the anuran calling data. The abundance of each anuran species, as well as species richness were analysed with generalized linear mixed modelling using the glmer function in the lme4 library in R 2.15.0. All three anuran species present in the region occupied the beaver ponds, including a species absent (the moor frog) in natural waters (non-beaver and temporary ponds). Moor frogs obviously benefitted from pond construction and tree removal by beavers leading to a plenitude of shallow

water and a wide belt of emergent vegetation. Results show that beavers offer high-quality habitats for anurans and facilitate the occurrence of moor frogs. It is suggested that these ecosystem engineers could be used in ecosystem restoration. The beaver clearly represents a species that promotes amphibian conservation.

**056 Antagonistic Indirect Interactions between Large and Small Frog Tadpoles via Intensified Predation from Larval Salamander**

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Intrapopulation size variation causes ecological interactions to have complicated outcomes because individuals belonging to different size groups have distinct functions, thus causing community properties to have a variable nature as well. Most demonstrations of the impacts of size variation in trophic systems have focused on size variation in predator species, and the consequences of size variation in prey species are less well understood. We investigated how prey size structure shapes intra- and interspecific interactions in experiments with a size-dependent predator (larvae of the Hokkaido salamander, *Hynobius retardatus*) and its heterospecific prey (tadpoles of the Hokkaido frog, *Rana pirica*). We found that large and small tadpole size groups each negatively affected mortality in the other group by intensifying salamander predation. The antagonistic impacts on the prey size groups were caused by different size-specific mechanisms. By consuming small tadpoles, the salamanders grew large enough to consume large tadpoles. The activity of large tadpoles, by increasing the activity of the small tadpoles, may increase the number of encounters with the predator and thus small tadpole mortality. These results suggest that the magnitude of a predator's ecological role, such as whether a top-down trophic cascade is initiated, depends on size variation in its heterospecific prey.

**057 Genetic Diversity and Phylogenetic Relationships of *Gazella subgutturosa* Based on MtDNA Cytochrome b Gene in Xinjiang, China**

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*Gazella subgutturosa* is an important ungulate species and ranked in class II key protected wildlife in China. To investigate and know genetic diversity and the phylogenetic relationships among *Gazella subgutturosa* in Xinjiang, China, we obtained muscle samples from individuals that were poached or died naturally. We also collected fecal samples. DNA was extracted using the improved method from both muscle and feces samples. The cytochrome b gene was PCR-amplified and sequenced. Alignment of sequences with ClustalW 1.6, construction of phylogenetic trees by the maximum likelihood, neighbor-joining methods, calculation of genetic distances were implemented in MEGA v. 6. Haplotype diversity, nucleotide diversity were calculated using DnaSP v. 5. The results showed that 12 haplotypes were defined. Relatively low haplotype diversity ( $0.756 \pm 0.037$ ) and nucleotide diversity ( $0.00146 \pm 0.0002$ ) were noted. The mean genetic distances between 12 haplotypes were 0.0009-0.0047. In both molecular phylogenetic trees, two main lineages were classified. Clade A was

clustered by two haplotypes with an 87% bootstrap value, and clade B was composed of 10 haplotypes. The level of genetic diversity is evidence of long term survival of species. Losing of genetic diversity has an adverse impact on the survival of species. We found that the variation of cytochrome b was lower. The decrease in habitat, degradation of vegetation, over-hunting and illegal poaching most likely contributed to this issue. In addition, no significant differentiations occurred among populations. This result is consistent with the haplotype results. Thus the results could provide a useful scientific data for future conservation management of *Gazella subgutturosa*. The study was supported by National Nature Science Fund project (Issue: 31360266; 31060152).

#### **058 Age Determination from Annual Layers Formed in the Horn Sheath**

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Age was determined from the keratin deposition in serow horns. Japanese serow (*Capricornis crispus*) is an endemic species belonging to the caprid group, and inhabits Honshu, Shikoku and Kyushu. A total of 40 horns were collected from carcasses that had died due to natural causes between 2004 and 2006 in the Akita Prefecture, northern Honshu. To estimate the demographic parameters of the serow population, we need to determine age and sex from the horns. Although horn rings were observed in the surface of the horn, these horns were incomplete because they were cut off by saw. We attempt, therefore, to determine the age by annual layers formed in the keratin deposition. The horn sheath was cut vertically at the midpoint by saw and the face of the section was polished with abrasive paper. The polished face of the horn was etched by immersing it in a solution of 60% nitric acid for 5-30 minutes. After the horn was rinsed in tap water and dried, we observed the face under a stereomicroscope. Annual layers were observed in the keratin deposition of the horn. The distinctness of the layers, however, varied with etching hours, probably due to a difference in density of keratin deposition. The maximum age of the samples was 25.5-26.5 years old with an average age of 5.7 years old. Further research is required to increase number of samples and analyze population dynamics.

#### **059 Indirect Impacts of Overbrowsing by Sika Deer on Bumblebees**

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Some previous studies suggested that deer browsing influenced bee species with a long-active season such as bumblebees. Despite hyper-abundant deer density in forest ecosystems of Japan, a little is known of the impacts of deer on Japanese bumblebee species. We assessed the influence of increasing deer population on the abundance, species richness, diversity and species composition of bumblebee communities. We collected bumblebees at Nakajima Island (high deer density: 11.5deer/km<sup>2</sup>) and lakeside forests (low deer density: >1deer/km<sup>2</sup>) in Lake Toya, in the southwest region of Hokkaido. We set up 3 plots at Nakajima Island and lakeside forests and recorded number of flowering plants in these plots. As a result, only few flowering plants were observed in Nakajima Island. Bumblebee abundance of lakeside forests was significantly higher than that of Nakajima Island; however, we could not determine the significant difference on species richness of bumblebee. We also calculated diversity index (Shannon-Wiener) and the results were statistically significant to

conclude, species composition segregation of bumblebee communities between Nakajima Island and lakeside forests. Our results also indicated that, the bumblebee community in high deer density ecosystem characterized by short-tongued species, including *Bombus hypocrita sapporoensis* and *B. ardens sakagamii*. Conversely, the bumblebee community in lower deer density was comprised by long-tongued species such as *B. diversus tersatus*.

In conclusion, these results suggested that deer density influenced bumblebee community through vegetation modification and temporary interruption of floral phenology by deer overbrowsing.

## **060 The Strategy of Forest Network Management: Reconciling Wildlife Conservation and Reduction of Crop Damage**

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Reconciling wildlife conservation and reduction of crop damage by animals is an essential issue for sustainable agriculture. Focusing on forest network is important to tackle this issue, because both the conservation and management of species require forest connectivity. Here, we hypothesized that the species groups to be conserved and those need to be managed to reduce crop damage have different requirements on forest network structure types. For example, preferable network structure of forest dwelling species (conservation target species) such as birds would be related to total component size or patch-aggregability because those species usually complete their lifecycle within the forest. On the other hand, the species which cause damage on crops, such as deer, would prefer network structure which only is related to centralities (i.e. number of direct and indirect connected patches regardless of patch size), because they require forest network to move around within the landscape. We clarified differences of required network structure types between two species groups (i.e. birds, carbide beetles, and spiders as conservation target species, and sika deer (*Cervus nippon*), red fox (*Vulpes vulpes*), and voles as management target species) in agricultural landscape. Although effective connectivity threshold varied with species, results supported our hypotheses. Additionally, most of the forest patches which have high contribution to maintaining management target species group and low contribution to maintaining conservation target species groups were riparian forests. These results suggest management of riparian forest taking into account network structure is a practical solution for future landscape management.

## **[061-090]**

### **061 Annual Changes of Spatial Genetic Structure in Gray-Sided Vole Populations**

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Spatial genetic structure is formed by gene flow and genetic drift in an ecological time scale. Population fluctuation may affect spatial genetic structure, because low densities may cause genetic drift, and high densities may enhance gene flow through density dependent dispersal. For example, a study shows that in cyclic populations of the fossorial water vole spatial genetic structure becomes obscure in high density years. However, in non-cyclic area of the gray-sided vole (Ishikari, Hokkaido, Japan), spatial genetic structure shows only little changes. Then, the following questions arise. Are these differences caused by a difference in the species? Or are these differences produced by the

different pattern of population fluctuation? In this study we investigated spatial genetic structure of gray-sided vole populations in cyclic area, in Nemuro, East Hokkaido, Japan. We will show changes of spatial genetic structure for consecutive years in which high density and low density are observed. Further, we will examine the relationship between spatial genetic structure and population fluctuation by comparing Ishikari populations.

**062 Different Processes of Acclimation to Acorn Tannins in the Three Sympatric Forest-Dwelling Rodent Species in the Field of Hokkaido, Japan**

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Acorns are an important resource for forest-dwelling rodents; however, some species of acorns contain high level of tannins and thus have a potential to cause negative effects to consumers. Contrary, *Apodemus speciosus* has been demonstrated to have the ability to mitigate negative effects of tannins through acclimation. In the Uryu Experimental Forest of Hokkaido University, the relationship between acorn crop and population dynamics of the three sympatric rodent species (*A. speciosus*, *A. argenteus*, and *Myodes rufocanus*) has been investigated since 1992. The population density of *A. speciosus* is well synchronized with acorn crop, but it is not true for the other two species. One of the reasons for this difference is thought to be the difference in tannin tolerance among the three rodent species. Then, in order to clarify interspecific differences in tannin tolerance, we conducted the feeding experiment using *Quercus crispula* acorns. Animals of the three species were provided only shelled acorns for 5 days after two weeks of the acclimation period. As a result, *A. argenteus* and *M. rufocanus* reduced their weight 7 and 14% in average despite the acclimation period, but *A. speciosus* increased their weight, which indicates that *A. speciosus* has higher tannin tolerance than the other two species. It suggests that interspecific differences in tannin tolerance may partly regulate the relationship between acorn crop and rodent population dynamics. In addition, we will report seasonal changes in tannin intake (estimated using feces) of the three species to understand the process of acclimation to tannins in the field.

**063 Space Use in a Seasonal Environment: Antelope Jackrabbits in the Sonoran Desert**

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Knowledge of the basic ecology of small game species is crucial to understanding how animals are using the landscape during a period of rapid and extreme changes due to human development and climate change. The antelope jackrabbit (*Lepus alleni*) is a large hare found in southern Arizona, USA and Mexico. Despite its large size and conspicuous presence on the desert landscape, little is known about the antelope jackrabbit. For this study, we track antelope jackrabbits across the Buenos Aires National Wildlife Refuge in southern Arizona across multiple seasons and years. Using data obtained from radio telemetry locations, we determine home range size and track seasonal movements of male and female animals. We use GIS to plot animal locations and habitat layers to determine whether animals change their locations seasonally, possibly indicating a shift in habitat based on food or cover availability. Our results show average male antelope jackrabbit home range size is smaller than female home range size. We have not detected significant seasonal movements. This

study is the first to document the large but stable home range of antelope jackrabbits. This information will allow managers to more accurately anticipate antelope jackrabbit space use patterns in a highly seasonal setting.

**064 Habitat Preference of the Japanese Giant Flying Squirrel *Petaurista leucogenys* at an Isolated Satoyama**

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We studied the distribution pattern of the Japanese giant flying squirrel *Petaurista leucogenys* at an isolated Satoyama forest at Machida city in Tokyo that have been encroached and fragmented by urbanization. The following three survey methods were conducted at a with mixture of secondary deciduous forest and homestead woodland: 1) nightly line transect covering an area of 54 ha, 2) finding tree hollows in an area of 33 ha, and watching the emergence of the squirrels from the hollows, and 3) counting. Pill-like feces were collected from the base of 10 large trees at 54 plots in a 98 ha study area. The population density obtained from the line transect was 0.41/ha at evergreen homestead woodlands and 0.03 / ha at deciduous Satoyama, averaging at 0.08/ha for the total area. The squirrel was not sighted at areas beyond 450 m away from the homestead woodlands. The distribution of tree hollow nests was much denser at homestead woodlands and the nest use ratio averaged at 47 %. The estimated density of nest use was 2.0/ha at homestead woodlands and 0.22/ha at deciduous Satoyama. The distribution of feces also concentrated in homestead woodlands. A maximum of 517 feces were found in a plot. Even at areas where the squirrel was not sighted by line transect, a small number of feces were found. All the methods indicated strong preference of the squirrel for large trees.

**065 Characteristics of Reproduction and Food Habits of Sika Deer Population in Oze Region, Gunma Prefecture, Japan**

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Characteristics of reproduction and food habits of the sika deer (*Cervus nippon*) in Oze region, Gunma Prefecture were studied based on fetal development and rumen contents analysis and compared to the population in Akagi Mountain, Gunma Prefecture in order to evaluate the condition status of the sika deer population. The bamboo grass (*Sasa* sp.), the sedge (*Carex* sp.) and graminoids made up the main diet, comprise more than 70% of rumen composition, year-round in the Oze population, and the Hiba arborvitae (*Thujaopsis dolabrata*) was noted for sika deer in Oze during April and May and crimson glory vine (*Vitis coignetiae*) during October to January. On the other hand, the sika deer in Akagi Mt. were consuming mainly the bamboo grass (*Sasa* sp.) year-round. Pregnant females were identified in both of the populations from age 1.5 but the percentage of pregnancy differed with 82.7~82.9% for sika deer in Oze and 58.8%~72.6% for sika deer in Akagi. It is assumed that the deer's diet reflects the diversity of food resources available in the region as well as seasonal variations, and the limitations in the diversity of food resources may lead to lower rate of pregnancy.



**067 Diet Composition of the Golden Jackal in an Area of Intensive Big Game Management (Somogy County, Hungary)**

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The golden jackal (*Canis aureus*) is one of the most successful medium-sized carnivores (mesopredator) of the 21st century in East-Central Europe. It is native to three continents as its occurrence area ranges from North- and East Africa to Southern Europe, and eastwards to Central- and South Asia. The dynamic spreading of golden jackal in the last two decades in Hungary generates various human - carnivore conflicts. In this study we presumed that jackals would consume ungulates (or viscera) in considerable proportions in an area of intensive big game management. We collected and analyzed 62 stomachs of golden jackals during a period of two years in Somogy County, south-west Hungary according to season, sex, age and time of collection. Viscera and cadavers of wild ungulates were the primary foods of jackals in every season (percentage of wet weight: 55%), additionally, the consumption of adult wild boar /cervids was remarkable. Calf of red deer/fallow deer was detected in one stomach. Adult jackals completed their primary food with big game in a greater ratio, while younger ones rather consumed plants and invertebrates complementary. There was no relevant detectable difference between the sexes. At night wild boar, while in the daytime plants and invertebrate species served as important complementary foods. We found no evidence for the significant damage jackals are believed to cause to big game populations.

**068 The Utilization of Latrines of the Raccoon Dog**

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We conducted a long-term field study on the use of latrines by raccoon dogs. The study areas included Mt. Koujin-yama, in the Otobe district and Mt. Sawaguchi-yama, in the Teshiromori district, Morioka, Iwate Prefecture, Japan. In each study area, we installed sensor cameras at the latrines from March to December, 2013. Each time a raccoon dog used the latrine, we recorded the individual and the time of day. A chi-square test was used to compare the number of times a latrine was used within different time periods for each month. There was a significant bias in latrine use according to month. In latrines that were used by multiple individuals, the use by different individuals fluctuated from May to August. During this time, raccoon dogs go through a period of pregnancy, birth and nursing, and it is thought that these events influence the use of latrines.

**069 Evaluation of Sex-Specific Ecological Traits of the Iriomote Cat by Using Faecal DNA**

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The Iriomote cat (*Prionailurus bengalensis iriomotensis*), with approximately 100 individuals, is one of the most critically endangered wild cat populations in the world, and it lives in the smallest

habitat for a native cat population. The conservation of female Iriomote cats is considered to be a high conservation priority since they are exclusively responsible for the rearing of kittens, and their presence is conditional on a high-quality habitat. Sex specific ecological data is important to determine how certain ecological variables affect both sexes. This study was conducted to test if both sexes, especially females, were still found in different habitats along roads on Iriomote-jima Island. Scat samples were collected, and genetic methods for species and sex determination from fecal DNA were elaborated. Sex-specific ecological traits were examined by nested GLM, assuming binomial error and log link function with the response variable as binary data. The presence of male samples was found to be statistically significant to certain degraded habitats, although female samples were also common along these habitats. The presence of female samples along degraded habitats could signify that the decrease of natural habitats in the lowlands is forcing female cats to use these areas. The high number of male samples along these same habitats could be explained by the presence of transient males and/or resident males. Further studies should be conducted to determine the population dynamics of Iriomote cats in these areas and sustainable management plans for these habitats should be established.

#### **070 Identifying Risk of Agricultural and Property Damage from Increasing Wild Mammal Populations in Shrinking Human Society**

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Accelerating depopulation has emerged as one of the most serious social problems in developed countries such as Japan and some European nations. In particular, depopulation in rural Japan has caused a marked hollowing out of communities and industries in the last three decades. This social phenomenon has inevitably led to declining stakeholders involved with wild mammals, such as agricultural workers, game hunters, and wildlife managers, thus resulting in the breakdown of the traditional wildlife management system. Here, we identified the social risk caused by increasing wild mammal populations, *e.g.*, Japanese macaque (*Macaca fuscata*), wild boar (*Sus Scrofa*), and masked palm civet (*Paguma larvata*) in Yamagata, Northern Japan. This is a typical prefecture with a high human depopulation rate (−7.2% per decade). We conducted a questionnaire survey on social risk in 2014. The results showed that crop damage is trending upward, although both the number of agricultural workers and the total cultivated area have declined over the past few years. This indicates that the shrinking human population encourages further expansion of mammal populations, leading to immense harm to the remaining agricultural workers, who have a low incentive to practice valid damage control methods. This trend is expected to remain unchanged in the future because it is predicted that more than 30% of the human population, including the stakeholders, in Yamagata will have disappeared by 2040. In our poster, we will also discuss the risk of property damage from increasing wild mammal populations.

### **071 Food Habits of Black Bears in Urban Versus Rural Alabama**

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Little is known about the food habits of the black bears (*Ursus americanus*) in Alabama. A major concern is the amount of human influence in the diet of these bears as humans and bear populations continue to expand in a finite landscape, and bear-human interactions increase. To better understand dietary habits of bears, 137 scats were collected during the fall months of 2011-2014. Food items were generally classified into the major categories of vegetation, animal prey, and human (cultivated) food. Plant items were classified down to the lowest possible taxon via DNA analysis, as this category composed a majority of the scat volumes. Frequency of occurrence and volumetric weight was also calculated for each of the food items. Interestingly, despite the proximity of these bear populations to urban and suburban locations, we estimated that their diet composition, at least during the period sampled, remained mostly composed of wild plant matter instead of human food. Also, dietary composition did not differ between bears living close to urban areas compared to bears occupying more rural areas.

### **072 Estimating Density of Sika Deer Population from Random Encounter Model Using Camera-Trap Survey**

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The random encounter model (REM) using camera-trap has been recently used to estimate the density of various wildlife species without unique naturally or artificially marked individuals, while the evaluation of factors affecting the estimates is still lacking. We evaluated the utility of REM as a tool for monitoring the sika deer (*Cervus nippon*) population. Density estimates showed a clear seasonal pattern with high density estimates in May-June and October and low density estimates in December-March due to seasonal variation of photographic frequency for sex-age classes. The speed of animal movement in the study area was relatively stable during all the seasons, and there were no significant differences with that in another study area, except during spring migration season. In addition, breeding and rutting behavior influenced photographic frequency, which may have caused a bias in density estimates. Consequently, we suggest that REM is the most suitable in summer and is a useful monitoring tool for the sika deer population.

**073 Does the Reproductive Cost to the Female Siberian Flying Squirrel Differ between Spring and Summer?**

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The Siberian flying squirrel *Pteromys volans orii* breeds twice a year. In the city of Obihiro, in northern Japan, the first (spring) breeding period starts in late February, and juveniles are weaned between June and July. The second (summer) breeding period starts after the first breeding period finishes. The short hiatus between the two breeding periods does not give enough time for restoration of the mother's body condition for the second breeding. The reproductive cost of the first breeding must therefore be low enough to enable the mother to start the second breeding. Moreover, the cost of the second breeding must be high enough to enable successful overwintering of her offspring. Therefore, we hypothesized that the reproductive cost to flying squirrels differs between seasons. To test our hypothesis we compared litter size, body mass at birth and weaning, growth rate of offspring to weaning, and change in maternal body mass up to weaning between seasons. There were no significant seasonal differences in any of the parameters. However, litter size tended to be larger in the second breeding than in the first, and maternal body mass tended to be lower in the second breeding than in the first. These results suggest that the reproductive cost to female Siberian flying squirrels for the second breeding is greater than that for the first.

**074 Analysis of Factors Affecting Brown Bear (*Ursus arctos*) Maize Consumption with Attention to the Effect of Landscape Structure and Genetic Information in Eastern Hokkaido, Japan**

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In Hokkaido, Japan, human-bear conflicts are increasing due to agricultural crop depredation and invasion of human settlements by brown bears (*Ursus arctos*). To manage these problems, many bears are killed annually. Recently, several studies have proven that brown bears show difference in consumption of agricultural crops, such as maize, among individuals. To conserve the bear population, non-harmful bears should not be killed. However, factors to determine crop consumption by brown bears is not studied in detail. To develop the strategies for minimizing the human-bear conflicts, detecting non-harmful bears and understanding why bears consume agricultural crops are necessary. Here, we introduce two hypotheses: (1) Bears, which inhabit the nearer crop fields, tend to consume more maize; (2) Maize consumers have a close kinship. To test these hypotheses, we examine landscape and genetic factors that affect maize consumption with brown bear by using bear hair samples (n=61) collected from 2011 to 2014 in eastern Hokkaido, Japan. In eastern Hokkaido, there are extensive agricultural areas and agricultural crop depredation by bears frequently occurs. Based on given the results, we discuss to detect factors that affect bear decision.

### **075 UAV Monitoring as a Non-Invasive Tool for Wildlife Management in Inaccessible Wetland Ecosystems**

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In recent years, Hokkaido, located in northern Japan, has seen an explosive increase in Sika deer (*Cervus nippon*) population. With the increase in deer population follows an increase in damage to the wetland ecosystem. To manage this increase in damage, monitoring data is required. Satellite imagery and aerial photography, as methods of data collection have been available for quite a while in habitat management; however the resolution of satellite imagery is limited. High-resolution satellite imagery and aerial photography are costly and thus not well suited for continuous monitoring. In recent years, the development of civilian UAV/UAS's has been on the rise. In this study we aim to evaluate the pro's, con's and cost performance of UAV use as a tool in wildlife management. As our study site we chose the wetland ecosystems of Kiritappu and Kushiro, located in the eastern part of Hokkaido. From imagery taken we aim to determine the visibility of deer game trails on UAV imagery by comparing it to deer game trails we recorded by GPS, in the wetlands. This may possibly eliminate the need for entering wetlands for monitoring, as well as enabling a cheaper way for continuous monitoring. Furthermore, we aim to determine if the use of UAV's has any impacts, or cause any disturbances to the birds of the wetlands, particularly the endangered Japanese red-crowned cranes (*Grus japonensis*).

### **076 Observations on the Ryukyu Long-Furred Rat in Captivity**

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The Ryukyu long-furred rat (*Diplothrix legata*) is a large-sized rodent with head body length of 220-330 mm and is endemic to the Amami-oshima, Tokuno-shima, and Okinawa-jima islands in the Ryukyu Archipelago, Japan. This species was designated as a National Natural Monument in 1972, and is listed as "endangered" by the IUCN (2014) and the Ministry of the Environment of Japan (2014). Predation by feral cats and introduced mongooses, habitat destruction and fragmentation, and the increase in road kills have contributed to the recent population declines of *D. legata* in all three islands. From some records, this species is known to be omnivorous, to be nocturnal, and to primarily live in trees and to nest in tree holes. In order to obtain more detailed ecological information on this species, we started rearing two individuals (1 male and 1 female) separately at Okinawa Zoo and Museum from March 2014. We are conducting observations using a fixed camera in each cage, and are recording calls using voice recorders and foraging behavior using video camera traps. In this presentation, we will report the preliminary results on the daily activity pattern, utilization of nest boxes, food choice, and some call characteristics of *D. legata* in captivity.

## **077 Estimation and Prevention Techniques of Transmission Risk of Avian Infectious Disease in Livestock Farms**

**Yuichi Osa**<sup>1</sup>, Kei Fujii<sup>2</sup>, Ango Okoshi<sup>1</sup>, Daiji Endoh<sup>3</sup>, Masami Kaneko<sup>3</sup>, Mitsuhiro Asakawa<sup>3</sup>, <sup>1</sup>Hokkaido Research Organization, Sapporo, Japan; <sup>2</sup>OAT Agrio Co., Ltd, Naruto, Japan; <sup>3</sup>Rakuno Gakuen University, Ebetsu, Japan. Contact: osa@hro.or.jp

There is a possibility that some pathogens of livestock infectious diseases, such as salmonella, are transmitted from crows, sparrows and other wild birds. To estimate the transmission risk of avian pathogens between wild birds and dairy cows, we carried out priority research project of Hokkaido Research Organization, "Development of risk estimation and prevention techniques for avian infectious disease (2011-2013)". The results of this project showed that jungle crow (*Corvus macrorhynchos*) and carrion crow (*Corvus corone*) are carriers of salmonella and estimated that its transmission risk is lower at stock farms in plain area than farms at mountains or hills in which crows roost. To minimize the transmission risk, we developed a birdproof sheet curtain and verified that it was effective for preventing invasion of crows into cowsheds. Furthermore, we established identification techniques of both pathogen and host by a comprehensive genetic analysis and constructed an electronic chart system for wildlife diseases. In conclusion, we prepared a guidebook for prevention techniques of infectious disease from wild birds to livestock. In this presentation, we will discuss a process of achieving the coexistence of wild birds with livestock farmers.

## **078 Genetic Structure of Formosan Sambar Deer Based on the Mitochondrial D-Loop Region**

**Chien-Yi Hung**<sup>1</sup>, Ying Wang<sup>2</sup>, Shih-Ching Yen<sup>2</sup>, Yu-Ten Ju<sup>1</sup>, <sup>1</sup>National Taiwan University, Taipei, Taiwan; <sup>2</sup>National Taiwan Normal University, Taipei, Taiwan. Contact: r00626012@ntu.edu.tw

Sambar deer is widely distributed in the south and southeast of Asia. Formosan sambar (*Rusa unicolor swinhoei*) is the only endemic subspecies in Taiwan. The population size of Formosan sambar had once declined due to hunting pressure and habitat fragmentation but recovered under conservation program. To provide effective conservation strategies, the genetic structure of Formosan sambar population is a discriminating source to obtain. In this study, we investigated the genetic structure of Formosan sambar based on the polymorphism of mitochondrial D-loop region, which is a preferable marker of phylogenetic relationship because of its high mutation rate and non-recombination feature. A total of 120 partial D-loop sequences of Formosan sambar from Sheipa (SP), Taroko (TRK), Yushan (YS) National Parks, and Dawushan Nature Reserve (DWS) had been amplified by polymerase chain reaction with DNA extracted from feces. Software including DNASTAR, DnaSP and MEGA were applied to analyze the haplotype categories, genetic distances, and phylogenetic trees. Fourteen haplotypes of partial D-loop sequences were obtained, and were significantly divided into two clades noted as the north and the south clade by phylogenetic tree. The north clade is distributed in SP and TRK, while the south clade in TRK, YS, and DWS. The genetic distance between two clades was 0.00682, and the divergence time was estimated to be 85,250 years before present. Overall, this study demonstrates that Formosan sambar is now divided into two groups. In the future, more evidences are required to verify the differentiation status of Formosan sambar nowadays.

**079 Winter Food Habits of the Raccoon Dogs in Snowy Cold Districts in Northern Japan: What Do They Eat in Winter without Hibernating?**

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This study was conducted to clarify the food habits in winter season of the raccoon dogs (*Nyctereutes procyonoides viverrinus*) which inhabit the snowy cold districts. The study was carried out in Morioka of Iwate Prefecture, in northern Japan, from December 2013 to April 2015. It is thought that it becomes difficult to get food in the winter season due to the snow in this districts. However, the raccoon dogs in Morioka do not hibernate. Therefore this study investigated what raccoon dogs eat in the winter season by feces analysis. 180 feces were collected and analyzed from December 2013 by April 2014. The raccoon dogs used cultivated plants (86.1%) and insects (78.3%) in winter. Particularly, apples (*Malus domestica* Borkh) and larvae of a kind of March flies (*Bibio tenebrosus*), were predominant. Apple's frequency of occurrence increased from December through April. The appearance frequency of March flies decreased from December to February and increased again in March and April. It is thought to be related to the difficulties of searching for March flies in the snow. This presentation reports food habits of the winter season in detail using the data of second season from December 2014 to April 2015.

**080 Home, Sweet Home: Heeding Range on Den Site Selection by Urban Red Foxes**

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A spatial model of den site selection by urban red foxes, *Vulpes vulpes*, the definitive host of *Echinococcus multilocularis*, was established to specify the optimal micro-habitats for delivering anthelmintic baits. The model was established for two cities (Obihiro and Sapporo) which have different degrees of urbanization in Hokkaido, Japan. The modeling process was designed to detect key environmental factors and spatial scale that foxes pay attention to most (here named "heeding range") when they select den sites. Logistic regression analysis was conducted with "presence" or "absence" of fox den as the objective variable and nine landscape categories customized for urban environments as predictor variables. This procedure was conducted for each of ten sizes of concentric circles (100-1000 m) from dens and control points. Established models suggest that requirements for denning are low percentages of wide roads, narrow roads, and occupied buildings, but high percentages of green covered areas within the circle of 500 m radius in Obihiro fox population; low percentages of wide roads, occupied buildings, but high percentages of riverbeds and green covered areas within 300 m radius in Sapporo. The difference in size of the key spatial scale between the two cities populations may come from the differences in their sensitivities to the surrounding environments. Both populations focused on the densities of wide roads, occupied buildings and green covered areas in common for their den sites. These models indicating suitable sites for delivering baits will improve the cost-benefit performance of the deworming campaign.

## **082 Camera Trap for Inquiring Feeding Pattern of Sika Deer in Deciduous Forest with Severely Declined Understory**

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Recently, sika deer population (*Cervus nippon*) have increased in several regions in Japan, and their overbrowsing leads to forest understory declines. In such forests, deer were surviving though there were fewer resource. There are few studies evaluating how deer get food resources necessary for survival in such an environment. The objective of this study was to determine deer foraging site and frequency in such forest with declined understory. We set 20 trap cameras with video-mode (made by Bushnell TrophyCam) in 522 ha. We measured their behavior time and divided them in six categories (foraging time, searching time, foraging behavior time, staying time, ruminating time, blind time) from recorded video to clarify the foraging site quantitatively. Deer foraged at specific sites intensively, and Relative Abundance Index (RAI) was not correlated with foraging time among camera points. It was suggested that deer used different places for migration, resting and foraging.

## **083 Genetic Characteristics of Japanese Wild Boars on Mt. Kinka, Gifu Prefecture, Japan**

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Mt. Kinka is an isolated mountain in the urban area of Gifu Prefecture, central Japan, covering 597 ha. Although there have been no reports on the existence of any other large mammals, it has been confirmed that wild boars (*Sus scrofa leucomystax*) have lived on the mountain for approximately 20 years. The possible risks caused by boars are represented by traffic accidents and the concern regarding the impact on tourism, and these risks increase the necessity of management. Although the origin of the wild boar population on Mt. Kinka is unknown, the knowledge about it, including the possibility of intentional introduction or natural invasion, is required to develop a management plan. In the present study, to reveal the origin of the population, we attempted to analyze the genetic relationship of boars on Mt. Kinka to boars in other areas in Gifu Prefecture. We used 29 microsatellite markers and elucidated the genetic structure by STRUCTURE software (n = 172, including 2 individuals from Mt. Kinka). In these 2 boars from Mt. Kinka, although 1 individual had a typical genotype as boars from the surrounding area, the other had a genotype close to the genotype of a distant area. The result suggests the possibility of intentional introduction; therefore, we should consider continuous population monitoring, investigation of the settlement details, and prevention of further introduction. Analysis of additional samples from Mt. Kinka will provide us with fundamental information for decision making.



**084 Trials for Extensive Trend Monitoring of Brown Bear (*Ursus arctos*) Population Using the Combination of Scented Wooden Post Hair-Snares and Camera Traps**

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Recently, human-bear conflicts such as crop depredation and invasion into human residential areas by Hokkaido brown bears (*Ursus arctos*) are increasing. In the landscape levels, crop fields and neighboring forests are located in the periphery of bear distribution and are an attractive habitat for bears where there are high quality food sources such as crops and sika-deer (*Cervus nippon*) carcasses, which are a product of culling the deer. Therefore there is a high conflict of habitat between human and bears which then produces high human-derived mortality of bears. If the present control kills of bears are continued as only management option without the non-lethal conflict prevention program, bears not only in peripheral areas, but also in core areas might become endangered. We, therefore, must monitor the population trend in extensive areas covering entire populations where spatial structures exist. We need to develop consistent and reliable methods for monitoring population trends in agreement with land managers. We are examining the applicability of a new sampling device which consisted of the combination of scented wooden post hair-snares and infra-red triggered camera traps since 2013. We have found that brown bears visited the devices frequently. We confirmed the seasonal differences in visitation rates for each sex-age cohort; adult males frequently visited in May and June and females with cubs during September and October. We could take bear hairs from 77% and movies and 92% of the devices, respectively. We will analyze these samples to find suitable indices for monitoring population trends.

**085 Feeding Habit of Red Foxes and Environmental Factors Determining Their Defecation Sites in Agricultural Tokachi, Hokkaido, Japan**

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Few reports focus on consumption of agricultural resources by red foxes. To evaluate agriculture losses due to red foxes, a precise grasp their feeding habits is necessary. Reduction of echinococcosis infection risk may be possible by determining red fox preferences for defecation sites. We determined whether red foxes depend on agricultural resources and identified environmental factors affecting defecation sites used by red foxes. This study was conducted in the agricultural areas of Obihiro, Hokkaido, Japan. From May to October 2012, we collected fox feces from 20 25-ha sites established randomly throughout the study area. Within collected feces, total volume percentage of agricultural crops was 9.6% and frequency of occurrence was 16.1%. These values were highest in autumn (26.4% and 39.5%, respectively). Feeding behavior of red foxes is reported as opportunistic. Since red foxes are generalist predators consuming easily accessible and abundant resources, agricultural crops could be an important food resource, especially in autumn. Four environmental factors (total areas of agricultural fields, forests, and structures; and total length of rivers) were associated with locations preferentially used by red foxes for defecate, but there were seasonal differences. Habitats with these factors might also be selected by red foxes for feeding, resting, or den sites.

**086 Elucidation of Mitochondrial DNA Haplotypes from Bone Samples of Extinct Japanese Black Bear in Kyushu Island**

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Japanese black bear have 57 mitochondrial DNA (mtDNA) haplotypes. Previous study showed that these haplotypes were clustered into 3 lineages (Eastern, Western, and Southern clusters). However, the mtDNA haplotypes of Japanese black bear in Kyushu Island, the southwestern part of the Japanese archipelago have not been sufficiently known due to the difficulties in collecting samples except for the only one sample reported. The last reliable record of Japanese black bear in Kyushu Island was that captured in 1957, and the population was determined to be extinct in Kyushu Island by The Ministry of the Environment of Japan in 2012. In this study, we determined the haplotypes of Japanese black bear in Kyushu Island by using four rare bone samples found in various locations and at different times on Kyushu Island to clarify the molecular phylogeny of Japanese black bear in Kyushu Island. Out of four samples tested, we succeeded in detecting two new haplotypes from two samples and a haplotype of the Western cluster from one sample. These two new haplotypes belong to the Western cluster. We therefore concluded that there was a continuous distribution of Japanese black bear between western Chugoku and Kyushu Island, and the genetic variation occurred after habitat fragmentation. Our results would be acceptable in terms of genetically and geographic variations, and have brought new knowledge the movement of Japanese black bear from the Asian continent to Japan. This was also valuable information of the genetic structure for the disappeared bear population in Kyushu Island which has never reported except only one article.

**087 Difference in Age at First Conception between Early and Late Litters of Feral Raccoon in Kanagawa, Japan**

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The feral raccoons (*Procyon lotor*) were demonstrated to have the long parturition period in Kanagawa, Japan. However, there are no studies on when late-born raccoons mate and conceive for the first time. We assumed that age at first conception of late-born females was later than that of early-born females, and this study was conducted to elucidate the age at first conceptions and to analyze the differences of growth patterns between early- and late-born raccoons in Kamakura City, Kanagawa. From March 2005 to September 2008, 201 females estimated to be younger than 24 months were separated into early-born (February to May) and late-born (June to October) groups on the basis of their estimated birth month (to the nearest 2 months by the methods of cranial suture obliteration), and parous status of the uteri and body mass index (BMI; BMI = Body weight (kg) / Body length (m)<sup>2</sup>) were examined. Of the 201 females, 129 were classified as early-born and 72 as late-born. In the early-born group, less than 12 months old females did not conceive (0/88), but pregnant females were found at 12 months old (4/14). On the other hand, no females conceived until 16 months old in the late-born group (0/47), whereas pregnant females of them were

confirmed at 18 months (2/3). The average BMI in early-born individuals at 10-12 months old was higher than that in the late-born group (Mann-Whitney U test,  $p < 0.01$ ) might have affected their ability to conceive because of body fat deposition.

#### **088 Genetic Structure of the Urban Fox Population in Sapporo**

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The red fox (*Vulpes vulpes*) has been rapidly expanding its distribution to urban and suburban areas in some countries, and this is also the case in the city of Sapporo, Japan, where there has been considerable expansion since the 1990s. This species in cities is often called the “urban fox”. Because even urban foxes can carry zoonoses, it is important to understand their population structure and migration status. To clarify the population genetic structure and gene flow in urban foxes in Sapporo, this study examined the genotypes of nine microsatellite loci for about 570 road-killed foxes collected around Sapporo from 2002 to 2014 (except for 2009 and 2010). Population genetic analyses using the genotype data and spatial information from the samples revealed that the urban fox population in Sapporo is divided into three subpopulations. The boundaries separating these subpopulations are a river and a railway crossing the central area of the city. Furthermore, the subpopulations separated by the railway are more genetically different from one another than those separated by the river. With heavy automobile and pedestrian traffic, the roads along the railway might greatly impede fox migration. However, the level of genetic differentiation among the subpopulations is lower than for urban foxes previously reported from other countries. This suggests that the geographical barriers for the urban foxes in Sapporo are not so strict.

#### **089 Winter Spatio-Temporal Dynamics of a Boreal Carnivore-Prey Complex: An 11-Year Study**

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Carnivore species sharing same prey often compete for the resource each other. The competition often results in spatial segregation among carnivore species. However, few studies have tested whether strong spatial association between a carnivore species and prey might decrease accessibility of other carnivore species to prey, leading to weaker association between them. Here, we explored spatio-temporal relationships among five mammal species including American marten (*Martes americana*), snowshoe hare (*Lepus americanus*), red squirrel (*Tamiasciurus hudsonicus*), red fox (*Vulpes vulpes*) and Canadian lynx (*Lynx canadensis*). More specifically, we examined whether spatial association between marten and hare was influenced by the association of known competitors, fox and lynx, with hare or by marten relative abundance. We conducted 11 years of snow-tracking in southern Quebec (Canada), surveyed on 976 km of transect in total. We conducted exploratory path analyses through d-separation test to obtain directed acyclic graphs representing direct links among species each year separately. We modeled marten-hare path coefficients (proxies for strength of spatial interaction) as a function of hare-lynx coefficients, hare-fox coefficients, marten-hare coefficients in the previous winter and marten population index. The graphs showed that there was no marten-hare direct link when lynx was positively associated with hare. However, the model for

marten-hare path coefficients including marten population index performed better than the model including hare-lynx coefficients. Our results indicated that there was potential negative effect of interspecific competition on marten's access to hare. However, intraspecific competition had higher importance in a predator's access to prey than interspecific competition.

#### **090 Is it Good News or Bad News? The Impact of Increasing Sika Deer Population for Foraging Behavior of Brown Bears**

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The interactions among multiple animals include predator-prey relationship and competitive relationship. In general, predator-prey relationships are often established between herbivores and carnivores. In Hokkaido, the northern island of Japan, brown bear (*Ursus arctos*) and sika deer (*Cervus nippon*) occur in the same habitat, where brown bear is the only large carnivore to become a potential predator on sika deer. However, brown bears in Hokkaido were considered to be opportunistic omnivores that mainly depended on plants and used little or no meat materials until the 1980s. It means that both predator-prey relationship and competitive relationship are established between brown bears and sika deer. Recently, the deer population has been irrupting in eastern Hokkaido. In this situation, it is necessary to understand how the sika deer population has influenced brown bears. In this research, we focused on the foraging behavior of brown bears, and investigated whether increasing the sika deer population had a positive or negative influence on brown bears. As a result, we found that carcasses and fawns of sika deer are important food resources to brown bears. Thus, deer meat availability had a positive influence on the growth of brown bears. On the other hand, we suggest the possibility that overgrazing by sika deer had a negative influence on important plant resources for bears.

### [091-120]

#### **091 Distribution Pattern of Deer Population Density in Osaka Prefecture: What Factors Can Affect Deer Populations?**

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Increasing sika deer (*Cervus nippon*) population has caused severe damage to forest vegetation as well as agriculture and forestry resources in Japan. In the northern area of Osaka Prefecture, deer population density is increasing and the densities are widely different among regions. For better management of deer population, it is therefore important to figure out distribution pattern of deer population density and factors which can affect deer populations. Although sighting per unit effort, as deer density index, has been calculated in each hunting unit, large hunting prohibited area and small patch size of forests in this area have made it difficult to estimate deer distribution pattern. Here, using the fecal accumulation rate technique, we estimated deer population densities in 99

forests which were randomly distributed all over northern area of Osaka Prefecture, and analyzed what factors can affect the distribution pattern of deer population density. In November 2014, we established the study transect (200 m<sup>2</sup>) in each forest and cleared all deer fecal pellets from transects. After about 40 days, we counted the number of fecal pellet groups which had accumulated in each transect during time interval. Then, we calculated deer population density in each transect, and estimated the distribution pattern using the inverse distance weighting method. We also analyzed the relationship among deer population density and several environmental factors using GIS software. In the presentation, we will discuss about estimated total number of deer and the impact of anthropogenic disturbance on deer population density.

## **092 Food Web Structures Influence the Regional Differences in Carbon Stable Isotope Ratios of Wild Bears**

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When Asiatic black bears (*Ursus thibetanus*) forage, their  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  levels differ between those of bears that eat their native foods in the mountains and those of bears consuming anthropogenic foods. Therefore, measures of  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  in the bears' parts (tissues) can be useful in clarifying the extent of damage inflicted by nuisance bears. However, the  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  values of bear foods differ across the bear's range, so researchers must clarify how food affects the  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  of bear parts. We collected Asiatic black bear feces and food items, analyzed their carbon and nitrogen stable isotope ratios, and compared them among central Japan in the Northern Japanese Alps (NJA) and Ashio-Nikko Mountains (ANM). The  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  was significantly higher in bear hair in the ANM than in the NJA. Bears in the ANM consumed deer in spring and ants in summer. Ants in the ANM have relatively higher  $\delta^{13}\text{C}$  value than ants from other regions. *Miscanthus sinensis*, a C4 plant, is abundant in the ANM. We also analyzed the  $\delta^{13}\text{C}$  of herbivorous insects that were not consumed by bears; these also had high  $\delta^{13}\text{C}$ . From these analyses, because bears consume deer in spring and ants in summer, and because ants in turn may consume herbivorous insects that feed on C4 plants, the  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  in bear hair in the ANM may be higher when compared with that of other bears in central Japan.

## **093 Development of an Immunocontraceptive Vaccine in the Small Indian Mongoose**

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Since the introduction of the small Indian mongoose (*Herpestes auropunctatus*) to the Japanese islands of Okinawa in 1910 and Amami in 1979, it has affected the islands' native species. Population control has mainly been attempted through capture, with excellent results, but the eradication hasn't been attained yet. New methods for population control, especially species-specific methods

with no effect on native species, are required. To this end, we aimed to develop a contraceptive vaccine inducing immunological sterilization in mongooses. We decoded the full-length sequence of the mongoose ovum *zona pellucida* protein, and we identified the amino acid sequence of the sperm-binding region, a potential component of the target antigen. Comparisons with homologous species showed high levels of specificity for the target. Based on these results, we produced two custom peptides (A and B). Immunized rabbit serums were verified for antibody binding through immunohistochemistry in some carnivore ovaries, and these showed a species-specific reaction in the mongoose. We injected two types of peptides into live mongooses (N = 6, control = 5), and then collected the blood samples to verify immunogenicity by indirect ELISA. We used anti-ferret IgG as a secondary antibody. Some mongooses injected with peptide A showed an antibody titer increase at 2-8 weeks from the first injection, indicating that peptide A is a potential antigen, inducing autoantibody generation. The actual contraceptive effect and duration of antibody titer on live animals has yet to be confirmed, and the delivery system enabling oral immunization in the field must still be developed.

#### **094 Current Status of the Critically Endangered Okinawa Spiny Rat in Okinawa Island, Japan**

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The Okinawa spiny rat (OSR), *Tokudaia muenninki*, is endemic to the northern part of Okinawa Island, Japan. The OSR was thought to be extinct for nearly 30 years since its last capturing in 1978. Fortunately, the OSR was reconfirmed in 2008 by trapping that took place seven years after the latest indirect survey evidence from analysis of feral cat feces in 2001. For the conservation, it is necessary to clarify the current status and trend of the OSR population. We thus attempted to compile information on OSR from relevant data such as sensor camera investigations and trapping. During 2008-2014, only a small population of OSR was confirmed, which distributed in an approximately 16 km<sup>2</sup> area around an old-growth forest patch of Mt. Nishime designated as a Prefectural Special Wildlife Protection Area. The population increased until 2011, then, turned to decline in 2012. During the population-increase period, in 2009 and 2010, we observed rich crops of acorn on *Castanopsis sieboldii*, a dominant tree species and one of the most important food resources for OSR. However, in 2012, three severe typhoons hit the OSR inhabitant area, where the forests were severely damaged and bad crops followed until 2014. Thus, forest conservation as well as control of invasive mammal predators such as feral cats and dogs are prerequisite for the survival of OSR. For the protection of the small declining OSR population, both in-situ and ex-situ conservation schemes and their implementation are urgently required.

**095 Effects of Population Fluctuation on Genetic Diversity in the Gray-Sided Vole, *Myodes rufocanus*: A Comparison of Genetic Diversity between Cyclic and Non-Cyclic Populations**

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The gray-sided vole, *Myodes rufocanus*, shows two types of population fluctuations. One is cyclic at a 3 or 4 year interval, and the other is non-cyclic that does not show regular periodicity. It is expected that cyclic populations undergo bottlenecks frequently, and their genetic diversity is likely to be low in comparison with non-cyclic populations. Although this is an important topic linking population ecology with population genetics, very limited number of researches have tested this prediction in the field. In this study, we compared the genetic diversity of vole populations between cyclic and non-cyclic populations in Hokkaido, Japan by using mitochondrial D-loop sequences and microsatellite loci. However, against our prediction we did not find any clear regional pattern of genetic diversity in relation to cyclic and non-cyclic. For clarifying effects of population fluctuation on genetic diversity, we will report results of analyses that consider effects of seasonal fluctuation and other factors.

**096 Craniodental Geometric Morphometry of Eurasian Otter (*Lutra lutra*) in South Korea**

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Variation of craniodental morphology of the Eurasian otter in South Korea was studied with geometric morphometrics to identify sexual dimorphism. A morphological study in regional population helps for basic data establishment which will support any other study in different aspect to eventually be able to predict the behavior, adaptation and evolution of this carnivore species more precisely. Thus, the direction for conserving this species from going extinct will have better resolutions. Thirty-three adult skulls (17 male and 16 female) were used. Images of the dorsal and ventral view of the skull and right lateral of mandible were taken and then digitized by using tpsdig2 with only right side of them taken into measure. Analysis was done with tpsRelw and PAST software. Results showed some of the RW1 and RW2 revealed significance with  $p < 0.05$  in shape variation to differentiate male and female; however, they were also significantly correlated with the size of skull. Size difference between male and female skulls was also found highly significant. Bivariate plots did not separate male and female skulls in distinct but did showed the tendency of pooling of same sex samples at same side of the graph. All the results were consistent showing that shape variation of skull in Eurasian otter is related with the skull size. Skull size difference between male and female were significant that until a point of assumption could be made that most likely bigger size of the skull might indicated sex of male.

**097 Genetic Diversity and Genetic Structure of the Siberian Roe Deer Populations from Asia**

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The Siberian roe deer, *Capreolus pygargus*, is one of the most widespread meso-mammals of Palearctic, distributed throughout continental Asia and restricted area of Eastern Europe. Natural process and human influence have led to genetic structuring in wild populations of many deer species. To understand how these factors have affected genetic structure and connectivity of Siberian roe deer, we investigated variability at 12 microsatellite loci from ten locations of Asia. Moderate levels of genetic diversity (HE = 0.522 to 0.628) were found in all populations except in Jeju Island, Korea where the lowest diversity was found (HE = 0.386). Measures of genetic diversity were relatively high in eastern populations compared with western ones. Bayesian-based clustering analysis displays the existence of genetically distinct populations for Siberian roe deer as a whole, which comprise of southeastern group, northwestern group and Jeju Island population, bound up with geographical and ecological barrier (High mountain range, snow depth and duration of the snow period). Such pattern of genetic structure is well in accordance with the subspecific classification system of the species. On the other hand, genetic evidence also suggests an ongoing migration that may facilitate genetic admixture among adjacent regions. We suggested at least three distinct management units of roe deer in continental Asia, although genetic admixture was evidenced at regional scale. The present results have significant implications on management and conservation of local populations of Siberian roe deer in Asia.

#### **098 Sequence Diversity and Phylogeographic Relationship of Lesser White-Toothed Shrew in Northeast Asia**

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Comparative analysis of genetic variation and phylogenetic relationship can aid the understanding of evolutionary history, correct taxonomic status of species, and establish conservation units. *Crocidura shantungensis*, the Asian lesser white-toothed shrew, is widely distributed in Northeast Asia. In the present study, we examined the genetic diversity and phylogenetic relationship using the entire mitochondrial cytochrome b gene sequence (1,140 bp) with specimens from South Korea, China, Russia, Mongolia, and Taiwan. We obtained 96 haplotypes from 237 *Crocidura shantungensis* individuals, which could be divided into 4 groups. Group A was comprised of haplotypes from the South Korean peninsula & some islands, China, Russia, and Mongolia. Group B consisted entirely of haplotypes from only Taiwan. Haplotypes from individuals of Jeju-island in South Korea made up



group C, while Group D was composed of haplotypes from islands off the Southern coast of South Korea. Network and phylogenetic trees constructed with NJ, ML, MP and Bayesian methods shows 4 groups of similar structure. The overall haplotype and nucleotide diversity were 0.971 and 1.136%, respectively. This study suggests several independent refugia for *Crocidura shantungensis* in the Northeast Asia during the Pleistocene glacial periods. In order to develop a more complete picture of the evolutionary history and phylogenetic relationships of this species in Northeast Asia, further sampling within central China and the use of additional markers such as microsatellites and nuclear DNA sequences are needed.

#### **099 Home Range and Habitat Suitability Modeling of Wild Boar Inhabiting in Urban Areas, Korea**

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Wild boar population have increased in recent years in Korea, where agricultural damage and appearing in downtown are emerging issues. Wild boar appearance in cities like Seoul has caused gradual increase of negative awareness of wildlife. It is essential to understand home range and habitat of wild boar to set up an effective management strategies to reduce Human - wild boars conflict. We captured and monitored movements of wild boars using GPS collar in forests of Mt. Bukhan, Seoul (urban area; n = 3) and conducted habitat suitability modeling using arcGIS and Maxent. The average home range of 3 individuals analyzed with MCP(100%) and KDE (95%) were 20.0±12.7km<sup>2</sup>, 4±1.4 km<sup>2</sup> respectively. Habitat suitability modeling from 2,054 coordinates showed that wild boar could only inhabit in edge area of Mt. Bukhan and elevation is main parameter to determine model. Our results suggested that appearance of wild boar in downtown could increase if there will be no management strategies on wild boar population because boar's habitat is very limited and could easily reach carrying capacity.

#### **100 Bayesian Estimation of Population Density of Asiatic Black Bears in a Low-Density Area in Akita, Northern Japan**

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Estimation of population density is essential for the effective conservation and management of wildlife species; however, for elusive animals accurate estimation is a challenge. Camera trapping has become a standard tool in estimating population of elusive carnivores. In a management practice for Asiatic black bears (*Ursus thibetanus*) in Akita Prefecture, northern Japan, annual population size is estimated based on visual counts for dens/footprints/feces etc., but recent increase in bear sightings by citizens from a montane forested landscape where bears did not inhabited a few decades ago suggests that the bear habitat is expanding recently and/or the bear population itself is increasing. This study is thus aimed to develop an estimation model that integrates multiple datasets with different sources to evaluate current status of inhabitation of the bears in the area. We installed 59 camera traps in a 42 × 84 km area that includes areas with stable bear population and those without settled bears. We first developed a hierarchical capture-

recapture model using spatial data obtained by the camera traps. A total of 14 bears were trapped in the cameras, and the population density was estimated to be 0.037 bears/km<sup>2</sup> (95% credible intervals: 0.018-0.051). Our model is on the way to be improved by integrating the dataset obtained through traditional observation and a dataset derived through compilation of the bear sightings by citizens, eliminating spatial bias that originates from discordance between bear home ranges and the citizen's activity range.

### **101 Pyrazine Analogs in Wolf Urine Induce Avoidance and Fright Behaviors in Hokkaido Deer**

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Our previous studies indicated that an odor of pyrazine analogs in a predator's urine, wolf, induced fear-related aversive behaviors in laboratory mice. We hypothesized that the pyrazine analogs might produce a similar effect on other prey animals. To test this hypothesis, we investigated the effects of the pyrazine analog mixture (DMP, TMP and EDMP; P-mix) on Hokkaido deer (*Cervus nippon yesoensis*). We performed a feeding bioassay in a semi-natural deer park (44°12' N and 142°48' E, Nishiokoppe, Hokkaido, Japan) in August and September 2013, and observed the behaviors of the individual deer in gaining access to the feeding area associated with or without P-mix. The P-mix odor effectively suppressed the access of the deer to the feeding area. In addition, the odor provoked vigilance and fright behaviors, such as "tail-flag", "flight" and "jump" actions, of the deer around the feeding area. These results showed that the odor of pyrazine analogs in wolf urine induced avoidance and directly elicited fear-related reactions on ungulates as well as mice. The mixture of pyrazine analogs might be suitable for a chemical repellent that could limit damage to forests and agricultural crops by wild ungulates.

### **102 The Difference in Factors That Associated with Bear Intrusions of into Human Settlements between Spring and Autumn**

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The conflict between humans and wildlife has become a significant issue in conservation. Among them, bears are more difficult to manage than other species, because of their lower reproductive rates and lower natural densities. Recently, massive intrusions of Asiatic black bear (*Ursus thibetanus*) into human settlements have become a serious social problem in Japan. Many investigations have demonstrated that the number of nuisance bears is relatively high in years of low acorn production, which is a key plant species for bears; however, the reason why as to the cause for intrusions into human settlements has not been completely explained. In this study, we clarified the food habits of the bear from 1206 fecal samples collected between 2008 and 2014 in Shirakawa village, Gifu Prefecture, Japan. Bears fed on buds or shoots, and if available, acorns from the previous autumn in spring. During summer, bears fed on insects in addition to the green vegetation; and after August, berries and oak acorns had increased. We analyzed the relationship between acorn crop index of three Fagaceae family (*Quercus serrata*, *Q.crispula* and *Fagus crenata*) and number of nuisance bears using Markov chain Monte Carlo methods. A negative relationship was found with all

the three species of Fagaceae in autumn. Positive relationship was found with *Q. serrata* in spring. This suggests that factors that bears intrusion of into human settlements in spring are differ from those in autumn.

**103 Regional-Scale Population Structure of the Japanese Wild Boar (*Sus scrofa leucomystax*), as Revealed by Multilocus Microsatellite Analysis: A Case Study from Gifu Prefecture, Central Japan**

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In recent years, the Japanese wild boar (*Sus scrofa leucomystax*) has caused significant damage to food crops along with the expansion of its distribution range. Therefore, wildlife managements for wild boars are conducted by many local governments in Japan. Information obtained from molecular population genetics approaches may be useful for the local-scale management of wild boars. However, very few studies focusing on a local population of the Japanese wild boar have been carried out in the past. In the present study, we attempted to assess genetic structure of wild boar in Gifu Prefecture, central Japan, as an example of a local Japanese wild boar population, using autosomal 29 microsatellite markers. Based on Bayesian model-based clustering, despite analysis at the local population level, we were successfully able to identify two or five genetically distinctive subpopulations and to reveal that these subpopulations had low levels of gene flow from other areas. Additionally, significant genetic differentiations ( $F_{ST}$ ) were estimated between these subpopulations of a range of 0.020-0.128. The boundaries of some of these subpopulations generally consisted with rivers, railways, and motorways. The results indicate that habitat fragmentation and genetic substructuring may occur in the local population. The present study demonstrated that multilocus microsatellite analysis is effective in detecting genetic structure and differentiation within a local population of the Japanese wild boar. Thus, this population genetics approach has the potential to contribute to conservation and management of local Japanese wild boar.

**104 Timing and Duration of Sika Deer Migration in Hokkaido, Shikotsu-Toya National Park**

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On Hokkaido, in the northern part of Japan, seasonal migration is common for the Sika deer (*Cervus nippon*). Spring migration is mainly triggered by snow melting. Autumn migration is mainly triggered by snow accumulation. However, previous studies have not provided precise timing nor duration of migration due to the use of VHF telemetry. In this study, in order to improve management practice, we sought to make both migration timing and duration clear by tracking 24 sika deer between 2012 and 2013 by using GPS in Shikotsu-Toya National Park, Hokkaido. We used snow cover data from meteorological stations to evaluate the effects of snow cover on the timing of migration. Spring migration occurred during about 20 days after the snow had completely disappeared. The duration of spring migration was 1 to 64 days (median: 5 days). Autumn migration occurred before snow depth reached about 10 cm. The duration of autumn migration was 1 to 94 days (median: 2 days). Snow cover provided predictive indicators for timing of migration that combined with migration duration data could have positive implications for deer management.

**105 An Evaluation of Body Mass and Hind Foot Length as Indicators of Population Monitoring in Hokkaido Sika Deer**

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To evaluate the utility of body mass and hind foot length for monitoring of Hokkaido sika deer (*Cervus nippon yesoensis*) populations, we analyzed the time-series data of the measurements in each age-sex class at 3 regions from data collected between 1987-2014 on Shiretoko Peninsula, Hokkaido, Japan, where hunting pressure and deer density are different (low, middle and high). We used a linear regression analysis of body mass or hind foot length in each age-sex class at 3 regions as response variable and year of capture (short-term effect) or birth year (cohort effects: long-term effect) as explanatory variable. A clearer decreasing trend in body mass was observed by the short-term effects as compared with the long-term effects. Body mass decreased only in fawns in a low density region, whereas in fawns and adult males in a middle-density region, respectively. On the other hand, a clearer decreasing trend in hind foot length was observed in the middle and high density regions by the long-term effects compared with the short-term effects. Hind foot length decreased in fawn and adult males at a middle-density region and in both sexes of adults at a high-density region, respectively. Thus, we clearly demonstrated that body mass and hind foot length in each age-sex class has different sensitivity to deer density and are useful indicator for sika deer population monitoring

**106 A Regional Comparison of Home Range Size of Asiatic Black Bears between Areas with High and Low Density of Sika Deer**

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Dramatic increase of sika deer, *Cervus nippon*, is the major issue among Japanese wildlife managers in recent years; however, the impact of high density of deer on other sympatric species of large mammals has rarely been investigated. Here, we aimed to exploring the impact on Asiatic black bears, *Ursus thebetanus*, by comparing 2 areas with either a high and low density of sika deer in Nagano Prefecture. Study areas were Utsukushigahara Heights (UH) and Central Japan Alps (CA). Despite high density of deer in UH, bear density is higher in CA. From 2012 to 2014, we tracked GPS collared bears (6 males, 3 females in UH and 7 males, 4 females in CA), measured the home range sizes as minimum convex polygon (MCP) and compared them between the regions by Mann-Whitney U test. As the result, the average size in UH and CA were  $137.6 \pm 205.3$  (SD) (max = 693.3, min = 21.4),  $65.8 \pm 55.8$  (SD) (max = 174.4, min = 8.2) km<sup>2</sup>, respectively, and there wasn't a significant difference in the home range size between 2 areas (U = 44, p = 0.676). We observed bears in UH tended to move extensively thus average, maximum and minimum home ranges in UH were larger than in CA. The topography or vegetation in UH may enable bears to move extensively, or unknown environmental factors may exist necessarily for the extensive movement. Hence, we expect that it is necessary to investigate whether other habitat characteristics are more influential than density of deer on the regional difference.

## 107 Use of the Unprotected Gap between Two Protected Parks as a Corridor in the Upland North Borneo by Mammal Species

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Wildlife corridors are important not to isolate habitats of animal communities; however, most of the studies about wildlife corridors have often focused on single animal species. We focused on the responses/dependence of mammal communities to a forest corridor, which was formed in the gap in between two protected parks, namely Kinabalu Park and Crocker Range Park in north Borneo. The two parks may function as a source of mammals, but separated by a narrow ridge where slash-and-burn agriculture occurs. Young-aged forest patches remain on the top of the ridge, which may function as a corridor connecting the two parks. The length of the plausible corridor is about 3km with 1-km width. Its periphery largely consists of slash-and-burn fields. We set 23 camera traps along the ridge at regular intervals for two years, and 20 camera traps in slash-and-burn fields of the periphery for a half-year. Results indicated that community composition of mammals on the ridge was significantly influenced by the distance from the two parks suggesting that the function of corridor became diluted with increasing distance. Indeed, several species (especially relatively rare species) did not appear in the middle of the ridge. On the other hand, several other species occurred preferentially in the middle of the ridge or the farming areas and even a few species appeared only on the ridge (gap), suggesting the presence of disturbance-dependent mammals. Our study indicates that the function of the gap in between as a corridor is species specific.

## 108 Individual Foraging Specialization in Female Asiatic Black Bear

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Individual foraging specialization has been identified in various animal species, and recognized as an important phenomenon for ecological and conservation implication; however, in some animal groups, their diet depends on the temporal and spatial variation and seasonal and yearly variation in resource availability making it difficult to reveal individual differences. The purposes of this study are to confirm dietary specialization in female Asiatic black bear, *Ursus thibetans*, and clarify the factors for it through the stable isotope analysis ( $\delta^{13}C$ ,  $\delta^{15}N$ ) from hair samples collected from 2003 to 2013 in the Ashio-Nikko Mountains, central Japan. To estimate temporal variation in diet and identify the cause of specialization, monthly mean of  $\delta^{13}C$  and  $\delta^{15}N$  values were calculated based on growth section analysis (GSA) using the sectioned hair samples from the root to the tip. We recognized dietary specialization in the female bears occurred and their factors varied seasonally. In summer, when food availability is low for bears, estimated diets, depending on staple food such as deer *Cervus nippon* or ants, varied among family groups. Spatial and temporal distribution in resources and learning from the mother bear to cubs might be causes for the individual specialization. In the fall, when the fagaceae produce acorns and nuts, the older bear depend on more mast, which might be caused by learning behavior with increasing age. Thus this study revealed that staple foods were different in individuals, which might be influenced by temporal and spatial variation of food availability and experience from learning.

### 109 Deer Bark Stripping Alters Spatially Distribution of Insect Herbivory within a Willow Tree

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Within a plant, spatially different responses of plant quality may be caused by mammalian herbivory, and it may affect subsequent herbivory by insects. To test this hypothesis, we examined effects of bark stripping by a deer (*Cervus nippon yezoensis*) on leaf quality and insect herbivory of a willow (*Salix sachalinensis*). We focused on leaf quality of two spatially different parts within a willow tree: resprouting leaves in lower parts and canopy leaves in upper parts. Field observation and experiment with artificial bark stripping were conducted on floodplain in Hokkaido, northern island of Japan. The field observation and experiment showed that natural and artificial bark stripping by the deer stimulated production of resprouting shoots in lower parts of willow trees. Resprouting leaves on bark stripping trees had lower total phenolics, condensed tannins and Carbon/Nitrogen ratio than canopy leaves on control trees. Herbivory rate was greater in resprouting leaves on bark stripping trees than in canopy leaves on control trees. On the other hand, canopy leaves on bark stripping trees had higher total phenolics than those on control trees. Herbivory rate was lower in canopy leaves on bark stripping trees than in those on control trees. These results suggest that bark stripping causes spatially different responses of leaf quality, and it alters spatial distribution of subsequent herbivory by insects within a willow tree. Our study implies that management of deer population is important for insect distribution in forest.

### 110 The Bone Abnormality Observed in the Japanese Black Bear of Hyogo

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Two populations of Japanese black bear, *Ursus thibetanus japonicas*, in Hyogo Prefecture distributed in the east-Chugoku and north-Kinki regions, and these populations have been isolated and decreased. By conducting the necropsies on bear carcass that were killed as damage control in Hyogo, we found abnormal bone morphology. In this study, we observed bones of 47 bears in Hyogo Prefecture (east-Chugoku: 34, north-Kinki: 13) and 21 bears in Iwate Prefecture. The bears of Iwate were used for the morphological comparison with the bears of Hyogo. Abnormal bone morphology were found in the bones of 39 bears in Hyogo, and they were mainly found in the joint of the humerus and the radio-ulna bone, the joint of the femur and the tibiofibular bone, the thoracic vertebrae, and the lumbar vertebrae. The abnormality ratio of the bone was higher in east-Chugoku than north-Kinki. By the histopathological observation of these abnormal lesions, inflammations were observed. On the other hand, the Iwate bears had no abnormal bone morphology. Because local differences were confirmed, hereditary factors were suggested as a cause of abnormal bone morphology.

### **111 Comparison of the Social Organizations between Two Insular Populations of the Small Wildcats, the Iriomote Cat and Tsushima Leopard Cat**

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Solitary felids generally show female philopatry, the male-biased dispersal, and polygamous or promiscuous mating system; therefore, the social organization of solitary felids includes successfully reproductive females and males with different social ranks. Such social organizations would be affected by changes in the stability of resources, which, thus, would be an index of the felid population integrity. Two insular population of the leopard cat are noted in Japan: the Iriomote cat (IC, *Prionailurus bengalensis iriomotensis*) on Iriomotejima Island and the Tsushima leopard cat (TLC, *P. b. euphilurus*) on Tsushima Islands. Further, although the IC population on the island was almost saturated, that of the TLC was decreasing. Here, we compared the social organization of two insular populations of small wildcats with different population status characteristics, and discussed the integrity of each population from the obtained differences. We set up camera traps and radio tracked these two small wildcat populations for 20 years to monitor the individuals settled in the study areas and reveal their durations of settlements, alternations of the resident cats, and spacing patterns of their home ranges. The IC showed the typical social organization of a solitary wildcat. The spacing pattern of the home ranges and durations of settlement were similar between the two populations. However, we observed less number of transient TLC males and unsuccessful alternations of resident TLC females for several years, which negatively affect the survival of this small wildcat population, and resulting in the differences in its population status.

### **112 The Capturing Transition of Asiatic Black Bear in Shiojiri, Nagano, during 2005-2014, and the Dependence of Bears on Human-Origin Food**

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We collected and analyzed data on Asiatic black bears (*Ursus thibetanus*) that was captured in Shiojiri City, Nagano, Japan during 2005-2014. Hair samples were also analyzed for carbon and nitrogen stable isotope ratios to examine the degree of dependence of bears on human-origin food such as field crops and livestock feed. Nagano Prefecture obtained 87 capture records in Shiojiri City during the study period, though the number of actual capture should be more, because we confirmed several bear captures and hunting without report. About 20 bears were captured during the early study period (2005-2009), most of which were nuisance kills in the vicinity of agricultural lands. More than 50 bears were captured during the late study period (2010-2014), which were not only nuisance kills but also indiscriminate captures in mountain forests by snare traps or box traps for wild boars, deers, and monkeys. The number of capture was higher in male than in female. Most of the capture sites were located along the Narai River, which suggests that the river reservation could be a migration pathway for bears to access human area. Around the Soga and Seba areas, located between the Narai and the Kosobu rivers, the number of bear capture was particularly high. It was also revealed by isotope analysis that the bears in these areas heavily depended on human-

origin food throughout the study period. It is imperative to take strict measures such as removal of bear attractants in this area, to prevent damage by bears.

### **113 Effects of Rodent Density (*Myodes* and *Apodemus*) on Birth Rates of the Red Fox**

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In the Nemuro Peninsula, the eastern part of Hokkaido, two long-term studies on wildlife have been carried out; one is about a population of red fox (*Vulpes vulpes*) from 1987 to the present to monitor the infection rate of tape worm diseases (*Echinococcus multilocularis*), and the other began in the 1970s and looks at the populations of the gray-sided vole (*Myodes rufocanus*) forest management. In demographic analyses using the former data, it was revealed that sarcoptic mange (*Sarcoptes scabiei*) had a great impact on the survival rate of red foxes and the survival rate depended on adult density. However, a factor that affected birth rate of red foxes was not identified. To explore a factor which affects the birth rate, we analyzed the two sets of time series data on those populations. As a result, a regression analysis showed a causal relationship between the density of gray-sided voles and the birth rate of red foxes. To the best of our knowledge this is the first report that shows the effect of vole density on birth rate of the red fox.

### **114 Genetic Polymorphisms of the MHC Class II DRB Gene of the Japanese Weasel (*Mustela itatsi*) and Siberian Weasel (*Mustela sibirica*)**

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To understand biogeographic uniqueness of Japanese islands, it is important to investigate genetic characteristics of species endemic to Japan, compared with the closely related species on the continent. In the present study, as target species, we selected the Japanese weasel (*Mustela itatsi*) endemic to Japan and the Siberian weasel (*Mustela sibirica*) distributed widely on the Asian continent. The target gene was the major histocompatibility complex (MHC), which gains a specific relevance in pathogen and mates choice. Especially, the antigen-binding site (ABS), encoded in exon 2 of the MHC class II DRB gene, exhibits numerous alleles and extensive sequence variations between alleles. We sequenced the 242-bp region in exon 2 using the cloning method, and determined the alleles in 31 *M. itatsi* and 21 *M. sibirica* for the MHC allelic diversity. As a result, 28 and 23 different alleles were identified from *M. itatsi* and *M. sibirica*, respectively. At least 5 and 3 alleles per individual were detected indicating a minimum number of 3 and 2 loci per individual of *M. itatsi* and *M. sibirica*, respectively. For the putative protein binding residues (PBR) in ABS, non-synonymous substitutions exceeded synonymous substitutions, showing positive selection. For the non-PBR, on the other hand, the number of non-synonymous substitutions was similar to that of synonymous substitutions, and not significantly different from 1. In addition, the phylogenetic



analysis revealed that some alleles, including pseudogenes, were shared between *M. itatsi* and *M. sibirica*, of which divergence time is about 1.7 million years ago.

#### **115 Female Sika Deer Form Home Ranges which Seldom Overlap with Those of Other Herds**

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Sika deer (*Cervus nippon*) generally create separate male and female herds, with mother and daughter deer forming their own maternal herds together. Furthermore, from the observation of a large number of herds in open grasslands, the exclusion from female herds of male deer, which are territorial during mating season, has been seen to be normal behavior. We have collected data on the locations of 62 deer in various regions of Shizuoka Prefecture from GPS tracking collars attached to them. Among these female deer, we were able to confirm seven instances of neighboring home ranges. In each instance, very few overlaps were observed, geographical features such as valleys often served as boundaries, and few deer were seen to wander outside of their home range. Also, this lack of overlap was observed not only within woodland, but also within relatively open environments. From the fact that a daughter inherits the herd of its mother, there is a possibility that closely related deer form overlapping home ranges while deer of distant relation create and maintain exclusive home ranges which do not overlap. In Japan, the sudden increase in deer population have had negative effects on agriculture and forestry, as well as the ecosystem which suffers from a decrease in its natural vegetation. We are able to determine the non-overlapping nature of the home ranges of female herds. From this, it is now thought that the luring and capture of female deer will only be effective when targeting those bound by the region's home range. Therefore, for the purpose of population control it is ideal to demarcate the boundaries of this patchwork of home ranges.

#### **116 Evaluation of Selective Harvest on Phenotypic and Genotypic Traits in White-Tailed Deer**

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Selective harvest, or culling, is a widely practiced strategy aimed at increasing antler size in managed populations of cervids. However, the effects of culling on deer populations are poorly documented. Culling based on age and antler size of male deer may change population sex ratio and age structure. As a result, culling practices may affect the distribution of male mating success, and ultimately genetic variation. The goal of this study was to define effects of culling on the demographic, phenotypic, and genotypic traits in white-tailed deer (*Odocoileus virginianus*) from southern Texas, USA. We established 3 study areas, one subject to intensive culling (14 km<sup>2</sup>), one to moderate culling (72 km<sup>2</sup>), and one as a control (20 km<sup>2</sup>). Each autumn during 2006 - 2014, we captured deer using the helicopter net-gun method. We estimated age, measured antler characteristics, and collected a tissue biopsy for genetic analyses. Deer that did not meet culling criteria for their age class were

sacrificed during 2006 -2012. We recorded 4,264 captures of 2,503 individual deer. The culling treatments altered sex ratio and male age structure, but we observed no treatment effects on antler size. We are conducting parentage analysis to determine if the treatment affected the distribution of male mating success or neutral genetic variation. The resulting information from this study will have important management implications for harvest management.

### **117 Landscape Factors Influencing on Genetic Structure of Asian Black Bear Populations**

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Although the Asian black bear (*Ursus thibetanus*) population of northern Japan is large and continuous, spatial heterogeneity is observed in the genetic structure. We aimed to reveal what factors have brought the genetics structure from the standpoint of landscape ecology. We collected 235 bears' DNA samples in northern part of Japan, and genotyped 16 loci of microsatellite DNA of them. Genetic distances of bear pairs were calculated using Bray-Curtis index, and then we estimated three effects on the genetic distances: Isolation-by-distance, Isolation-by-barrier, and Isolation-by-resistance. First, Isolation-by-distance is detected. The longer the Euclid distances are, the larger the pairwise genetic distances are. Next, Isolation-by-barrier also influenced on the structure. A large difference in elevation between two bears brought large genetic distance, whereas mean elevation of a bear-pair brought small genetic distance. Last, Isolation-by-resistance is supported, too. Three land cover classes (agricultural, urban, and water) were assumed as resistances of bears gene flow.

### **118 Genetic Structure and Cryptic Genealogy of the Bonin Flying Fox Revealed by Mitochondrial DNA and Microsatellite Markers**

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The Bonin flying fox (*Pteropus pselaphon*) is endemic to the Ogasawara Islands, a collection of small oceanic islands in the Pacific Ocean. It inhabits only five islands: Chichi-jima, Haha-jima, Kita-iwo, Iwo, and Minami-iwo (arranged from north to south). Haha-jima and Kita-iwo, the most-widely spaced islands, are separated by a distance of about 160 km. The islands have different histories in the modern era with respect to human activity. At present, *P. pselaphon* population sizes exceed 100 on Chichi-jima and Minami-iwo, but the species is rare on the other three islands. Loss of genetic diversity is of concern because of the small population sizes. We obtained samples from four of the five islands, Chichi-jima, Kita-iwo, Iwo, and Minami-iwo, and investigated species genetic diversity and genetic structure based on mitochondrial DNA (mtDNA) control region sequences and microsatellite markers. Different mtDNA haplotypes were found in each island population. Based on the mtDNA sequence data, *P. pselaphon* displayed a cryptic genealogy, as haplotypes on each island did not cluster together. The microsatellite marker data, however, revealed a clear genetic structure

among the island populations, suggesting the absence of recent inter-island gene flow. Based on these results, we propose that the individual island populations are not evolutionarily significant units, but should be conserved collectively as a single management unit.

#### 119 Flexible Food Selectivity by an Omnivorous Carnivore, Tsushima Marten

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Members of the genus *Martes* consume various types of foods, ranging from vertebrates and arthropods to fruits. Therefore, the availability of food overlaps intricately and shifts one after another. The significance and role of each food item in the diet of martens likely differs depending on whether the animal selectively consumes it from a variety of foods available or from limited food items. This study aimed to elucidate the effect of a combination of food items available on the food selectivity patterns of Tsushima marten (*M. melampus tsuensis*) inhabiting Tsushima Islands in the Nagasaki Prefecture of Japan. Food selectivity was determined via different techniques performed once or twice a month for the period of one year. Scat contents were analyzed to determine the diet consumed by the animal, and route census (fruits, amphibians, mollusks, and arthropods), pitfall trap (arthropods), and quadrat sampling (earthworms) techniques were performed to estimate food availability. Two different patterns of food utilization by the martens were identified density-dependent and density-independent patterns. For latter example, traces of holly fruit (*Ilex integra*), Japanese eurya fruit (*Eurya japonica*), and Tsushima ground beetle (*Carabus japonicus tsushimae*) were rarely detected in the scat samples during peaks of food availability, but were frequently detected in the samples before and/or after the peak period. This was because martens consumed other available foods at this period. Thus, food selectivity of a food by the marten is considered to change flexibly according to the combinations of available food resources.

#### 120 Daytime Activities of Birdlike Noctule in Saitama

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Bats are normally nocturnal, but are occasionally seen flying during the day. Most daytime flight reports in Saitama were presumed to be Birdlike Noctule (*Nyctalus aviator*) and most of them gathered in November. We surveyed *N. aviator*'s daytime fly outs from a fall-to-spring roost in Saitama in fall 2012, spring 2013, fall 2013, spring 2014, and fall 2014. We also observed their daytime activities near the roost and at a riverside about 1.5km away from the roost with binoculars and bat detectors. We analyzed the bats' feces during these periods. Daytime emergences from the roost were seen from late October to late November and from early March to early April. At maximum, 97% of the bats in the roost emerged, but the percentages fluctuated from day to day. We often watched the bats chasing insects, confirmed feeding buzzes, and photographed a bat holding a dragonfly in its mouth in daylight. We identified some diurnal insects such as Odonata, Orthoptera, and Syrphidae in the feces. These results suggest that the main purpose of *N. aviator*'s daytime flights is to feed. When daytime flights occurred, it was often cold at night and the bats returned to the roost less than 1 hour after emerging for the evening. We suspect that insufficient

nighttime insect food supplies might cause the bats to feed during the day. *Vespertilio sinensis* and *Pipistrellus abramus* share the nearby roosts with *N. aviator* but they never fly out during the day.

## [121-150]

### 121 Effect of Feeding Behavior of Raccoon Dogs on the Seed Dispersal and Germination Rate of *Ginkgo biloba*

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Very few animals can consume Ginkgo seeds because of its toxicity, but raccoon dogs consume Ginkgo seeds and defecate undamaged seeds making raccoon dogs are efficient disperser of Ginkgo. Until now no actual evidence has been found to prove this. To clarify raccoon dogs are presumed to be efficient disperser of Ginkgo, we gathered seeds from latrines in planted Ginkgo woods, and in woods without Ginkgo trees in them. Ginkgo seeds were collected whole from latrines. We compared germination rate of Ginkgo seeds dispersed by raccoon dogs and gravity. Each of the seeds were divided into wash and control groups. As a result, germination rate of fed seeds are clearly higher than naturally fallen seeds. Germination rate of washed seeds showed between fed and fallen seeds. The raccoon dog is an efficient disperser of Ginkgo seeds because we found seeds defecated at the place where no mother trees exist, and dispersed seeds germinated at higher rate.

### 122 Distribution and Habitat Preference of Red Panda in Jumla District, Nepal

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Reliable and sufficient information regarding status, distribution and habitat preference of red panda (*Ailurus fulgens fulgens*) is lacking in Nepal. The study conducted in three Village Development Committees (VDCs) namely Godhemahadev, Malikathata and Tamti of Jumla district was an important step for providing vital information including distribution and habitat preference of this species. The study included the reconnaissance, key informants survey, interviews and consultation for the most potential area identification, opportunistic survey comprising the direct observation and indirect sign count method for the presence and distribution, habitat assessment consisting vegetation sampling and ocular estimation. The study revealed the presence of red panda in three forests namely Bahirepatan, Imilchadamar and Tyakot of Godhemahadev, Tamti and Malikathata VDCs respectively. The species was found distributed between 2880 and 3244 m with an average dropping encounter rate of 1.04 per hour of searching effort and 12 pellets per dropping. Red panda mostly preferred the habitat in the elevation range of 2900 - 3000 m with southwest facing steep slopes (36° - 45°), associated with water sources at the distance of ≤100 m. Trees such as *Acer spp.*, *Betula utilis* and *Quercus semecarpifolia*, shrub species of *Elaeagnus parvifolia*, *Drepanostachyum spp.* and *Jasminum humile*, and the herbs like *Polygonatum cirrhifolium*, *Fragaria nubicola* and *Galium asperifolium* were found to be the most preferred species by red panda. The red panda preferred the habitat with dense crown coverage (>20% - 100%) and 31% - 50% ground cover. Fallen logs (39%) were the most preferred substrate used for defecation.

### 123 Phylogenetic Status and Divergence Time of Japanese Otter Using Complete Cytochrome b Sequence

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Japanese otter (*Lutra nippon*) that is extinct in Japan has been suggested as a distinct species from Eurasian otter (*Lutra lutra*); however, the issue remains controversial as there is possibility that it is a subspecies of Eurasian otter. Information on the exact taxonomic status of Japanese otter is important for future reintroduction plan. To resolve the precise phylogenetic status and evolutionary history of Japanese otter, DNA was extracted from a Japanese otter museum specimen. Complete cytochrome *b* sequence (1140 bp) of mitochondrial DNA was determined and compared with other species from subfamily of Lutrinae, as well as with Mustelid family as control. The results of present study revealed that genetic distances between Japanese otter and other Eurasian otter are 2.4~2.8%. The phylogenetic tree was reconstructed by using Maximum likelihood and Bayesian method have displayed a unique lineage of the Japanese otter, which is distinct from all other Eurasian otter including the one in Europe and Korea (*L. l. lutra*). Moreover, the result analyzed by BEAST (ver.1.8.1) suggested that the Japanese otter diverged from other Eurasian otter approximately 0.89~1.2 million years ago. Considering the genetic distances between species within the genus of *Lutra* (6.7 ~ 7.2%), the result supported the notion that Japanese otter should be considered as a subspecies of Eurasian otter, rather than a distinct species.

### 124 The History of Korean Predators Extirpation: Records of Wolf Attacks on Human (1920-1939)

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Wolves (*Canis lupus chanco*) in the Republic of Korea have been believed to become a potential extirpation after 1960s. The extirpation of the predator led to a break in the balance of our ecosystem resulting in various consequences such as the increment of herbivorous animals. As a part of the ecosystem rehabilitation, restoration projects of the extirpated predators like tiger (*Panthera tigris altaica*), leopard (*Panthera pardus orientalis*), wolf, etc. are being suggested. This study aims to be a preliminary work to track the history of carnivore extirpation in Korea and to collect basic historical information on Korean wolf ecology in Korean Peninsula. We first collected 194 news articles about wolf attacks toward human between 1920 and 1939 reported on the Dong-a Ilbo newspaper accounts. Then we categorized these records according to season and region of the incidents, and sex and age of victims. As a result, wolves attacked men and women similar ratio (45.36 % respectively and 9.28 % were unknown). Forty-nine times the wolf attacks occurred in July and 77 times in August. Gyeongsangnam Province was where wolf attacks were the most recorded and subsequently Gyeongsangbuk Province, 39 and 38 times, respectively. Wolves attacked mainly children between 2 and 6 years old, and 53.61% of victims died. We do not know why Korean wolf population decreased rapidly, thus finding a cause of their extirpation have to be studied. It is needed to compare Korean and Japanese historical documents related to wolf extirpation.

Furthermore, excavation of proper specimens and phylogenetic study is also required for their restoration.

### **125 Population Structure of the Raccoon Dogs around the Imperial Palace, Revealed by Microsatellite Analysis**

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To examine the population structure of the raccoon dog (*Nyctereutes procyonoides*) living around the Imperial Palace located at central Tokyo, we determined the genotypes of ten microsatellite loci on 41 individuals from the Imperial Palace, the Akasaka Imperial Gardens, and other locations in Tokyo. Those samples were all muscles of individuals collected from carcasses from 2006 to 2014. The population genetic analyses using the genotype data showed that the raccoon dog population of the Imperial Palace is differentiated from that of the Akasaka Imperial Gardens, and that the individuals within each population are genetically closely related to each other. No obvious evidence was observed that some individuals were mutually migrated between two areas. The genetic diversities of both populations were lower than that of the other population. These results suggest the lower level of gene flow between the two populations, leading to the genetic differentiation. In addition, about 100 raccoon dog fecal samples collected from the Imperial Palace in 2014 were applied to the microsatellite genotyping. The successful genotype data were obtained from about 60% of the samples. The comparison between the data of muscle and fecal samples from the Imperial Palace indicated very similar genetic characteristics to each other. Furthermore, we discuss the behavioral range of the raccoon dogs within the Imperial Palace based on the microsatellite genotypes.

### **126 Nest-Site Selection of the Japanese Squirrel**

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Tree squirrels use nests for rest and reproduction, and as refuges from predators or shelters from bad weather. The Japanese squirrel (*Sciurus lis*), endemic to Japan, has become rare in western Japan and in the Tokyo metropolitan area; therefore, information on nest-site selection of *S. lis* is necessary for its conservation. At the foot of Mt. Fuji in central Japan, we studied the nest-site selection at three different scales: the forest stand, the individual tree, and the branch. Factors related to stability, escape from predators, comfort, and food availability were analyzed in comparison between the Japanese larch (*Larix kaempferi*) and the Japanese red pine (*Pinus densiflora*), which served as nesting trees. The Japanese walnut (*Juglans ailantifolia*) and *P. densiflora* were used for foraging trees. Tested explanatory factors were basal area of each of these three important tree species at the forest stand scale; the tree height, the presence/absence of climbing plants, the crown length, the number of canopy linkages, and the distance from the nearest forest edge for the individual tree scale; and the branch diameter at base, the length, the vertical angle, and the azimuth for the branch scale. In the study area *L. kaempferi* played a prominent role

for nesting. *S. lis* selected thick upward branches of *L. kaempferi* trees with a long canopy and climbing plants. On the basis of these results we will discuss forest management strategy for the conservation of *S. lis*.

### **127 Snow Depth of 40cm as a Threshold for Winter Habitat Selection of Sika Deer**

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Sika deer (*Cervus nippon*) is widely distributed on Hokkaido, the northernmost island of Japan. On a large scale, previous studies suggested that the main factor determining winter habitat selection of deer on Hokkaido is snow depth. However, what effects differing snow depth levels within the same wintering area has on the deer density has not been well studied. Thus, in this study we aim to investigate winter habitat selection at a forest stand scale, within the same winter habitat. Lake Shikotsu, located in southern Hokkaido, which has become one of the big winter habitats for deer on Hokkaido in recent years, was selected as the study site. Sixteen study plots around the lake were defined. Eight south-facing locations on the North Side (NS), and eight north-facing locations on the South Side (SS). NS had, in comparison to SS, higher solar radiation which affected snow depth which in turn led to a higher density of deer. We used sensor cameras in all plots to measure relative deer densities. Furthermore, we measured snow depth and conducted surveys to determine the overall constitution of the forest. In Hokkaido, a snow depth of 100 cm has been considered to be the threshold for sika deer in the past. However, our study findings imply that the threshold for population stability for deer in winter was about 40 cm of snow accumulation in the Shikotsu-Toya National Park.

### **128 Behavior and Seasonal Habitat Selection of Non-Migratory Sika Deer in Coastal Landscape of Notsuke Peninsula, Hokkaido**

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Sika deer (*Cervus nippon*) use forest environments and farmlands of Japan, and deer usually migrate in spring and fall. Winter population of sika deer concentrate in the protected areas such as national parks and wildlife refuges during hunting season. In Hokkaido, the northernmost island of Japan, over-abundant wintering population of sika deer is a serious ecological concern for biodiversity conservation. The Notsuke Peninsula one of the most diverse avian communities of Asia-Pacific Region, has invaded by over abundant deer population in recent years. Although winter deer density increased to 50 -200/km in the study area, summer density was relatively low. Estimated summer density of sika deer however, became high in recent years because of non-migratory deer. Only few empirical studies of non-migratory deer have reported in Japan. Therefore, this study aimed to evaluate habitat selection and behavior of non-migratory deer in the study area. We evaluated seasonal habitat selection and interpreted periodical behaviors with 4 GPS-collared female deer. Our study indicated that deer used coastal areas more in summer than in winter. In this study, we also examine effective capturing methods for non-migrating sika deer in winter.

### 129 Molecular Phylogeography of the Least Weasel in Eurasia, Based on Analysis of a Paternal Y Chromosomal Gene and Maternal Mitochondrial DNA Sequences

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The least weasel (*Mustela nivalis*) is one of the most widely distributed carnivore species, has a high level of geographic variation. Although two differentiated mitochondrial DNA (mtDNA) lineages were reported to have been found in the least weasel on the Eurasian continent, the distribution of these lineages are still poorly known. Phylogenetic data for many populations such as in the Balkan Peninsula and central Siberia is absent. Further investigation of detailed phylogeographic structure including previously unexamined areas could contribute to understanding comprehensive zoogeographic history in Eurasia. In the present study, for the samples of Bulgaria, Ural Mountains, central Siberia, and Hokkaido Island of Japan, we sequenced fragments of mtDNA control region as a maternal gene as well as fragments of the final intron of the zinc finger protein on Y chromosome (*ZFY*) as a paternal gene. Then, based on the obtained sequences, the phylogenetic relationships among the regional populations were investigated. As a result, both mtDNA and *ZFY* phylogenies showed the two main clades similar to the previous study. Of the determined *ZFY* sequences, 16 nucleotide sites were polymorphic including an 8-bp insertion. This 8-bp insertion was shared by the Bulgarian individuals, suggesting the distinctiveness of the Balkan population. The results indicate that the *ZFY* phylogeny is an effective indicator for revealing the phylogeographic structure. Meanwhile, by the mtDNA results, individuals of the Ural Mountains, central Siberia, and Hokkaido were classified into the northern clade in Eurasia, whereas the Bulgarian individuals were in the southern clade.

### 130 Country-Wide Range Mapping Revealed the Geographic Range of Asiatic Black Bears and Brown Bears Increased in Japan

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In the last decade, human-bear conflicts such as bear invasion into human residential areas, crop depredation, bear attacks on human, and a number of nuisance kills of bears are increasing for 2 bear species, Asiatic black bears (*Ursus thibetanus*) in Honshu and Shikoku Islands and brown bears (*U. arctos*) in Hokkaido Island of Japan. However, there is not yet an accurate assessment of trends in geographic range of bears at the national level after 1978 and 2003 survey conducted by the Ministry of the Environment of JAPAN (MOE). We, the Japan Bear Network, conducted a country-wide range mapping project for 2 Japan bear species during 2011-2013 with a grant from the Environment Restoration and Conservation Agency. We collected diverse geographic information about bears including the location of nuisance kills, direct observation, and bear-caused human injury or human property damage. Then, we mapped it into country-wide 5 x 5-km grids. The bear



distribution area clearly increased after 2003. Range expansion was more prominent in the western part of Japan, where distribution range had once decreased between 1978 and 2003. Present geographic range became broader than in 1978. We also confirmed the expansion of geographic range of the population listed on Red List by the MOE except for Shikoku Island population. The increase of bear distribution range leads to a closer proximity between bear range and human-settled areas, and would cause human-bear conflicts. In Japan, as depopulation progresses, we need to consider how we manage the distribution range of bears.

### **131 Habitats of Harvest Mouse in Shiga Prefecture, Central Japan**

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Grasslands of Japan have been sharply reduced over the last 100 years. This reduction puts the harvest mouse, *Micromys minutus* in danger of extinction. *M. minutus* lives in tall grasslands in the Palaearctic and Indomalayan regions (IUCN Red List ver.2.1). In Japan, *M. munitus* is distributed in Honshu, Shikoku, and Kyushu islands. In this species, the connectivity of small grassy areas including hills had studied few, but it isn't enough. We investigated the nests of *M. minutus* to clarify the habitat preference and continuity of the habitats of this species. During the breeding season of *M. minutus*, September-November in 2014, we surveyed 114 semi-natural grasslands located in hills and plains of Shiga Prefecture, in the central part of Japan. Out of the 114 study sites we found nests at 71 sites. At 19 sites only 1 nest was found. At 38 sites 2-4 nests were found and at 14 sites 5 or more nests were found. *M. minutus* usually uses 2-4 nests for breeding, so *M. minutus* may have bred in the sites with two or more nests. *M. minutus* used perennial grasses, *Imperata cylindrica* var. *koenigii*, *Miscanthus sinensis* and *Miscanthus sacchariflorus* to make the nest. We analyzed habitat suitability for this species by GLM.

### **132 Does Deer Population Affect the Habitat Use of Japanese Serows?**

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The two ungulates, sika deer (*Cervus nippon*) and Japanese serows (*Capricornis crispus*), are normally allopatric in Japan; however, recent deer range expansion combined with an increase in abundance has caused overlap of the ungulates' distribution ranges. Because decreases in the serow populations have been reported in several areas with high deer densities, evaluation of interspecific interactions between the two species is important for the conservation of serows as well as for deer management.

To assess the interactions, we investigated how the deer population affects the habitat use of serows. We placed remote cameras at 83 sites in Tsumagoi, Gunma Prefecture, Japan, from July to September 2012, and predicted how the trap rates (number of photographs/day) of serows are affected by deer trap rates and landscape structure surrounding the trap sites, by using generalized linear models. A best-fitted model with the least value of Akaike's information criterion showed that the serow trap rates increased with increase in mean slope values, but decreased with increase in the area of evergreen conifers and distance to the river. The deer trap rates were not selected in the best-fitted model. Studies have shown that the serow population decreased when deer densities

exceeded 20 individuals/km<sup>2</sup>; the deer densities in the study area were less than 2/km<sup>2</sup>. We conclude that the effects of deer populations on the habitat use of serows are not strong with low deer densities, and that the low density level should, therefore, be maintained for the conservation of serows.

### **133 Use of Siberian Roe Deer (*Capreolus pygargus* Pall) Population in the Republic of Buryatia**

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Siberian roe deer is the main object of hunting in the Republic of Buryatia. The authors have carried out their studies in the Siberian roe deer habitat, conducted a questionnaire survey of hunters, and analyzed documents of the State Hunting Management Dept. of the Republic of Buryatia for the past 15 years.

The total hunting area of the Republic of Buryatia is 29 million hectares. There are 74 hunting organizations in the Republic. Today, the purpose of deer hunting is mostly for meat and trophy hunting is not common. Every year specialists of the State Hunting Department monitor the population of the Siberian roe deer and do winter population count. According to its results the harvest numbers of roe deer and hunting periods are planned. In 2013, the hunting rangers of the Republic of Buryatia completed 3618 hunting routes with their total length of 36,106 kilometers. According to the count of 2013 the deer population in the Republic of Buryatia had sharply declined. The decline in deer population is attributed to severe winter weather conditions, high snow, difficulty of access to food and vulnerability to predators. It should be noted, that in 2014 the index numbers have increased, which was influenced by the weather conditions of the Republic, namely the lack of heavy snowfall and low air temperatures. For 2014 hunting season 1914 licenses for Siberian roe deer were issued. However, according to our research, 3 times more hunters in this area wish to hunt roe deer.

### **134 Effects of Food Quality and Availability on the Life History Traits of Sika Deer**

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Several empirical studies indicated that sika deer (*Cervus nippon*) could be maintained at a high density with abundant low quality forages. We hypothesized that sika deer could have high survivorship even in harsh condition under trade-offs of their fecundity. To validate this, we compared fecundity and survivorship of two sika deer populations which inhabit in contrasting habitats, Oku-Nikko (ON) and Ashio (AS), central Japan, that have a different staple food resource, dwarf bamboo (*Sasa nipponica*) and Japanese pampas grass (*Miscanthus sinensis*). The crude protein contents of dwarf bamboo and Japanese pampas grass in summer were 15% and 7%, respectively. Both populations have been culled since 1995 and deer age was determined by wildlife managers on the basis of tooth replacement and counts of annuli in the cementum of the first incisors. Pregnancy was investigated by dissecting female deer. We calculated age-specific minimum number, when culling operation had just started, by summing harvest-at-age data and conducted static life table analysis. We found longer life expectancy and lower pregnancy rate in AS than those in ON. The

values of average age, longevity, proportion of the old individual and generation interval in AS were larger than those in ON, whereas mortality rate, net reproductive rate, and population growth rate in ON were higher than those in AS. Thus, we concluded that trade-offs between fecundity and survivorship were induced by using abundant low quality forages.

### **135 Ranging Behavior of Japanese Macaques (*Macaca fuscata*) Invading “Uninhabited Area”: The Relationship between Vegetation and Travel Speed around Lake Okutama, Tokyo**

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The number of Japanese macaques (*Macaca fuscata*) has increased after the war all over the country, and it is reported that some troops recently expanded their distribution to the “uninhabited area,” where macaques have never been observed. The previous studies reported that the troops extended along the riverside and damaged human agricultural products. On the contrary, few studies have been done on the troops that crossed the river and revealed how they used the “uninhabited area” on the mountainside. We studied the Yamafuru troop (YF troop) that recently appeared on the mountainside around Lake Okutama, western Tokyo. The vegetation of the ranging area and the travel speed per hour were studied in summer and fall in 2014. In summer, the troop members mainly fed on the fruits of cherry trees which distributed in the nature park adjacent to a village along the lake, while in fall, they fed on the fruits of persimmon trees near the villages. They traveled faster in fall than in summer, and traveled faster in the deciduous forest distant from the human activity than in the core area where they often used in each season. The present study suggests that the YF troop members strongly depend on the fruits produced by humans in both seasons. Even though the “inhabited area” where the macaques newly invaded includes large deciduous forest, they depend on the food items near human settlements, if the harvest in the forest is insufficient.

### **136 Validation of Fecal Progesterone Analysis in Siberian Flying Squirrels**

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The Siberian flying squirrel, *Pteromys volans*, spends almost all of its life in trees and thus depends extremely on forests. Forest fragmentation has been reducing its habitat. To conserve the squirrel's populations in fragmented landscapes we need information on not only its ecology but also its physiology, because stress and poor body condition resulting from clear-cutting could negatively influence its reproductive physiology. However, there is a paucity of information on the Siberian flying squirrel's basic reproductive physiology, and there is no established method for studying its reproductive physiology. We therefore validated a method of measuring progesterone concentrations in research into the squirrel's reproductive physiology. We measured fecal progesterone concentrations with a commercial Enzyme Immunoassay (EIA) kit, because this method is suitable for small mammals; non-invasive and repeatedly available. We compared

progesterone concentrations among four groups-pregnant females, non-reproductive females, juvenile females, and adult males-to determine whether fecal progesterone was useful for evaluating reproductive status. Fecal progesterone concentrations were significantly higher in pregnant females than in other groups. We also present the results of serial dilution tests performed to evaluate whether EIA would properly react and we discuss the validation of fecal progesterone analysis in this species.

### **137 Reproductive Parameters and Male Dispersal of Brown Bears in the Rusha Area of Shiretoko National Park, Hokkaido, Japan**

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Determining reproductive characteristics such as litter size, reproductive cycles, and reproductive rates, is essential for wildlife conservation and management. The Rusha area, located near the tip of the Shiretoko Peninsula, is a special wildlife protection area within the Shiretoko Natural World Heritage area, where the Japanese brown bear (*Ursus arctos yesoensis*) occurs at high density. Brown bears living in this area have become accustomed to the existence of humans, which has made it possible to record their reproductive activities during long-term monitoring of identifiable bears. In the present study, the reproductive histories of female brown bears were recorded to estimate reproductive parameters. We observed a total of 37 reproductive events for 11 adult female bears from 2006 to 2014. The average of litter size, the inter-birth interval, and the reproductive rate were calculated as 1.84 offspring (ranged from 1 to 3), 2.23 (ranged from 1 to 4 years), and 0.83 cubs/year, respectively. The annual survival rate of cubs was estimated as 71-76%. Young males began to disperse at ages between 2 to 4 years, and over half died from management kills near human residential areas, which may be due to lack of awareness of human's presence. These results suggest that the Rusha area is one of the most highly reproductive bear habitats in the world; however, males born within this highly protected area are likely to cause human-bear conflicts during dispersal.

### **138 A Preliminary Survey for Selectively Culling Sika Deer in the Wild Boar High Density Area**

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In recent years, sika deer (*Cervus nippon centralis*) population has increased in Satoyama Park in urban Hyogo Prefecture. This area has a forest ecosystem including endangered plants. The population increase of sika deer has an impact on the forest vegetation; therefore, it is necessary to manage the deer density from a forest ecosystem conservation point of view. We will have to consider selective culling of sika deer because the density of wild boar (*Sus scrofa*) is high in Satoyama Park. This study aimed to identify the differences in the seasonal pattern and the pattern of appearance time between sika deer and wild boar in order to plan selective culling of sika deer. We placed 8 camera trap stations in this park from October 2013 to March 2014. We collected data on the number of sika deer and wild boar photographed, at the same time we recorded appearance

time and date. Results from camera trapping showed that both species simultaneously increased from October and decreased after January. Further, the frequency with which sika deer was photographed increased, whereas that of wild boar decreased in the morning. This study suggests that the most suitable selective culling sika deer is at the morning from October to December.

### **139 Preliminary Study of Individual Identification of Yellow-Throated Marten (*Martes flavigula*) in Korea Using Microsatellite Markers**

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Yellow-throated marten (*Martes flavigula*) is one of the top-predator in Korean ecosystem which has been designated as an endangered species by the Korean Ministry of Environment and listed as Least Concern on IUCN Red List. To design efficient conservation strategies, fundamental information, such as demography and social structure of the *M. flavigula* is essential. However, due to subtle sexual dimorphism and morphological uniqueness, individual identification by observation is challenging for *M. flavigula*. In such species, microsatellite analysis can be applied for individual identification as well as for analyzing relatedness and population structure. To investigate the utility of microsatellite markers for individual identification, we conducted cross amplification analysis of ten microsatellite markers that have been previously developed in the same family (Mustelidae). All tested markers were successfully amplified DNA from tissue samples of 12 *M. flavigula* individuals. The level of genetic diversity estimated by the cross-amplified markers was moderate with a mean observed heterozygosity (HO) of 0.439 and a mean expected heterozygosity (HE) of 0.457. The number of allele per locus in the 12 samples ranged from 2 to 7 with a mean of 3.4. When ten microsatellite loci were combined into a set of marker loci, the probability of identity (PI) was  $7.9 \times 10^{-6}$  for unrelated individuals and  $5.6 \times 10^{-3}$  for siblings (PIsib). When the genotypes of all 12 samples were compared together, no individuals displayed the same genotype. The result suggests that at least ten microsatellite loci are necessary for individual identification of *M. flavigula* at the PI level of 0.01.

### **140 Spatial Distribution of Brown Bear Occurrence and Mortality Points in Urahoro, Eastern Hokkaido, Japan**

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Increasing frequency of appearances of brown bears (*Ursus arcos*) near crop fields has become a serious problem in the Urahoro region, eastern Hokkaido, Japan. Nuisance bear kills have gradually increased because of agricultural crop damage. It is necessary to analyze the spatial distribution of bear occurrences and mortality points and build an integrated occurrence-mortality model. We built two spatial models. One is a bear occurrence model based on bear presence data (152 locations) from 2005 to 2007. The other is a mortality model based on human-caused mortality data (74 locations) from 1991 to 2010. The predicted environmental variables for these models are river, road, crop field, plantation and natural forest. We modeled the bear occurrence and mortality geographic distributions by MaxEnt (Maximum entropy) algorithms. As a result of the analysis, the bear occurrence model showed that bear presence is associated with nature and plantation forests

around it. On the other hand, mortality model showed high score in and around crop field and plantation. To integrate occurrence-mortality model showed, some of the high mortality risk areas overlapped with bear frequent occurrence areas. These areas were small and fragmented, and include a lot of crop field and plantation. In these areas, it is necessary to create a management and conservation plan to reduce human-caused mortality.

#### **141 Towards Solving a Problem in Invasive Alien Raccoon Control Focusing on Information Sharing in Japan**

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Raccoon (*Procyon lotor*) has been designated as an invasive alien species, and an eradication program has been undertaken in Japan reducing damage to native ecosystems, agriculture loss, and property damage. The raccoon is already naturalized in almost all prefectures and is recognized as a nationwide problem. To control raccoons, cooperation between and among prefectures and municipalities is needed; however, local governments control individually. Local governments neither cooperate with contiguous regions nor do they share information. We investigated the actual demand for information sharing and the situation of each region. Hence, we discussed the necessity for and the local governments' capability of information sharing. We administered questionnaire survey of 47 prefectures and 366 municipalities, and hearing survey of actively controlling local governments. Many local governments hoped for information sharing; moreover, in terms of the functions of a network (if building up for information sharing), respondents demanded and hoped for information (e.g., anecdotal reports) sharing and discussing difficulties. They implemented efforts to through trapping within procedure, though the following were implemented less than through trapping: monitoring after trapping, technical development, revision of the control plan. Results from current situation indicate that scientific control programs on the basis of adaptive management are not functioned. We concluded that information sharing is needed. When constructing a network, it is important to note that the following are necessary: functions that lighten some of the burden of officers and supports for officers who find control difficult. Furthermore we need collecting anecdotal reports of actively controlling local governments.

#### **142 Effect of Mowing on Behavior of Japanese Grass Voles**

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We studied response of Japanese Grass Voles, *Microtus montebelli*, to vegetation change by mowing. The voles are a major prey of the endangered raptor Eastern Marsh Harriers, *Circus spilonotus*, that we are working on conservation. The purpose of this study is to get information to consider management of grasslands that are hunting habitats of the Harriers. We set 3 study sites (A, B, C) on the grassland in the Hachiro-gata polder, northern Japan, captured the Voles for 8 days each before and after mowing in each site by using 20 Sherman traps (5 rows × 4 columns, 5m spacing). The captured Voles were released after marking. In site A and B, We mowed by using brush cutter on Sept. 24, 2013, removed grass clippings in site A, left grass clippings there in site B. In control site C, mowing was not done. In mowing sites, the numbers of captures was significantly different before

and after mowing, decreased from  $14.9 \pm 4.8$  (mean  $\pm$  s.d.) to  $4.5 \pm 1.9$  in site A ( $P < 0.01$ , Mann–Whitney U test), decreased from  $13.3 \pm 3.2$  to  $6.6 \pm 1.5$  in site B ( $P < 0.01$ ). In contrast, in non-mowing site C, the number of captures increased from  $13.8 \pm 3.7$  to  $17.6 \pm 1.2$  ( $P < 0.05$ ). This result suggested that mowing gave significant change to behavior of the Voles, and some voles disappeared from open space that lost canopy.

#### **143 Why Do Deer Break Stem and/or Branch to Feed Top Shoots?**

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Deer can eat many different plant species by using a number of foraging behaviors, such as grazing, browsing, bark stripping and stem and/or branch breaking for leader shoots. This means that deer are less restricted and can choose their food from a wide variety of forage plants. Stem and/or branch breaking foraging, SBBF, can be found in woods with forest floor vegetation, though it might be a more cumbersome foraging behavior than simple browsing or grazing. Why do deer take the trouble to break stems to eat leaves from top shoots instead of feeding on other more easily accessible plants? In this study, some foraging theories are examined to explain SBBF by sika deer. SBBF can be found more frequently in forests with less forest floor vegetation than in those with plentiful resources. It appears to be an important way to get more energy in a challenging environment. The cause of SBBF is discussed from the view points of deer foraging strategy.

#### **144 Temporal Changes in Molar Wear Rate and Survival Pattern of Sika Deer Population under the Density Dependent Food Limitation**

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Negative feedback effects of density dependent food limitation on molar wear rate in ungulate population have been discussed for a long time. Previous studies were based on the comparisons of populations from different districts or habitats. Temporal changes in molar wear rate in a single population and the feedback effect on the wear rate are still unclear. Thus, when selective feeding makes changes in quality and quantity of food, it is important to make clear how molar wear rate changes and determine the main factor. We examined temporal change in molar wear rate using long-term monitoring data of sika deer (*Cervus nippon*) population on Nakanoshima Island, Hokkaido, Japan. In addition, we also examined temporal changes in survival pattern as a consequence of molar wear rate, because considerable tooth wear may have a negative impact on animal's survival. Corresponding to the change of food habit, the molar wear rate had changed mainly depending on the amount of soil which was ingested. After the first population crash on Nakanoshima Island, molar wear rate became faster, and then it might affect the longevity of sika deer population; moreover, the initial molar height tended to increase after the first population crash. These results implied that a fundamental change in the life history strategy of sika deer might have occurred due to density-dependent food limitation.

#### 145 Status, Conservation, Population Control and Agricultural Damage Management of the Wild Boar in Japan

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Two sub-species of wild boar (*Sus scrofa*) inhabit Japan. One is the Japanese wild boar, *S. s. leucomystax* which occurs on Honshu, Shikoku, Kyushu and Awaji-shima Islands. The other is the Ryukyu wild boar, *S. s. riukiuanus* which lives on Amami-oshima, Tokuno-shima, Okinawa-jima, Miyako-jima, Ishigaki-jima and Iriomote-jima of the Ryukyu Archipelago. The Japanese wild boar is ranked as common in the red list of the Japanese government and is a major big game. It frequently causes agricultural damage. The Ryukyu wild boar has a small population limited to the islands, but also causes some damage to agriculture. One hundred sixty-one thousand wild boars were captured during the hunting season in 2012. Annual agricultural damage by wild boars has been continuing at a high level and average 5 billion yen/year from 1999 to 2014. Two hundred sixty-five thousand animals were killed in 2012 as pest control. Conflicts between agricultural producers and wild boar are a serious social problem in Japan. Japanese stakeholders employ three types of counter-measures to the conflicts. These are 1) population control by capturing, 2) reduction of agricultural damage by exclusion and 3) management of natural habitat, abundant farmland and orchards by land manipulation. The wild boar division was created as a part of the wild mammal conservation and management committee of the Mammal Society of Japan in 2013. About 30 people belong to our division and work to reduce the conflicts. We will report on improved measures for conservation and management of wild boars nationwide.

#### 146 Comparison of Tooth Wear in Contrasting Sika Deer Populations

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Overgrazing of food resources in high-density population might increase tooth wear, which might be a proximate cause of senescence in ruminants. The hypothesis that diet-quality in low-quality habitats predicts increased wear is still limited. To verify this diet-quality hypothesis, we investigated tooth wear using long-term data in three contrasting populations of sika deer (*Cervus nippon*) in Nikko(NI), Ashio(AS) and Tanzawa(TA), the central of Japan. First, we compared incisor wear rates among populations and between different periods in high and low density in each population. Second, we inspected molars in NI and AS populations and from two periods because they are more important for mastication and have different functions from incisors. According to some previous studies, molars seem to show a similar wear pattern to incisors. AS population had the fastest incisor wear rates in both sexes among populations. In AS and NI only males that were born when population density was higher, wore incisors more rapidly in each population. In TA, there are no sex differences in the wear rates and they recovered with density decrease. Molar wear rates in both sexes did not show significant differences, though the wear in AS was higher than that in NI. Incisor wear rates were different among the populations in response to food quality and low quality food also led to be higher wear rates. This supported the diet-quality hypothesis. Further studies on tooth wear would be needed in females to explain the results of tooth in males.



#### **147 Factors Incurring Stem and Branch Breakage by Deer in Broad-Leaved Forest**

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There are few previous studies on deer foraging behavior with stem and branch breakage, breakage foraging; BF, and factors incurring BF was not revealed. In this study, to reveal the reason for BF, comparative studies were conducted on nutritional condition between leaves of (a) palatable and non-palatable tree species and (b) upper (2 m above the ground) and lower (1 m above the ground) shoots of the trees. The survey was conducted at Takaragaike Park broad-leaved forest in Kyoto city, central Japan. Leaves on 30 cm long tips of 54 trees of 7 species were sampled in July, and measured relative photon flux density (RPF) in October at the same 54 sites. Seven species were selected by frequency of BF and tree size. Selected species were *Quercus glauca*, *Photinia glabra*, *Rhododendron reticulatum*, *Rhododendron macrosepalum*, *Lyonia ovalifolia* var. *elliptica*, *Cleyera japonica*, *Ilex pedunculosa*. Each sample was measured by dry weight, water content, crude protein, crude fat, and crude fiber (NDF). Damage survey was conducted in a 4 m circle around each sample tree. Dry weights in upper leaves were significantly heavier than lower leaves. RPF in upper places were significantly higher than in lower ( $p < 0.05$ ). Differences in nutrition values explaining BF were found in neither the (a) nor (b) comparison. The estimated factor incurring BF was the difference not in nutritional condition, but in biomass between upper and lower shoots.

#### **148 The Eradication Project of Alien Eurasian Red Squirrels on Honshu Island, Japan**

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The Eurasian red squirrel, *Sciurus vulgaris*, has been established in the Sayama hill since the 1980s. The Sayama hill is an isolated wooded area of 3500 ha surrounded by residential areas. The hill is located in the northwest of Tokyo and is at a distance of five kilometers from the Kanto Mountains where the Japanese squirrel, *Sciurus lis*, is distributed. To conserve the genetic characteristics of the endemic Japanese squirrel, inbreeding between the two species has to be prevented. The Mammal Society of Japan submitted a letter demanding the eradication of Eurasian red squirrel in November 2013. In response to this request, Ministry of the Environment immediately started the eradication project in June 2014. The distribution and density of the Eurasian red squirrel are becoming clear and the genetic analyses of captured squirrels are being analyzed.

#### **149 Spatial Distribution of Roadkill Frequencies for Japanese Terrestrial Mammals, as Indices of Animal Density**

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The purpose of this study is to understand distributions of roadkilled mammals in Japan, as indices of animal density. We sent a questionnaire to 650 (37.3 % of 1741) local government in Japan from May to December, 2014. The questionnaire asked three questions: (1) numbers of roadkills collected from April 2013 to March 2014, (2) the species name of roadkills that you are responsible for collect, and (3) road classes of which you are responsible for remove the roadkills. We calculated a roadkill frequency for each species as the number of roadkills divided by total road length responsible for

each local government. The questionnaires were returned from 513 (78.9 % of 650) local government. The number of roadkills were larger for feral cats (N = 72379), following by raccoon dogs (7695), feral dogs (2637), masked palm civets (1546), and sika deers (1089). The distributions of the roadkill frequency differed among the animals. For example, the distribution of roadkill frequency for the sika deers were higher in the Kansai, Chubu, Hokkaido region in Japan, while that for the red foxes were higher in snowy regions as the northern Japan and the region along the Sea of Japan. We examined the large scale distribution of the roadkill frequencies for the Japanese animals, and showed the interspecific difference in the distribution of roadkills. The frequencies of roadkill may be related to the density for each animals, although we need to separate the effect of confounding factors from roadkill frequencies.

## [151-180]

### 151 Case Study: Use of Deer Decoys and Artificial Grass for Attracting Wild Sika Deer

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Crop damage by wild sika deer (*Cervus nippon*) in Japan reached 8.2 billion yen in 2012, and this problem requires an immediate solution. An effective attractant is essential for the successful capture of the deer. By using deer characteristics, including their sociality and herbivore diet, we studied the effect of deer decoys as companions and of artificial grass as food resources on the attraction of wild sika deer to a specific area of pasture. We used four treatments: control with no artificial material (C), decoy only (D), artificial grass only (G), and both decoy and artificial grass (DG). Each area was 4 × 4 m and contained two motion sensor cameras. Before and after positioning the materials, we monitored the number of deer detected by the cameras for 7–14 days. A  $\chi^2$  goodness-of-fit test was used for statistical analysis. Before setting the materials, the population of sika deer was significantly higher in one study area than in the others (41 heads/day vs. 12.3, 12.1, and 13.0 heads/day,  $p < 0.001$ ). This area was used for treatment C. After setting the materials, the number of deer detected in the different areas was in the following order: G (7.0 heads/day) > DG (4.2 heads/day) > D (0.4 heads/day), and there was a tendency ( $p < 0.1$ ). For treatment C, the deer appeared at a rate of 2.9 heads/day. Artificial grass or a combination of artificial grass and deer decoys can attract wild sika deer more effectively than deer decoys alone.

### 152 Cross-Cluster Genetic Exchange of the Brown Bear Population Occurs at the Base of Shiretoko Peninsula

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The Brown Bear Study Project was initiated in 2007 in Shibetsu Town area located at the base of Shiretoko Peninsula. This promotes radio-tracking and DNA sample collection to determine whether genetic exchange occur between the two clusters, Cluster A (North-Central) and Cluster B (East). Regarding the radio-tracking, findings on home range and movement have been obtained in 15 brown bears (*Ursus arctos*) with the mobile phone-type GPS radio-collars (NTT DOCOMO, INC, HOKKAIDO BRANCH). DNA samples were collected by live-capturing and hair-trapping and from

bears killed due to nuisance control and hunting. Mitochondrial DNA was used for cluster identification, and blood relationships were determined by genomic DNA. As a result, it was revealed that there were 3 movement patterns: 1) heading to the tip of Shiretoko Peninsula (to the north), 2) heading to the Nemuro Peninsula (to the south), and 3) staying around Shibetsu Town area. Mitochondrial and genomic DNA analysis led to results that all of females belonged to cluster B while males were divided into 40% cluster A and 60% cluster B. Reproduction between a male of cluster A from Nemuro area and a female of cluster B from Shibetsu Town area was confirmed. These results suggest that the base of Shiretoko Peninsula (Shibetsu Town area) is an important site for cross-cluster genetic exchange and more future studies on genetic structure of brown bear population are necessary to know spatial relationship between the tip and base of Shiretoko Peninsula.

### **153 Urbanization Decreases Seasonality in Vigilance Behavior: Flight Responses of Red Squirrels to Human Approach**

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Urbanization may have a variety of effects on behaviors of animals. For example, reductions in vigilance and increases of boldness have been documented in many species. These may be because there are usually fewer predators in urban areas. However, although animals usually alter their vigilance in response to the resources or environmental conditions that fluctuate temporally, seasonal differences in vigilance behavior have not been studied in urban populations. Seasonality of vigilance is predicted to be small in urban areas compared to rural areas because many studies showed resource stability in urban areas due to, for example, artificial feeding. Here we compare seasonality of vigilance behavior in the Eurasian Red Squirrel (*Sciurus vulgaris orientis*) between urban and rural habitats (each n=6) in Hokkaido, Japan. We measured flight initiation distance (FID) to human approach as a measure of vigilance. We also assessed whether the frightened squirrels in trees continued antipredator behavior (call and gaze) or not. We found that squirrels in rural areas showed seasonal differences both in FID and antipredator behavior: vigilance significantly lowered in autumn. In urban squirrels, on the other hand, no seasonality was observed in FID, whereas antipredator behavior differed across seasons. These results suggest that seasonality in some vigilance behavior seem to be reduced in urban areas. In such populations that have diminished seasonality in vigilance behavior, responses to future environmental changes, such as novel predator invasions or ceasing of artificial feeding, might be difficult.

### **155 Interspecific Variation of Testes Size and Sperm Morphology Can Be Explained by an Index of Sperm Competition (Multiple Paternity) in Field Mice**

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In mammals, positive relationships between female promiscuity and testes size are observed. This suggests that intense sperm competition promotes evolution of large testes that can produce more spermatozoa. Sperm competition is also considered as a selection pressure on sperm morphology. Relationships between sperm competition and sperm morphologies have been discussed with cause

and effect confused in some cases. For example testes size that is a result has been employed as an indicator of sperm competition that is the cause. Multiple paternity rates (proportion of litters sired by two or more males to all observed litters) can be more direct indicator of intensity of sperm competition, and make it possible to discuss sperm quantity and morphology in parallel. *Apodemus* is a suitable genus to detect effects of multiple paternity rates on testes size and sperm morphologies, because they have high interspecific variation of those traits. In this study we aimed to reveal relationships between sperm competition and sperm traits in genus *Apodemus* using multiple paternity rate as the indicator of sperm competition. Data on multiple paternity, testis size and sperm morphologies of six species were collected from populations in Hokkaido and from previous studies. Species that have higher multiple paternity rates have bigger testes size and longer sperm hook. These suggest that sperm competition promotes evolution of sperm quantity and morphology.

### **156 Identification of Microsatellite Markers and Application in Leopard Cats in Taiwan**

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The microsatellite marker has become a powerful genetic tool in the field of wildlife conservation owing to its co-dominant nature, high level of allelic diversity, and ease of genotyping. The characteristics of microsatellite marker have made it suitable for studying the genetic diversity of leopard cat (*Prionailurus bengalensis*) population in Taiwan, where the leopard cat is suffering from the risk of extinction. However, *de novo* development of microsatellites often comes with complex and tiring methodology, which is time- and cost-consuming. As an alternative, cross-species microsatellites, which can be applied between closely related species, were utilized. Eighteen microsatellite loci originally developed from domestic cat (*Felis catus*) were examined for repeated sequence characteristics in leopard cat population in Taiwan. In addition, the allele number, heterozygosity and polymorphism information content (PIC) of selected loci were examined from 20 tissue samples by genotyping via capillary electrophoresis. Finally, eleven polymorphic microsatellite loci were confirmed with 2 to 7 alleles per locus. The average PIC value, observed and expected heterozygosity were 0.54, 0.57 and 0.61, respectively. Taken together, these loci could be regarded as an ideal genetic analysis tool to evaluate the genetic structure of leopard cat population in Taiwan; furthermore, if the microsatellite markers can be applied for individual identification via fecal samples, it will be a useful monitoring tool for population genetics in the wild.

**157 Present Status of Sika Deer Population and Management on the Ebino Plateau, Kirishima-Kinkowan National Park, Southern Kyushu**

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From the 1970s to recent years, sika deer (*Cervus nippon*) have increased around the facility area in the central part of the Ebino Plateau in Kirishima-Kinkowan National Park because of increase of deer population in the Kirisima Mountains and artificial feeding. The natural vegetation has been damaged by deer more seriously in recent years. To understand a present status of the sika deer population and to consider future management plan, we set a 32.6 ha-census area and counted deer from August 2008. In addition, we estimated deer density by pellet count method, tracked deer using GPS-collar, and measured canopy shape of scrub species as a relative feeding pressure index. From 2010 to 2013, the Ebino City Government and the Kyushu Regional Environment Office captured a total of 102 deer on the Ebino Plateau. In the census area, annual average number of deer from 2009 to 2013 decreased from 46 to 7. Majority of female were considered sedentary. In 2013, the estimated deer density was 13.3 deer / km<sup>2</sup> in the central part of the Ebino Plateau and 26.3-29.4 deer / km<sup>2</sup> in the surrounding area. The feeding pressure index of 2014 indicated lower feeding pressure than that of 2010. These results suggest that the capturing from 2010 to 2013 removed a considerable part of the sedentary deer on the Ebino Plateau and feeding pressure were reduced to some extent. However, the apparent structure of overall vegetation has not been recovered. Continuous deer capturing and protection of the vegetation are needed.

**158 Ecological and Conservation Studies on the Japanese Serow in the Southern Alps, Japan**

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In this study, we investigated the home ranges and densities of Japanese serows (*Capricornis crispus*) in the Southern Alps to assess the quality of habitat of this species. Between July 2012 and February 2014, we tracked 4 GPS collared individuals (2 adult males and 2 adult females). The home-range sizes for 4 individuals were 91.7-214.7 ha and the core areas of all individuals included slopes. The serow densities, which were estimated by the block count method in November 2012, were 1.1-1.4 individuals/km<sup>2</sup>. The home-range sizes were greater and the densities were lower in the study area than those in other areas. This result indicates that the present study area is harsh habitat for Japanese serows. In this area, it has been reported that the modification of vegetation by sika deer (*Cervus nippon*) has become significant and that slopes were reported to be important forage places for sika deer, indicating that sika deer exert negative effects on Japanese serows by consuming food resources. Therefore, the density of Japanese serows may decrease if the extent of the effects of sika deer on vegetation becomes larger in the future.

**159 Monitoring of Population Trends in Asiatic Black Bears in Iwate Prefecture Using Bayesian State-Space Models with Population Indexes Developed Using the Hair-Trapping Method**

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Asiatic black bear (*Ursus thibetanus*) population sizes were estimated for the entire areas of both North Ou (Ou) and Kitakami, Iwate Prefecture. Local population sizes were estimated using the hair-trapping method, which had been established previously as an efficient method for estimating population size in bears. Harvest-based Bayesian estimation using state-space models from the past to the present were used in conjunction with hair-trapping results to estimate population sizes. Numbers and variances of bears (Ou,  $N = 1,314$ , 95% CI = 988-1,640 in 2009; Kitakami,  $N = 2,094$ , 95% CI = 1,777-2,411 in 2012) estimated previously using the hair-trapping method were used as prior distributions for initial numbers in the system process. Observational data of population densities in particular study areas estimated using the hair-trapping method were also collected. Credible intervals of these population estimates were narrower than those made using a model in which the prior distributions of initial numbers is uninformative. Estimated population size has either remained unchanged or increased only slightly over the past decade; however, a temporary decrease in population size was observed in a year during which a large number of bears were killed. We predicted that population size would gradually decrease if increased hunting pressure was maintained over a longer period. Applying the harvest-based Bayesian estimation method using population parameter indexes developed through hair-trapping would allow for the successful monitoring of population dynamics of bear populations. Moreover, these models enable managers to set appropriate hunting quotas.

**161 Current Status of the Southernmost Population of Japanese Dormouse (Gliridae, Rodnetia) in Kyushu Island, Japan**

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The distribution and ecology of the endemic rodent, the Japanese dormouse (*Glirulus japonicus*, Gliridae, Rodnetia), was studied to identify the current status of the southernmost population of the species on Kyushu Island, Japan. A literature survey and a field survey using nest-box and camera-trap were carried out in 2006-2014. Although the Japanese dormouse is an arboreal and nocturnal small rodent (20-40 g in body weight), it is one of the most famous mammals in Japan since it is designated as a national natural monument. Over 60 records of the species were collected in the period between 1757 and 2014. The oldest was a drawing from the Edo era. Although the dormouse distributes widely in Kyushu Island from warm temperate forests at low elevation to cool temperate forests at high elevation, there are many gaps in natural forests which suffered heavy artificial disturbances in the past, probably in the 19th-20th centuries. The litter size of the Kyushu population is 3-5, smaller than in the northern populations. The hibernation period is from late November to late April on average, however, much shorter in some areas at low elevation. Two peninsular local populations were considered to be threatened because of their geographical isolation from a core population in mainland Kyushu. Cooperative conservation actions should be planned for the two threatened local populations.

**162 Current Status of a Threatened Population of Japanese Serow (Bovidae, Cetartiodactyla) in Kyushu Island, Japan.**

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The distribution of an endemic herbivore, the Japanese serow (*Capricornis crispus*, Bovidae, Cetartiodactyla), was studied to identify the current status of a threatened population of the species in Kyushu Island, Japan. The species is designated as a special natural monument of Japan and the hunting is strictly prohibited; however, the population is restricted to small, fragmented areas in Kyushu. The population has declined, as the latest population estimate was ca. 800 animals by the feces count method (the census 2011-2012). In 2012-2015, we carried out a field survey using camera traps and video-camera traps in the range of 500-1500 m asl in Sobo Mountains and obtained over 300 photos/videos of the species. The Japanese serow was frequently photographed at lower altitude (500-1000 m asl) while not at higher altitude (1000-1500 m asl) where the serow had been considered to prefer. In contrast, the Sika deer (*Cervus nippon*, Cervidae, Cetartiodactyla) frequently photographed at all altitude studied. Our result supports the hypothesis that the recent population decline and distribution changes of the serow in Kyushu was caused by the competition with the Sika deer increased in mountain areas. Other mortality factors still exist, e.g. poaching and disease (scabies). Cooperative conservation actions should be planned for the threatened serow population.

**163 Estimating Energy Contents of Edible Plants by Sika Deer in the Warm-Temperate Forest in Izu Peninsula, Japan**

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Energy content is one of the most important pieces of information for deer population management and accurate estimation of the carrying capacity of their habitat. In order to describe the food resources of sika deer in the forest, we investigated the plant biomass and estimate energy content of edible plants by sika deer. In the national forest of Izu Peninsula, we investigated in August (summer), October (fall), February (winter) and scheduling May (spring), respectively. We observed the coverage and the number of plant species at eight experimental sites (planted forest, broad-leaved forest). Then, the edible plants were harvested at three places with a vertical, three-dimensional (1 × 1 × 2 m) quadrat at each sites. The clipped plants were divided into six types of vegetation (graminoids, bamboo, tree leaves, forbs, ferns, and others) and analyzed energy content. The biomass was higher in planted forests than in broad-leaved forests. Planted forests were also made up of a large part of unpalatable plant species. The biomass was higher in fall than in other season.

**164 Radiocesium Concentration and Partial Albinism in Lesser Japanese Moles in Eastern Fukushima Prefecture, Japan, Following the Nuclear Disaster of 2011**

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In 2013 and 2014, 34 lesser Japanese moles (*Mogera imaizumii*) were captured in eastern Fukushima Prefecture, Tohoku Region, Japan. Twenty-five were captured from abandoned paddy fields in Namie, approximately 25 km from Fukushima Daiichi Nuclear Power Station (FDNPS); 5 were captured from paddy fields and forests in Minamisoma, approximately 40 km from FDNPS; and 4 were captured from a school garden and a paddy field in Aizumisato, approximately 100 km from FDNPS. Concentrations of <sup>134</sup>Cs and <sup>137</sup>Cs in the muscle tissues of the moles were measured using a germanium detector. Concentrations of <sup>137</sup>Cs were much higher in moles from Namie (944±881 Bq/kg in 2013 and 835±361 Bq/kg in 2014) than in moles from Minamisoma (paddy fields: 41±11 Bq/kg, N=4; forests: 915 Bq/kg, N=1) and Aizumisato (11±8 Bq/kg). Concentrations of <sup>134</sup>Cs and <sup>137</sup>Cs in soil and earthworm (*Pheretima* spp. *sense lato*) samples from mole capture sites were also measured, and were much higher than those in moles (for example, <sup>137</sup>Cs concentrations of ten soil samples from Namie in 2014 were 11873±7172 Bq/kg). This indicates that the concentrations found in moles are not result of biomagnification. Four out of 25 moles from Namie exhibited partial albinism in the form of a whitish patch or line on the throat or chest. This represents a much higher rate of occurrence than that in the past populations of lesser Japanese moles in the Tohoku region (for example, only 2 out of 168 skin specimens in the Hokkaido University Botanic Garden Museum exhibit partial albinism).

**165 Habitat Use of Wild Boar and Influences of Arbitrary Feeding to Its Behavior in Mt. Rokko, Central Honshu, Japan**

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Japanese wild boars (*Sus scrofa*) often appear in the residential area of Kobe City. Artificial feeding in residential areas and habitat degradation might trigger the behavior; however, their habitat has recovered from its overuse by human activities around 100 years ago. Mt. Rokko even became a suitable habitat for wild boars in recent years. In this study, we compare habitat use of wild boar in urban environments around the Mt. Rokko and the agricultural area of Sasayama. We are especially interested in 1) the relationships between behavioral patterns and habitat characteristics, and 2) the effect of artificial feeding on their behaviors. For the habitat use study, we tracked wild boars using GPS collars. We also used wildlife incident reports from the city of Kobe to analyze behavioral patterns in the residential areas. In the agricultural areas, wild boars traveled away from forest in an average of 19.6 m when they used non-forested areas such as agricultural fields and residential areas, whereas they traveled farther away in the urban environment (average of 192.9 m). The median distance between feeding sites and observed points was 178 m and wild boars were usually stayed close to the feeding sites when they used the urban environment.



## 166 Predicting Time and Location for Effective Sika Deer Culling in Marsh Ecosystem

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The high density of Sika deer (*Cervus nippon*) has a strong impact on marsh or wetland ecosystems in the northernmost island of Japan, Hokkaido. Deer management in marsh environment involves many difficult tasks for wildlife professions. Generally, marsh landscapes make it difficult to cull deer because of its limited accessibility. Deer density of the study area, the Kushiro Shitsugen, the largest marsh and the first Ramsar site in Japan, is becoming hyper-abundant in recent years. Deer browsing on marsh vegetation is serious ecological concern. Damage to crops or agricultural products around the study area is increasing every year. Additionally, the Kushiro Shitsugen is a habitat for endangered species in particularly for Red crowned cranes (*Grus japonensis*). Deer culling must avoid the breeding season of cranes from spring to summer. We used 20 GPS- collared female deer for determining appropriate time and location to cull deer in the study area. We assessed habitat selection and seasonal and daily activity patterns of deer. We investigated our results by GIS map to review appropriate locations, times and methods to cull deer with consideration of the distribution and density of Red crowned crane.

## 167 Changes to the Home Range of a Wild Japanese Macaque Troop in the Northern Area of Mt. Fuji, Japan, Caused by the Driving Behavior of Trained Dogs

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In Japan, wild Japanese macaques (*Macaca fuscata*) cause damage to crops and human property, and can intimidate and attack humans and pets. Therefore, trained dogs have been recently deployed to drive them away. This study examined how being driven by such dogs affected the habitat selection of a wild Japanese macaque troop. We tracked a troop in the northern part of Mt. Fuji, Japan from June 2004 and August 2010 by attaching radio transmitters to adult female macaques. In two settlements that began using dogs to drive away the macaques in June 2008, the troop deviated from its core area (kernel method, 50%). In contrast, in three settlements that began using dogs in December 2009, the troop remained in its core area. In settlements that began using dogs earlier, the macaques' utilization rate of residential areas and farmland was reduced from 16.3% to 1.8% ( $p < 0.05$ , chi-square test), while in settlements that began using dogs later, the utilization rate was only slightly reduced, from 29.3% to 23.7% ( $p < 0.05$ , chi-square test). We conclude that i) dogs kept the macaques away from populated and agricultural areas and reduced the damage they caused, ii) the macaque troop maintained its territory in settlements that began using dogs later, iii) damage management was better in settlements that adopted the use of dogs earlier.

## 168 Identification and Application of Cross-Species Microsatellite Markers in Formosan Sika Deer

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Formosan sika deer (*Cervus nippon taiouanus*) is one subspecies of sika deer which is endemic to Taiwan; however, wild Formosan sika deer has been extinct since 1969. The Recovering Program of Formosan sika deer started in 1984, and 22 individuals from the Taipei zoo were conserved in the wild of Kenting National Park (KNP). The population size of wild sika deer in KNP has increased to about 1,500 individuals. The genetic diversity of this population remains unknown. No microsatellite marker was selected directly from sika deer. The aim of this study is to identify microsatellite markers from documented cross-species microsatellite markers. Twenty-two candidate microsatellite markers development from bovine and ovine were selected. Eleven loci of markers were confirmed possessing short tandem repeat in Formosan sika deer by cloning and sequencing. The polymorphism and power of individual identity of the 11 selected microsatellite markers were estimated from 30 Formosan sika deer. The effective numbers of allele were 2.096. The average  $H_e$  and  $H_o$  values were both about 0.5. The average PIC value was 0.441. All the microsatellite loci did not deviate from the Hardy-Weinberg equilibrium. In conclusion, these results show the selected 11 cross-species microsatellite markers possess enough polymorphic information content and are proper for studying population genetics of Formosan sika deer in the future.

## 169 Does Stream Restoration Impact Riparian Wildlife?

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Restoration of riparian zones, as part of stream restoration, can improve water quality and aquatic life by decreasing nutrient and sediment loads into streams. Although in-stream monitoring is often a focus for evaluating restoration success, fewer studies have emphasized potential short-term impacts of the disturbance on riparian wildlife. Our objective was to monitor riparian wildlife responses during a natural stream channel design restoration project along a 1,100-m restoration reach (RR) of the Cacapon River, West Virginia, USA. Reference (RS) and control (CS) sites were located upstream and downstream of the RR. Small mammal trapping, bird counts, frog call surveys, and vegetation surveys were conducted from April 2009 - April 2010 (pre-impact) and during May 2010 - August 2011 (post-impact). Among the 5 sites, 6 species of small mammals, 79 species of birds, 8 species of anurans, and 96 species of plants were observed. Small mammal abundance had a minor time effect, and was higher in CS than RR post-impact. Small mammal richness, diversity, or evenness did not differ between sites or time periods. Overall bird abundance, richness, and diversity were higher in the RR compared to CS post-impact. No effect on passerine diversity metrics, the abundances of each of the five most common bird species, or anuran richness was observed. Vegetative diversity metrics tended to be higher in the RS compared to the CS or RR for native species. Community composition of both plants and wildlife exhibited minor variations between pre- to post- monitoring. Riparian restoration does influence riparian wildlife, but overall there were few negative effects and we anticipate observing increasing riparian biodiversity as post-restoration time length increases and the riparian zone matures.

**170 Conservation of the Local Wetland with Local Stakeholders: Case Study in Yamanakatouge Marsh, Central Japan**

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*Lysichiton camtschatcense* (L.) Schott (Araceae) is a perennial plant and popular as a representative flower of the subalpine and boreal wetlands in Japan. The *L. camtschatcense* community had been damaged by sika deer (*Cervus nippon* Temminck) and wild boar (*Sus scrofa* L.) in the Yamanakatouge Marsh, Gifu Prefecture, central Japan, which is designated a Prefectural Natural Monument. In 2011, The Local government, branch of the National forestry agency, and the local people constructed and started to maintain the electric fence in the wetland. In this study, we monitored wild animals with camera traps inside and outside of the fence to evaluate the effects of the fence from 2011 to 2013. We also recorded damaged status and the number of *L. camtschatcense* in 12 fixed plots (1 m × 3 m) inside and outside to reveal the effects on survival and growth of *L. camtschatcense*. In addition, we surveyed the coverage of *L. camtschatcense* in the wetland in each year. The results showed that the electric fence performed properly. Few animals were detected by camera traps inside of the fence. Outside the fence, the number of the photos of deer was peaked in June and July. Inside the fence, few *L. camtschatcense* individuals were damaged, the number of *L. camtschatcense* was increased, and the coverage of the *L. camtschatcense* was spread in 3 years. Continuing conservation coaction by local stakeholders with the electric fence will restore *L. camtschatcense* community in Yamanakatouge Marsh.

**171 The Relationship between the Migration of the Weather Loach and Environmental Factors in the Paddy Field on Sado Island, Japan**

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Connectivity of watersheds is crucially important to fishes and other aquatic organisms. In Japan, fragmentation of rivers and ditches connecting paddy fields has become a serious problem. On Sado Island, habitat restoration for the oriental weatherloach, *Misgurnus anguillicaudatus*, is particular importance. But association of environmental factors and migration of the loach is not known. Therefore, we surveyed the relationship between migration of loaches from river to ditch and from ditch to paddy field using PIT tag and environmental factors. Loaches were collected from river and ditch sites and PIT tags were implanted in their bodies. Following this, they were released at the collected site. Migration of loaches was monitored using underwater PIT tag reception antennas at both river and ditch sites, and paddy fields. Environmental factors were obtained and their relationship to migration was analyzed. Loaches were collected from river and ditch sites and PIT tags were implanted in their bodies. Following this, they were released at the collected site. Migration of loaches was monitored using underwater PIT tag reception antennas at both river and ditch sites, and paddy fields. Environmental factors were obtained and their relationship to migration was analyzed. From these results, it was found that migration is associated to inflow from next migration site and not associated to rain or non-rain periods. We assume that the influence of humans on water rising is important rather than that of rain alone. If we actively change water depth this will stimulate loaches to migrate more.

## 172 Effects of Wild Boar Digging on Wetland Ecosystem in Nakaikemi, Fukui, Japan

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Nakaikemi wetland located in Tsuruga, Fukui prefecture, Japan, which harbors more than 2,000 plant species in a basin of about 20 ha, has been registered as a Ramsar Convention site. It has been speculated that the endangered plants at this site are seriously damaged by wild boar (*Sus scrofa*) digging. Therefore, I aimed to study the revegetation of plants after wild boar digging. From April to October 2014, every two months, I monitored the eight different quadrats (1m x 1m) set upon the places where the boar dug around. As controls, I also monitored eleven undisturbed quadrats over 2 years. All disturbed quadrats where soil was exposed were covered by various plants in August, i.e. vegetation cover rate was 100%. However, the mean species richness in the disturbed quadrats was rather lower compared to that in undisturbed quadrats; disturbed quadrats: 7.1 (SD: 3.2); undisturbed quadrats: 18.8 (SD: 6.9). On the other hand, the mean number of annual herbaceous plants found in disturbed quadrats was higher than that in control quadrats. Contrary to earlier speculations that wild boar digging has the negative impacts on the landscape and endangered plant species, i.e. destruction of waterways and treading on plants by the wild boars, wild boars may play an important role to maintain plant diversity in this site. Since the population of endangered annual herbaceous has been decreasing, to sustain various plant communities in Nakaikemi, it should be reconsidered the value of wild boars in wetland ecosystem.

## 173 The Influence of Forest Structure and Composition on Bornean Orangutan (*Pongo pygmaeus morio*) Nest Density and Characteristics in Kutai National Park

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Forest structure and composition differ between primary and secondary forests in Kutai National Park (KNP). This study examined how forest type influenced orangutan (*Pongo pygmaeus morio*) habitat use and nesting behavior by using transect surveys to observe nest characteristics and vegetation plots to assess forest structure and composition. Within secondary forest, land cover was dominated by pioneer vegetation, whereas primary forest was dominated by Dipterocarpaceae species, and this variation affected nesting characteristics within the two places. Orangutans primarily nested in several tree species (i.e., *Eusideroxylon zwageri*, *Dyospyros* sp. and *Cananga odorata*), about 90% of nest is on high around 11 - 30 m from the ground, and the position of nest were most often at the main of stem than another position (e.g., at the top of a tree crown, at the edge of a tree). The highest nest density was found in primary forest, reaching 1286 nests/km<sup>2</sup>, and the lowest density was in secondary forest, nearing 345 nests/km<sup>2</sup>. The density of the orangutan nests in primary versus secondary forests is very different, possibly due to variation of vegetation and habitat quality and the effect of human activities such as deforestation, hunting, and other forms of forest encroachment. Study on orangutan nest density and characteristics in KNP is very important to understand the influence of forest structure and composition on sleeping sites selected by orangutans and their importance for management and conservation efforts in KNP.

**174 The Modification of Insect Assemblages by Deer Overabundance: A Comparison between Multi-Taxa or Functional Groups**

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Overabundant populations of large herbivores alter forest ecosystems, particularly in the Northern Hemisphere. To predict the response of ecosystems to large herbivore overabundance, determination of species that are sensitive to large herbivore overabundance is required. In this study, we compared the influence of the manipulation of sika deer (*Cervus nippon*) density among five insect taxa or functional groups, and we discussed the features of the impact that the overabundant sika deer population had on species. The impact of sites with deer densities of 0/km<sup>2</sup>, 10/km<sup>2</sup>, and 20/km<sup>2</sup> was investigated. For each site, we sampled insects using several types of traps corresponding to each taxon. To test the differences of insect taxa between sites, we used generalized linear models or generalized linear mixed models; explanatory variable was combination of sites, and response variables were abundance, species richness, and diversity of each taxon and functional group. The results showed differences of the response to deer overabundance between taxa or functional groups. Increased deer overabundance had negative effects on some taxa or functional groups, which were dependent on the understory, whereas others had positive effects by increasing food resources. These results indicate that large herbivore overabundance may produce biotic homogenization, which is likely to influence ecosystem functions and services. In addition, our study suggests that trophic cascades caused by large herbivore overabundance are more complex than that previously thought.

**175 Effect of Sika Deer and Dwarf Bamboo on *Trillium* Populations in Natural Forests, Japan**

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Previous studies reported the utility of *Trillium* spp. as an indicator of white-tailed deer impact in North America; however, to use the abundance and size of *Trillium* spp. as the indicator, the effects of dwarf bamboo on them should be clarified because dwarf bamboo is one of the dominant understory species and can be competitive for light in many natural forests, northern Japan. In order to evaluate the effect of sika deer and dwarf bamboo on trillium populations, we examined the size structure of *Trillium* spp. (*Trillium camschatcense* and *T. tschonoskii*) population, the frequency of deer use from camera trapping and the coverage of dwarf bamboo in ex-closures where deer has been eliminated and unfenced controls in Akan National Park from 1995 to 2014. The effects of deer use and dwarf bamboo cover on the changes in size class were analyzed using cumulative link mixed models (CLMMs). Results of CLMMs indicated that the proportion of large size plants decreased with the increase of deer usage. This suggests that deer tends to select larger plants. On the other hand, the proportion of small size plants decreased with the increase of dwarf bamboo cover. This suggests the negative effect of dwarf bamboo on trillium recruitment. We concluded that the size of trillium plants could be a useful index to evaluate the grazing impact of sika deer; however we should notice the effect of other dominant understory species such as dwarf bamboo on trillium population.

**176 Invasive Black Rat Population Dynamics and Bird Community in the Natural Forest on Amami**

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Black Rat (*Rattus rattus*) is one of the 100 worst invasive species (IUCN). It is abundant around human residences and agricultural land near the coast, and expands its activity into the natural forest on the hills when the acorn production is rich on Amami-oshima Island. We have been monitoring the population dynamics of black rats in the natural subtropical forest on this island, with cage and camera traps since 2003. Black rats increased up to 12 rats / 100 trap-nights (with 50 traps x 7 nights surveys), and sometimes no rats were caught after continuous no acorn crop years. On Kakeroma-jima Island, close to Amami-oshima Island, no rat intrusion into the natural forest has been recorded and no rat foraging bites on the plenty of acorns on the ground in spring were recorded. The bird community diversity is higher in species number or with Shannon - Wiener diversity index on Amami-oshima forest, but the abundance of endemic Ryukyu Robin (*Luscinia komadori*) and Amami Jay (*Garrulus lidthi*) is higher in Kakeroma-jima Island. Black rats often predate on the bird nests on the trees, its presence may have changed the bird community structure.

**177 Scale Dependent Effects in Resource Selection by Crop-Raiding Japanese Macaques in Niigata Prefecture, Japan**

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A resource selection function is one that yields values proportional to the probability of use of a resource unit. The quantity of resource unit is influenced by the heterogeneity of landscape structures, which occurs over multiple spatial scales. To provide input into wildlife management strategies, we investigated the scale dependency and functional responses of Japanese macaques (*Macaca fuscata*) using multiple scale analysis. The multiple buffers with radii of 100, 500, 1000, 1500, 2000, and 2500 m were defined as the spatial scale. Crop damage was predicted at the within-home range scale, using the random forests algorithm with environmental variables linked to resource selection of Japanese macaques. Sixteen environmental variables were defined, covering aspects of landscape configuration, human disturbance, topography, and adopted countermeasures. Crop damage was most accurately predicted within a buffer zone of 1000 m, although radii exceeding 1000 m were also highly accurate. Although the importance of variables differed among spatial extents, the functional responses for each environmental variable were independent of spatial extent. These results suggest that the limiting factors of crop damage depend on spatial extent, while functional responses in resource selection remain constant across spatial extents. We also compared a multi-scale gradient map with a typical binary map to demonstrate the uncertainty in damage predictions at different spatial scales. Our results may aid wildlife management planning, for which differences in resource selection across different spatial scales are critically important.

**178 Effects of Sika Deer (*Cervus nippon*) on Alpine Zone and Countermeasures in Minami-Alps National Park, Central Japan**

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In Japan, the population of sika deer (*Cervus nippon*) is sharply increasing, consequently, the effects (e.g., grazing, debarking) is expanding from low elevation area (e.g., coniferous plantations) to high (e.g., alpine zone). Since alpine plants did not experience grazing by sika deer until now, local extinction of alpine plants is a recent concern. To plan countermeasures, we have surveyed and monitored where and what kind of species are being grazed and debarked in northern part of Minami-Alps National Park, central Japan. Grazing was more severe in understory of dwarf *Betula ermanii* forests than in tall-grasslands. The grazing intensity was strong irrespective of culling in low elevation area. In some areas, since vegetation had disappeared and the soil had eroded, the countermeasure (e.g., setting fence, making construction preventing soil erosion) should be urgently necessary. For debarking, among deciduous broad-leaved forests, sub-alpine coniferous forests, and dwarf *Betula ermanii* forests, ratio of debarking trees to total number of stems was the highest in deciduous broad-leaved forests and the lowest in *Betula ermanii* forests. In each forest type, the ratio was higher in 2012 than in 2008, nevertheless unchanged deer abundance. In particular, *Betula ermanii* forests were not affected at all in 2008, but affected in 2012 because isolate distributed *Abies* spp was debarked. Also, intensity of debarking in sub-alpine coniferous forests was stronger in mountains with alpine grasslands than in mountains without alpine grasslands. The factors affecting the differences suggested that the grasslands would be important as foraging sites in summer; therefore, such mountains with alpine grasslands should be monitored carefully.

**179 Effect of Reduction of Human Activity in a Mountainous Area on the Utilization of Farmlands by Wild Boars (*Sus scrofa*)**

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To assess the influence of reduced human activity on encroachment on farmland by wild boars, this study selected two adjacent study sites in Fukushima Prefecture site A (40 km<sup>2</sup>) in Kawamata town, designated as the evacuation directive lift prepared area with low human activity, and site B (80 km<sup>2</sup>) in Nihonmatsu city and recorded locations of damage (feeding, trampling, rooting) to farmland and crops caused by wild boars from June to December 2013. The locations of wild boar feces found were also recorded and collected. These feces, as well as tissue samples collected from individuals trapped during the period, were subjected to DNA microsatellite analysis to identify individuals. More locations affected by damage were found in site A (150) than B (94) (P < 0.001). The total number of feces was also higher in site A (332) than B (62). The number of feces found within each location increased from summer (0.49-0.74) to autumn (1.70-3.67). These results suggest reduced human activity expands the range of wild boars, particularly in autumn. The accuracy of individual identification by microsatellite analysis differed with the primer sets used, and the best results were obtained using nine primers (six primers reported as applicable for individuals in Japan and three primers reported in Europe) (PID-sib = 0.011). Successful individual identification was achieved for 38 fecal samples, including three pairs of fecal sample derived from the same individual. However,

the fecal sample pairs were collected within the same location and on the same measurement occasion.

### **180 Using Stable Isotopes to Determine Japanese Water Shrew Trophic Position in Headwater Food Webs and Importance of Continuity of Riverine Ecotone**

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The Japanese water shrew (*Chimarrogale platycephalus*) has adapted to an aquatic habitat, and commonly preys upon small aquatic animals. This species uses riverine ecotone and is fragile and sensitive to sudden changes of habitat. To illustrate the food web in the headwater stream whose top predator is the Japanese water shrew, we measured its stable isotope ratios of carbon and nitrogen ( $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$ ). We compared the stable isotope ratios among water shrews, aquatic animals and plants collected from the headwater streams of the Iwaki river system in Aomori Prefecture, Japan. The water shrews have lower  $\delta^{13}\text{C}$  and higher  $\delta^{15}\text{N}$  than Japanese fluvial sculpins (*Cottus pollux*) that prey mostly upon aquatic insects and have site fidelity. This result suggested that the water shrews preyed not only upon aquatic animals but also terrestrial animals that have lower  $\delta^{13}\text{C}$ . The water shrews during summer have an especially lower  $\delta^{13}\text{C}$  than those in other seasons in some areas. As a result the Japanese water shrew often preys upon terrestrial animals in summer, the riverine physical structure and environmental quality of riverine ecotone is a very important feeding ground and refuge. Construction of the revetment could negatively impact the habitat quality of the Japanese water shrews.

## **[181-210]**

### **181 Indirect Positive Effects of Seasonal High Abundance Deer on Summer-Green Herb Species in a Deer Wintering Area.**

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The cervids in high latitude regions often congregate in limited part of their habitats during winter. Although numerous studies have examined the effects of continual feeding pressure all year round, the effects of seasonal high feeding pressure on vegetation is not well understood. Sika deer (*Cervus nippon*) feed on plants with different life form: herbs have aboveground parts only in summer, on the other hand, dwarf bamboo and woody plants have aboveground parts all year around. We studied the effects of seasonal high feeding pressure on understory vegetation, particularly focused on plant life forms, in forests around Lake Shikotsu, northern Japan. We compared between a deer wintering area, the north slope (NS), and a control area, the south slope (SS). We established research plots in NS (seven plots) and SS (three plots). In each plot, we set camera traps to assess relative deer density and surveyed forest structure and understory vegetation. The number of deer photographed in NS in winter were about 15 times higher than that of SS (around year) and of NS in summer. In NS, the abundance of dwarf bamboo and tree saplings were much lower than those of



SS; however, the abundance and species richness of summer-green herbs in NS was significantly higher than that of SS. These results suggested that seasonal high abundance of deer during winter indirectly increased the abundance and species richness of summer-green herb species, by decreasing the abundance of dwarf bamboo and tree saplings.

### **182 Necessity of Restoring Habitat of Conflict Peak Season: A Result from Spatial Prediction of Habitat for Asiatic Black Bears**

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Whereas several regional populations of Asiatic black bears (*Ursus thibetanus*) are designated as endangered, human-bear interaction has dramatically increased in Japan. Much of the interactions occur in areas near human settlements and it is highly seasonal. However, reliable habitat studies have yet been enough to explore underlying causes for the selection of anthropogenic landscape by bears. We estimated spatial distribution of season specific habitat of bears to provide baseline for appropriate long-term habitat management. In a mountain-valley landscape of the central Japan Alps, over 60 bears were captured and equipped with GPS collars during 2007-14. We selected 20 females and 18 males bear years having only serial observations from spring to autumn. Resource selection function (RSF) was employed based on used and available resource units sampled from the GPS relocation points and random points drawn from the individual annual home range. After selection of variables grouped of resources, constraints and terrains by univariate logistic regression, we predicted spatial distribution of season-sex specific habitat for our entire research area. The distributions of relatively high probability of bear selection for both females and males were substantially skewed toward human-dominated lowlands during summer; the peak season of human-bear interactions. Our results indicate that summer habitat is extremely fragmented and restricted, and it may be one of causes for the frequent use of human-dominated landscape. Therefore, restoration of season specific habitat in remote mountains should be firstly taken account for conservation of bear populations and correspondingly for conflict mitigation.

### **183 Relationship between Population Density of Dolly Varden and Environmental Factors in Shiretoko Peninsula: Effects of Global Warming and Dams**

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Previous research suggests that low-head dams change physical habitat characteristics of mountain streams that affect Dolly Varden (*Salvelinus malma*) density in the Shiretoko Peninsula, Hokkaido, Japan. However, relative importance of environment variables to explain physical habitat characteristics has not been clear. The objective of this study is to evaluate impacts of environmental variables on Dolly Varden population density and daily maximum stream temperature. We selected three reaches with dams in six streams and three reference reaches in another six streams in the region. Dolly Varden density in each study reach was estimated using the two-pass removal method. Physical habitat characteristics including depth, velocity, and surface area of five channel unit types, frequency of six substrate types, stream temperature, and area of canopy

cover were measured in each study section. We used GLMM as statistical analysis. Results showed that the higher the average maximum daily stream temperature was in summer, the lower the fish density. As expected, maximum daily stream temperature was most influenced by mean daily air temperature. Also, the greater the densities of low-head dams were, the higher the maximum daily stream temperature was. Specifically, the impact by installing 5 dams in a stream was equivalent to the increase of 1 °C of the mean daily air temperature caused by global warming. Increases in daily maximum stream temperature in the streams of Shiretoko were observed due to the high density of dams. At present, fish ways have been installed on to the dams in Shiretoko to improve fish habitat. However, rehabilitation to prevent stream water temperature from increasing is important for the habitat improvement.

#### **184 Beaver-Created Dead Wood Dynamics**

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Dead wood is a limited resource in boreal ecosystems, where it is of marked importance to several ecological processes and species, and therefore a frequently used biodiversity indicator. Dead wood is created through natural processes, especially by various disturbance factors, leading to the formation of several distinct dead wood types. Dead wood occurrence is scarce in boreal regions, but certain types (e.g. snags, fresh dead wood) are even less common. Beavers (*Castor sp.*) are ecosystem engineers of boreal wetlands. They create dead wood through their damming behavior, which raises flood waters into adjacent forests, thus weakening and killing trees. We compared six beaver sites (with distinguishable signs of beaver activity) with 12 non-beaver sites in southern Finland. All dead wood pieces  $\geq 5$  cm in diameter were measured (e.g. species, width, type, decay stage) from two sampling locations per site. Data analyses were performed using generalized mixed modeling in R 3.0.2. Results indicate that beaver disturbance creates significant amounts of dead wood in landscapes (moist and lowland areas) that usually do not experience other disturbance regimes (e.g. forest fires), and due to the beavers' behavior the dead wood types most commonly created by them are some of the rarest (e.g. snags, fresh dead wood). The beaver's cyclical nature in the landscape additionally indicates that dead-wood creation will occur repeatedly in beaver-inhabited areas. This is significant for dead wood dynamics in boreal areas, where disturbances are commonly of single-occurrence.

#### **185 A Preliminary Review on the Factors Regulating the Strength of Top-Down Trophic Cascades Following Wolf Recolonization**

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Understanding top-down trophic cascades (indirect effects from predators to plants mediated by herbivores; hereafter, TTCs) has been a recent focus in ecology and large carnivore conservation. Conservation efforts in recent decades have restored previously extirpated populations of wolves (*Canis lupus*) to much of their former ranges throughout North America and Europe. In some regions, wolf recolonization has resulted in the revegetation of browsed plants; a TTC mediated via a concurrent decline in ungulates abundance. We reviewed seven documented cases of TTCs following

wolf recolonization in North America to elucidate the factors that regulate the strength of TTCs. The ratio of wolves to ungulates was a major factor regulating the strength of TTCs, with TTCs absent when the ratio was relatively small. Intense human disturbance also interrupted TTCs, likely because wolves were less active in and avoided human-dominant landscapes. Regional primary productivity could also affect the strength of TTCs, because predatory impacts of large carnivores on ungulates are weakened in regions with higher primary productivity (i.e., warmer climate regions). However, we could not assess in the present study as the majority of the documented cases were in cooler climates (i.e., areas of lower primary productivity). This review indicates that TTCs following wolf recolonization will be less apparent in regions with hyper-abundant deer populations, in fragmented forests with intense human development, and in temperate regions at low latitudes and altitudes. Further studies in a wider variety of climates and landscapes are needed to verify the effectiveness of wolf reintroduction for ecosystem restoration.

### **186 The Biogeochemistry of Boreal Lakes with Beaver Inhabitation**

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It has been suggested that beavers (*Castor* sp.) as ecosystem engineers may affect biogeochemical processes as well as the environment on a relatively large scale. In this long-term study we evaluated the effects of beavers on water chemistry in small boreal lakes of Southern Finland. We mainly addressed the following questions; 1) does water chemistry differ between beaver and non-beaver lakes; 2) does water chemistry differ between the flood years in comparison to the antecedent years; 3) and does the flood impact downstream lakes? We collected data from a total of 37 lakes, 16 of which have been dammed by beavers, and 21 of which have never been dammed or flooded by beavers (1978-2012). The lakes were sampled for total phosphorus, total nitrogen, dissolved organic carbon (DOC), dissolved oxygen (DO) and pH. The results showed that beaver lakes had higher DOC, nitrogen and phosphorus concentrations than non-beaver lakes, while beaver lakes had lower DO concentrations than non-beaver lakes. DOC concentration increased significantly during the first three beaver-flood years when compared to the pre-flood situation, and DO concentrations simultaneously decreased. Lake DOC concentrations furthermore declined back to initial levels after the flood had lasted for four to six years. The opposite occurred with DO. No clear effects caused by beaver floods were found in downstream lakes. Our results emphasize that the beaver is among the important organisms, which affect the carbon balance of the boreal zone, and further research is therefore needed to clarify its effect on the carbon cycle at different spatial scales.

### **187 Effects of Land Abandonment on the Species Composition of Ground Beetles Assemblages (Coleoptera: Carabidae) in Hokkaido, Japan**

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Wetlands are one of the most threatened ecosystems, and one of the main drivers of its degradation is agricultural activities. The amount of abandoned farmland has been increasing in many developed countries associated with depopulation, and abandoned farmland may provide an opportunity for

restoration of wetland ecosystem. We studied the influence of years after land abandonment on ground beetles assemblages (Coleoptera: Carabidae) in abandoned grasslands in Kushiro region, eastern Hokkaido, Japan. In addition, we examined whether abandoned land provides preferable habitat for hygrophilous species (moisture-loving species). In the summer and autumn of 2014, we sampled ground beetles in three categories of abandoned grassland (I: grassland abandoned in 2000s~2010s, II: 1980s~1990s, III: ~1970s) and we also sampled at grassland that reflects original environment immediately after the abandonment, and at fen as reference sites of natural wetland vegetation. A total of 15,564 individuals from 63 species were collected. The proportion of number of hygrophilous species increased by land abandonment (grassland 33.6 %, abandoned land 59.8~71.8 %, fen 89.7 %) regardless of the years after abandonment. The composition of hygrophilous species was more similar to that in fen than in grassland. Our findings suggest that the influence of the years after abandonment on hygrophilous species is limited and abandoned land can provide alternative habitat for hygrophilous species of ground beetles.

### **188 Contemporary Problems of the Restitution of European Bison *Bison bonasus* L. in Russian Federation**

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Restoring *Bison bonasus* began in the USSR in 1948. Michael Zablotsky created the Main Breeding Center of European bison (zubr) in the Prioksko-Terrasny Reserve. During this time, the number of *B. bonasus* in Russia increased from 7 (in 1948) to 750-800 by the beginning of 2014. According to IUCN criteria and based on population genetics, in order to keep the population European bison in the wild natural, at least two large self-regulating herds should be created with an effective number (breeding part of the population) 500 individuals. During 65 years of working in the nursery 2 groups of free-living wild pureblood *B. bonasus* Caucasian-Belovezhian line (*B. bonasus caucasicus* Sat. x *B. bonasus bonasus* L.) were created, from 300 to 400 individuals in each herd - in the North Caucasus (Teberda) and in the central part of Russia (Orel and Kaluga region). These areas are the most suitable for these purposes. The reserve is working on the raising of genetically pure, the most viable and exterior individuals. For this purpose, the nursery contains 15% of the total number of pureblood bison living in Russia. Returning of European bison (zubr) to the wild is a priority course of the state policy of the Russian Federation.

### **189 Captive Breeding of Leopard Cat in Taiwan**

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The leopard cat (*Prionailurus bengalensis chinensis*) in Taiwan is listed as an "Endangered Species" and is facing several threats such as habitat loss and fragmentation, vehicle collisions, illegal trapping and poisoning by pesticide. We conducted a leopard cat captive-breeding program using animals that were rescued from the wild. Two young leopard cats, one male and one female, were born at the Endemic Species Research Institute on 1 March 2013. The two young leopard cats were raised and trained by their mother till the age of approximately 5-month old, and then were transferred to

individual cages with larger space and enriched environment for further training. We carried out several measures to help the two young leopard cats to develop hunting skills and identifying prey items. The male young leopard cat was fitted with a radio collar and was released to the wild in the Jiji area, Nantou County, on the 20th November 2013. It was successfully monitored for 23 days and then the signals lost. The female was released on the 20th December 2013. Unfortunately, it was recorded by remote cameras showing that one of its forelimbs was injured eight days after the release. We recaptured the female 20 days after the release and removed a small part of its forelimb. This female recovered well from the injury but it was evaluated unable to survive in the wild. She was transported to Taipei Zoo and has been exhibited for educational purpose since July 2014.

#### **190 Origins of Introduced and Captive Formosan Sika Deer (*Cervus nippon taiouanus*) in Japan: Perspectives on the Conservation**

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Formosan sika deer (*Cervus nippon taiouanus*) became extinct in the wild due to hunting and habitat destruction by the 1960s. While introduced and captive Formosan sika deer found in Japan may be potential genetic resources for conservation, little is known about their history. To reveal origins of these populations, we analyzed the genetic polymorphisms found in the maternal mitochondrial DNA (mtDNA) cytochrome *b* and nuclear DNA alpha-lactalbumin (*αLAlb*) genes. Using sixteen tissue samples collected from the introduced population in Okinoshima Island, we identified three cytochrome *b* haplotypes: two associated with Formosan sika deer and one from Formosan sambar (*C. unicolor swinhoei*). However, we found three *αLAlb* sequences, Formosan sika deer, red deer (*C. elaphus*) and one unidentifiable sequence. We also observed cytonuclear disequilibrium in five individuals, indicating that the introduced population in Okinoshima Island consists of the hybrid of three deer species and that might have originated from a private deer-breeding facility in Taiwan. We suggested that isolating the introduced deer population in Okinoshima Island to prevent uncontrolled gene flow to native Japanese sika deer. By contrast, the sequences of cytochrome *b* and *αLAlb* from captive deer at Hirakawa Zoo were identical to Formosan sika deer. Our results supported that the captive stocks of Hirakawa Zoo might be a suitable genetic resource for the reestablished Formosan sika deer.

#### **191 Ex situ Conservation of Tsushima Leopard Cat by the Cooperation with JAZA and MOE**

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The Tsushima Leopard Cat inhabits exclusively Tsushima Island. It is considered an isolated population of the Amur leopard cat (*Prionailurus bengalensis euptilurus*). It is listed by Ministry of the Environment (MOE) as “Critically Endangered” on its Red List of Threatened Species. Its *Ex situ* conservation at zoos has been implemented since 1996. The captive population is 21 (12 males and

9 females) as of the end of 2013. However, high infant mortality and aging are serious problems in maintaining the population. Japanese Association of Zoos and Aquariums (JAZA) and MOE reviewed the population management plan with the cooperation of academic organizations and the zoos which keep the animal. First, Fukuoka Zoo and Kujukushima Zoo have been designated as the breeding base, because their climate is considered to be similar to Tsushima, the animal's natural habitat. Four (two male, two female) and five (three male, one female) fertile young cats are transferred to these two zoos respectively. At each location, various combination of mating has successfully been done. As a result, three (one male, two female) kittens are born and two females have survived at Fukuoka Zoo. At Kujukushima, two male kittens are born. Secondly, the experimental artificial insemination is carried out at Inokashira Park Zoo using the Amur leopard cat originally from Korea. Two kittens are born as a result and one has survived. Our attempt suggests that effective *Ex situ* conservation is achieved by integration of all responsible parties for one species.

### **192 Assessment of Habitat Use, Fatality, and Efficiency of Hair Trapping of Long Tailed Goral (*Naemorhedus caudatus*) in the Edge Area, South Korea**

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Long tailed goral (*Naemorhedus caudatus*) is listed as an endangered species in IUCN and designated as national monument (no. 217) in Korea. Parts of Gangwon province are restoring the species in the national park. The species was known to live on rocky and steep slopes. Ul-jin has been known to the lowest area in South Korea, it is important to assess the habitat use and fatality in the edge area in order to study the ecological aspects of the species. Using barbed-wire enclosure hair-trap and hair collection from rocks and branches were counted to analyze the efficiency of hair trapping and habitat use. During 21 months from Feb. 2009 to Oct. 2010, 21 sites were investigated. We collected the 217 hair samples at the 15 sites. The southwestern direction, altitude between 300 and 500m, gradient between 30 and 45, 1500m from a road and a distance of less than 500m from waterway were categorized into the core habitat. Although the hairs collected by hair-trap were not the highest proportion, the probability of collecting the feasible hairs was higher than hairs naturally collected. From March to June, the 24 individuals (four pregnant female and thirteen juvenile) died from the starvation. Habitat use in edge areas was not different from other areas, so we concluded that population size affected the distribution of the gorals. In addition, relatively weak individuals were easily affected by the climate factors, and the preservation of the least population is necessary to rescuing the endangered individuals.

### **193 Change in Activity Pattern of Sika Deer before, during, and after Culling Operation**

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It is important to understand the effects of culling operations on activity patterns and behavior of ungulates, in order to conduct effective culling operations on overabundant populations. However,

there is no information on how the operation might alter activity patterns and vigilance levels of ungulates. Conducting camera-trap surveys during May 2012-November 2014, we investigated changes in activity patterns and vigilance levels of sika deer by the operation. In our study area, 57 deer were culled during August 2012-March 2013 and 148 deer during April 2013-March 2014. We calculated the total number of deer photographed for dawn, dusk, day, and night. Vigilance level was calculated from non-vigilance and vigilance behavior before, during, and after the culling operation. Number of deer photographed at dawn, dusk, and night during summer-autumn were more than that in day during the culling operation, suggesting that deer were predominately nocturnal. In addition, we found a clear pattern of vigilance levels, with low levels before the culling operation and high levels during and after the operation, indicating that deer would immediately show a high vigilance level when the operation is conducted, and remain at high levels after the operation. Our study revealed that deer activity patterns and vigilance levels are significantly altered by culling operations.

#### **194 Hunting Accidents and Hunter Education in Japan**

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Hunting accidents were evaluated in detail to identify risk factors and to develop a solution. We analyzed 1,471 cases which were reported to Japanese Hunting Association as fraternal insurance from 2007 to 2011. Most hunters responsible for accidents were sixties and/or veterans. Although these cases were treated as “hunting” accidents, the accidents associated with firearms were low. Only 144 of all “hunting” accidents were related to firearms (9.8%). Of the firearm related accidents, 18.6% cases resulted in death. The most frequent factor responsible for firearm accidents was improper handling of firearms. In case of mistaking the victim for game, at least 61.5% of victims were wearing fluorescent orange. It became clear that the main cause of firearm accident was violation of basic hunting rules. It is time to introduce a new qualification system for hunters and managers to demonstrate their understanding of basic hunting principles.

#### **195 Seasonal Change in Grazing Damage on Mixed Sown Pasture by Wild Boar**

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Wild boars (*Sus scrofa*) cause serious damage to temperate grassland dominated by Italian ryegrass (*Lolium multiflorum*). Wild boar also cause serious damage on mixed sown pasture (Italian ryegrass and rye) and percentage of yield reduction was about 80 % in Shimane, western Japan. However, there is no available information about when serious grazing damages occur from winter to spring. This information may help us to decide when we should focus on a countermeasure for grazing damage. We investigated a seasonal change in grazing damage by wild boars on 2 ha mixed sown pasture (Italian ryegrass and rye). Biomass and consumption of grass were estimated for each month using the movable cage technique from December 2013 to April 2014. We used five movable cages (1 m × 1 m × 0.6 m). Consumption was defined as the difference between the biomass inside and outside of the cages. There was a significant difference in the biomass between inside and outside

the cage from December to March (paired t-test,  $p < 0.01$ , respectively). Percentage consumption by wild boar ranged from 74.5 % to 91.7 % during these months; however, there was no significant difference in the biomass between inside and outside the cage in April (paired t-test,  $p = 0.44$ ). Percentage consumption was only 9.3 %. These results suggest that serious grazing during winter caused yield reduction in May. Therefore fencing such as electric fence during winter may prevent grazing damage on mixed sown pasture.

#### **196 Determining Factors for Deer Culling Suitability Evaluated by Forest GIS and Professional Hunters**

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Deer population control is an essential scheme for forest management of Japan. This study calculated suitability of deer culling for conifer plantation forest stands of Hokkaido Prefectural Forests. We estimated culling suitability with firearms based on both quantitatively and qualitatively evaluations. We used GIS spatial analyses in particularly using forest management records and digital elevation model (DEM). Furthermore, this study confirmed our results on spatial analysis on-site with professional hunters. Our study indicated three preferable conditions to use firearms in forests. These were topography, vista within forest stands, and cost of carrying carcass out from the stands. The topography study used 10m DEM and professional hunter's qualitative evaluation by linear discriminant statistical analysis. Vista within forest stands was calculated by stepwise method general linear model approach with five variables including stand type, stand age class, thinning practices, harvesting records, and sasa bamboo height and confirmed by the field survey with on-site evaluation of professional hunters. Physical cost of carrying carcass was estimated from 61 culling samples in the forests. This study successfully proved that topography, vista, and carcass delivering cost were the most preferable factors to determine suitability of culling in the conifer forests.

#### **198 Wildlife Conservation and Tourist Satisfaction at Kenya's Community Tourism Enterprises**

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This qualitative study examined the tourism experience in Laikipia, Kenya. A series of photographs and statements representing Laikipia's wildlife, landscape features, cultural heritage, and a variety of service variables that may influence visitor satisfaction were Q sorted by a non-random sample of guides and managers of four nature-based tourism enterprises and visiting tourists. Using factor analyses, the data yielded 3 groups each describing a distinct visitor experience. We characterized these as "Ecotourist Experience," "Comfortable Wildlife Experience," and "Vacation Experience," based on rankings of variables and respondent comments. The results identified wildlife and cultural resources of importance to Laikipia tourists as well as relative values of service quality attributes and ecotourism benefits. Educational aspects of ecotourism were not highly valued and information about local natural and cultural history was mainly disseminated by guides and managers. Findings suggest the importance of management actions to maintain threatened, but controversial, wildlife



species such as lions and elephants, and promotion by guides of the region's rare dryland species will contribute to tourism satisfaction. Promotion of ecotourism benefits, currently a focus of tourism enterprise websites, appeals mainly to only one type of tourist attracted to Laikipia. Few information/visitor centers are available in the Laikipia region, and are not highly valued by most tourists. A broader study is needed to further enhance tourism-centered information and outreach.

**199 Residents' Attitudes toward Brown Bears and Brown Bear Management in Sapporo, 2012-2014**

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In Sapporo, a metropolis with two million residents, more and more bear sightings have been reported in recent years. This research aims to provide basic information on the attitudes of residents in Sapporo toward brown bears (*Ursus arctos*) and brown bear management. In 2012, the author conducted a mail survey among the residents of Sapporo. They were divided into 4 categories: (a) residents of urban areas where bears were sighted in 2011 for the first time in the past half century, (b) residents of urban areas where bears had been repeatedly sighted, (c) residents of suburban areas where bears had been repeatedly sighted, (d) residents of urban areas with no bear sightings. The number of samples was 1,443, and respondents, 868. The response rate was 60%. The results showed: (1) the level of acceptance of bears outside human residential areas is as high as half in categories(a), (b) and (d), but slightly lower in category(c), (2) mass media, neighborhood associations and the municipal government play important roles in dispersing information and knowledge about bears among the people, (3) residents want the municipal government to conduct a variety of activities, especially bear habitat investigation and public education about bear biology and garbage management, (4) farmers and orchard owners in category(c) also want more direct measures to avoid product losses, including helping farmers install electric fences, and control kill of bears in the springtime. In 2014, the author conducted a follow-up survey. No essential changes were observed.

**200 Spatio-Temporal Factors Affecting Bark-Stripping of Conifer Trees by Bears in Japan**

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Bark stripping (BS) of conifer trees by Asiatic black bears (*Ursus thibetanus*) has seriously affected forestry in Japan. It primarily occurs between May and July in conifer plantations. Effective measures for preventing BS have not been established because there is no way to predict the targeted areas; therefore, we aimed to clarify the annual and spatial factors associated with BS. This study was conducted in Kusaki University Forest, Tokyo University of Agriculture and Technology, central Japan. We set 65 quadrats in conifer stands of varying status, calculated the number of damaged trees, and measured several environmental variables to clarify the factors that affected the spatial fluctuations of BS. We collected previously recorded data for acorn masting and meteorology to clarify the factors that affected the annual fluctuations in BS. From our results, BS occurred in areas that were stripped the previous year. The number of bark-stripped trees increased when acorn masting was low in the previous autumn or when the average temperature of the previous winter was high. Furthermore, the distribution of bark-stripped trees in young stands expanded faster than in older

stands. Therefore, forest owners should preferentially protect the young stands where BS has occurred in the past. Protective measures should be strengthened in years following a low acorn masting or a mild winter.

## **201 Vitalize Local Community with Tackling Wildlife Damage Management Practices: Possibility of Wildlife Co-Management in Depopulation Society in Japan**

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Human-wildlife conflicts have become as a serious problem in Japan. In addition to the economic damage, damage to small-scale farming, for household consumption, could result in a decreased motivation to continue farming in mountainous areas, where the human population has been declining and aging since the 1960s. On the other hand, to alleviate human-wildlife conflicts, a new effective methodology for damage management has recently been developed in Japan, which explicitly targets local people and farmers, as well as the wildlife and their habitat. Although local government try to promote damage management by local people, it is getting difficult for the aging community, where manpower and motivation are declining year by year. Accordingly, we conducted the alternative programs which vitalize the local community by tackling damage management practices in Sasayama City in 2013 and 2014. These were aimed to share the damage management practices in the local community, such as maintenance work of fences or removal of unharvested fruits, by various people as the urban-rural exchange programs. In addition to promotion of damage management in the community, questionnaire survey revealed that participants from urban areas showed high satisfaction for the programs and found various resources in the region attractive. Although these programs have currently been conducted in community-based study of the universities, we need to develop these approaches to apply in other communities. Furthermore we will discuss the requirements of the governance system to realize the wildlife co-management by various stakeholders including social enterprise in the depopulation society.

## **202 A Problem of Sika Deer in Arashiyama: A Perspective of Millennial Landscapes in Kyoto**

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The urban area of the historic city of Kyoto, in central Japan, is surrounded by scenic forests, and temple and shrine forests including cultural world heritage sites. In Arashiyama, flowering cherry trees (mainly *Prunus jamasakura*) were initially planted since the thirteenth century to create scenic landscapes. During the past two decades, there have been problems with sustainability of the forests. For example, feeding on saplings and seedlings by sika deer (*Cervus nippon*) prevents regeneration of the forest, and overgrazing on understory plants causes erosion and a decrease in biodiversity. The National Forest Agency that owns the core area (59 ha) of Arashiyama organized a committee for consensus building among stakeholders. To discuss and decide how we should manage the forest, we surveyed use of the forest by deer with camera traps. As a result, deer were photographed through the year and six or seven deer were simultaneously on a photo in each season. Thus, the population density was estimated to be more than 10 deer/km<sup>2</sup> in the area, too high to allow forest regeneration and the recovery of understory plants. We also made field trips

with local citizens to share our understandings. The committee reached a consensus that the population density of deer should be decreased for both land restoration and historical landscapes maintenance. Capturing deer in this area is difficult because of steep topography, fragile soil, dense footpaths and openness to the public, so that we discuss how we control the deer population effectively.

### **203 Planning of Deer Culling in an Uncertain Society: A Trial of Sharpshooting on National Highway in a National Park**

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Although roadsides in national parks and serves as refuge areas to deer in Japan, the legal regulations and government sectionalism makes it difficult to manage deer populations in such areas. The purpose of this study is to evaluate methods for planning deer culling in an uncertain society. Serious bark-stripping damage and deer-vehicle collision has occurred due to high deer density around the national route 453 adjacent to Shikotsu Lake in Shikotsu-Toya National Park, Japan. To develop deer management option program around the road in cooperation with local authorities, we blocked the national highway to conduct sharpshooting with a vehicle from roadside, which is a first attempt in Japan. We implemented the sharpshooting program from 6:30 to 8:00 a.m. during two days in February 2014. Sharpshooting was focused in a 6.4km section of the national route 453. We held a number of meetings with ministries, agencies, and local governments to make sure we were able to carry out the sharpshooting plan from one year before the implementation. Additionally, we used pamphlets, signboards and mass media to get the understanding of local residents regarding the cull. Based on the results of the first day of the cull, we improved the methods of carcass removal and shooting range to meet social demands. For successful deer management in an uncertain society, it is important to repeat feedback from stakeholder discussions and trials.

### **204 Comparative Morphology of the Geographical Variations of Skull of the Red Jungle Fowl**

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The geographical variations of size and shape of the skull of the red jungle fowl (*Gallus gallus*) were osteometrically examined from various localities. The specimens used in this study were collected from Vietnam, Laos and Bangladesh. Skull of 41 adult males from 5 localities belonging to Japanese Society for the study of H. I. H. Akishinonomiya Collection and The University Museum of The University Tokyo were examined. Although the zoogeographical barriers have been confirmed among the localities of the Southeast Asian District, the size of the skull were similar among geographical populations. Certainly statistical differences were observed in some measurement; however, the size differences even between Bangladesh and Laos or North Vietnam and South

Vietnam were not so large as the other species or taxa in this region. Since the population from North Vietnam was larger and the skull from Bangladesh represented smaller in size, we suggest that the size tendency may be present according to the temperature condition as Bergmann's rule. In the multivariate analysis, the principal component analysis did not obviously confirm the morphological differences among populations, whereas the canonical discriminant analysis mostly separated the populations. The morphological similarities among populations in the red jungle fowl may be consistent with the low genetic variability revealed from the species. We also suggest that the gene flow continues between the wild and domesticated populations to contribute to the morphological and genetic uniformities in this species.

## **205 The Slim Body of the Coypu from the Lower Yoshii Region in Okayama Prefecture, Japan**

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Coypu (*Myocastor coypus*) is semi-aquatic and large-sized rodents native to South America. They were introduced to Japan in the 1930s, abandoned two times by failure of the national policy propagation and consequently changed to naturalized animal subsequently caused damage to food crops. The local variation of coypu in Japan was not ever investigated. We compared the body size and the craniometric measurements (26 items) of adult coypu based on habitation altitudes at Yoshii Riv., Asahi Riv. and Takahashi Riv. First, we calculated fundamental statistics of body size and craniometric measurements. Next, we used multivariate ANCOVA and PCA to explore the possibility of morphological characteristic by habitation altitudes. In the HBL and BW comparison did not observe a big difference most of watershed areas at three rivers and habitation altitudes in both sexes, although the only HBL showed high value and BW showed low value in the lower Yoshii region. Additionally, the length of premolars and molars row of upper and lower was low average, whereas the width of frontal bone and cerebral cranium, with tympanic bulla was high average. The result of PCA, though the component score was different in both sexes, the extreme length and breadth of skull and the height of proboscis, the length of the diastema, the premolars and molars row of upper and lower and the width of frontal bone and cerebral cranium showed high score. The possibility that local populations has its own morphological characteristics, leads to a demand for continuing sample collection and measuring.

## **206 Paternal Evolutionary History of the Brown Bear around Northeast Asia Reconstructed by the Analysis of the Y-Chromosomal Genetic Variations**

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The brown bear (*Ursus arctos*) is widely distributed throughout the Holarctic region. Sexually dimorphic behaviors are observed in the brown bear; males disperse from the natal areas whereas

females are philopatric. This sex-biased migration is presumed to have extensively contributed to the brown bear evolutionary history. Previous phylogeographic studies based on the mitochondrial DNA, which maternally inherited, showed that maternal lineages of the brown bear are geographically differentiated from each other. Especially, the brown bear population on Hokkaido Island is composed of three distinct maternal lineages. Female philopatric nature is considered to be one of the causes of this pattern. Considering the sex-biased migration, it is essential for clarifying their comprehensive evolutionary history around northeastern Asia to reveal paternal genetic variation of the brown bear of these regions. In this study, we analyzed paternally inherited genetic markers (Y-chromosomal sequences and Y-linked microsatellites) of the brown bear from Hokkaido, southern Kuril Islands, Sakhalin, and Eurasia. The Y-chromosomal haplotypes were determined based on the Y-chromosomal sequences combined with Y-linked microsatellite markers. Phylogenetic relationships among the Y-chromosomal haplotypes were inferred, and haplotype diversity was calculated. Based on the Y-chromosomal polymorphic data, we tested the paternal population differentiation among brown bear population as well as the signals of demography. Then, we compare the phylogeographic patterns of paternal markers with those of maternal, and biparental genetic markers. In addition, we discuss the effects of the sex-biased migration to the brown bear evolutionary history.

## 207 Problems with Incidental Captures of Asian Black Bear

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Occurrences of the incidental captures of Asian black bear (*Ursus thibetanus*), by deer or wild boar traps, have increased since 2001 at Kinki and Chugoku-District. Bears intrude into residential areas frequently and incidental captures have increased especially in a bad nut harvest year. In recent years, a remarkable increase has occurred in both hunting and non-hunting seasons. The situation probably resulted from the strong hunting pressure on deer for nuisance control during non-hunting season, which led to an increase in abandoned deer carcass, which in turn and the carcass may be one of the reasons inducing bears to the trap site. We analyzed 556 cases of incidental captures, including 232 box traps and 324 wire snares. In a bad harvest nut year the number of box trap capture exceeded that of snare, which showed that the bait in the box trap attracted bears more strongly. The incidental capture causes damage to the bear. It is also dangerous to the persons who maintain the traps. It is necessary to find the way to reduce the occurrence rate of the incidental captures.

## 208 Reevaluation of the Agouti Allele in the Japanese Wild Mice

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To evaluate the allele at the agouti locus in the Japanese wild mice showing the agouti (wild) and light-bellied coat which is expressed by probably  $A^w/-$ , we examined the allele typing by three PCRs and nucleotide sequences for them and four mouse strains (C57BL/6N with  $a/a$ , DBA/2 with  $a/a$ , C3H/HeJ with  $A/A$  and 129X1/SvJ with  $A^w/A^w$ ). Theoretically, three PCRs can detect as follows, PCR I: the  $A$ ,  $a$  and  $A^w$  alleles by 162 bp, 11 kbp and 0.7 kbp fragments, respectively, PCR II: the  $a$  and  $A^w$  alleles by 263 bp fragment, and PCR III: the  $a$  allele by 3 kbp fragment, based on previous studies.

According to current analyses, PCR I could amplify only the 162 bp fragments in C3H/HeJ and 129X1/SvJ. PCR II detected the 263 bp fragments in the Japanese wild mice, C57BL/6N and DBA/2. In addition, PCR III also detected the 3 kbp fragments in only C57BL/6N and DBA/2. Furthermore, we sequenced the exon 1A region (approx. 1.2 kbp) of the agouti allele and we obtained three sequence types in the Japanese wild mice. These sequences were identical to those of C57BL/6N and DBA/2 (*a*), C3H/HeJ (*A*), and 129X1/SvJ (*A<sup>w</sup>*). However, the sequences of most individuals showed the identity with the *a* allele. Considering the present PCR and sequencing results, we conclude that the component of the agouti allele of the Japanese wild mice is not identical to that of 129X1/SvJ and is similar to those of C57BL/6N and DBA/2 at least.

## **209 Geographic Patterns in the Skull Morphology of Red Foxes Occurring Extensively in the Northern Hemisphere**

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Red fox, *Vulpes vulpes*, has the widest distribution across the Northern Hemisphere of all terrestrial carnivore species. This species is heavily polymorphic due to the geographic variation. Presently, 44 subspecies are described based on regional morphological characteristics with poor ecological information. Although morphological variation on several red fox populations has been documented, the geographic pattern throughout the Northern Hemisphere blurs with their high dispersal ability and adaptability. To elucidate the geographic patterns of red foxes, we analyzed morphological variation of skull specimens from Northern Hemisphere: China, Japan, Pakistan, Yemen, Iran, Hungary, Spain, Alaska, Canada, and United States. Significant geographic difference on the morphological variation is observed in this study. In the result of the analysis of variance, the populations of Hungary, Alaska, and Canada were larger in most of skull measurements. On the other hand, red foxes from United States and Southwest Asia had relatively smaller skull traits. We observed clear distinctions between the red foxes of Palearctic and Nearctic with significantly larger postorbital constriction of United States, Canada, and Alaska populations. Also, the principal component analysis showed similar pattern: measurements related to skull length, muzzle length, and mandible length strongly support the result. Our findings suggest that the skull morphological variation of red foxes might be affected by the environmental determinants.

## **210 Genetic Variation of the Major Histocompatibility Complex Class II DRB Genes in the Japanese Island Populations of the Leopard Cat: Tsushima and Iriomote Wildcats**

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Of the Japanese islands, the leopard cat (*Prionailurus bengalensis*) is distributed on the Tsushima Island and the Iriomote Island. The population sizes of the wildcats are estimated to be about 100 on both islands, and they are considered endangered populations. For conservation of these wildcat populations, it is important to understand their genetic diversity, especially the ability of adaptation to environmental changes and disease infection. In the present study, we investigated the allele

variation and polymorphisms of the major histocompatibility complex (MHC) class II DRB in both populations, using direct sequencing and molecular cloning of PCR products. As a result, we have found at least one specific allele in the Iriomote wildcats and eight different alleles in the Tsushima wildcats so far. Each individual of the Tsushima wildcat shared three alleles at maximum, indicating occurrence of at least two loci of DRB. The frequency of non-synonymous substitutions was higher at the antigen-binding site (ABS) than non-ABS, although the frequency difference was not significant between both sites. The genetic variation was lower on Iriomote than Tsushima. The results indicate that the Iriomote wildcat population has experienced severe founder effect during the isolation within the island. In addition, finding two alleles shared by the Tsushima wildcat and the continental leopard cat suggests balancing selection of the DRB locus during the long period on the Tsushima Island isolated from the continent.

## [211-240]

### 211 Phylogenetic History of the Northern Pika Inferred from Mitochondrial and Nuclear Genes

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In the glacial periods during the Pleistocene, the northern Far East was mostly free from massive ice sheet, and its coastal lines were reshaped by lowered sea level and emerged land-bridges; however, how the climate changes and the geographic structures had affected on demographic histories of boreal species in the northern Far East is still not well understood. The northern pika (*Ochotona hyperborea*) is widely distributed from central Siberia to northern Far East, including Kamchatka Peninsula, Sakhalin and Hokkaido Islands. To investigate the phylogeographic history of *O. hyperborea*, we collected samples from Primorsky and Hokkaido, and determined sequences of the mitochondrial *cytochrome b* and nuclear *Mc1r*. The mitochondrial phylogenetic tree constructed with database sequences of other populations revealed population-specific lineages that were integrated into two major clades: the southern (Primorsky, Sakhalin and Hokkaido) and northern (Buryatia, Chita, northern Krasnoyarsk, Magadan and Chukotka) clades. The Bayesian chronological analysis suggested that the two major clades diverged before the Middle Pleistocene, and the local populations were genetically differentiated before the Late Pleistocene. In addition, the network analysis using *Mc1r* sequences showed that haplotypes from the Primorsky and Hokkaido populations were grouped into different clusters. One haplotype from Primorsky contained a mutation (G361A; D121N) plausibly responsible for black coat variant that is absent in Hokkaido. These results imply that local populations of *O. hyperborea* have the mutually independent demographic histories since the Middle Pleistocene, suggesting the presence of multiple refugia in northern Far East during the glacial periods.

## 212 Functional Anatomy of the Hind Limb of Greater Horseshoe Bat and Japanese Little Horseshoe Bat in the Roosting Posture

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The roosting posture of bats is classified as terrestrial or hanging. It is known that species with a hanging posture tend to have suitable musculature. *Rhinolophus ferrumequinum* and *R. cornutus* belong to same genus, but have adapted the extended hanging posture and flexed hanging posture, respectively. The difference in the roosting posture of the two species suggests that they have different adaptive muscles form in the hind limbs. In the present study, the musculature of the hind limbs related to the hanging posture in these two species is described and the form adaptations to the posture are reported. Four specimens of *R. ferrumequinum* and two specimens of *R. cornutus* were examined. The specimens were dissected under a stereo microscope because of their small size. The musculature of *R. ferrumequinum* differs from that of *R. cornutus* in the extensor group of the thigh, the flexor group of the foot, and the tendon sheath of the foot toe. The musculus quadriceps femoris of *R. ferrumequinum* is a very weak muscle. Therefore, during the extended hanging posture, *R. ferrumequinum* extends its hind limbs using its own weight. With regard to flexion of the foot toe, *R. ferrumequinum* flexes only the distal interphalangeal joints because tendon sheaths cover the proximal interphalangeal joints and the muscle for flexion of the proximal interphalangeal joint is lost. From this study, it is concluded that *R. ferrumequinum* has a specific musculature system for the extended hanging posture.

## 213 Acoustic Relationships between the Structure of Sound-Propagating Organs and the Acoustic Properties of Clicks in Small Toothed Whales

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Relationships between the structure of sound-propagating organs and the acoustic properties of clicks of three toothed whale species, harbor porpoise, Dall's porpoise and striped dolphin have been examined to find social structure or habitat environment which markedly different among species. Due to the lack of information about physical property of head soft tissue, acoustic researches have not been sufficiently carried out yet. In this research, for the more precise understanding on the relationship between the structure of sound-propagating organ and the acoustic property of clicks, the distributions of acoustic impedance in head tissue of the three species were estimated. In melon of all species, acoustic impedance gradually changed from sound source to emitting surface (ES) and matched with seawater at ES. This implied that all 3 species utilize this impedance cline for effective sound propagation of clicks. Additionally, harbor porpoise and Dall's porpoise had larger ES than striped dolphin. Larger ES could reduce diffraction at the boundary of ES and increase directivity of the clicks. Previous research suggested that small coastal



toothed whales including harbor porpoise and Dall's porpoise might have evolved narrow-band high frequency (NBHF) clicks to avoid predation by killer whales, which is one of the most threatening predators. From the results, it was suggested that small coastal toothed whales have obtained not only NBHF clicks but also a characteristic sound-propagating organ to increase clicks directivity for the same reason.

#### 214 Reexamination of Desmostylian Phylogenetic Relationship

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Desmostyilia is an extinct clade of marine mammals belonging to Tethytheria or possibly Perissodactyla. Traditionally, Desmostyilia has been divided into two families, Desmostylidae and Paleoparadoxiidae, based on their teeth morphology, with the former including 4 or 5 genera and the latter 4 genera. Although the phylogenetic relationships within Desmostyilia have been mostly unclear, two hypotheses were proposed: both Desmostylidae and Paleoparadoxiidae are monophyletic groups in one hypothesis whereas Paleoparadoxiidae are considered paraphyletic in another. One factor contributing to such difference in the hypothesis was the lack of well-preserved specimens as suitable outgroups for phylogenetic analyses. Cooper et al. (2014), however, described a well-preserved skull of *Anthracocone* that is considered as an appropriate outgroup of Desmostyilia. In this study, I ran analyses on data matrices on the desmostylian interrelationship published in previous studies to examine reproducibility of the results, i.e., whether or not tree topologies reported in these studies could be recovered. Second, I analyzed the Desmostylian relationship by newly adding *Anthracocone* as an out-group to such data sets after examining the accuracy of their character coding. As a result of the first analysis, the tree topology reported in Inuzuka (2005) was not recovered whereas those in other studies were. Accordingly, Inuzuka's data set was not used for the second analysis. In the second analysis, all analyses of these data sets resulted in Paleoparadoxiidae forming paraphyletic, successive outgroups for the monophyletic Desmostylidae. This result provides a phylogenetic framework for discussing various aspects of Desmostylian evolution.

#### 215 Characterization of Coat Color Variation in Bandicoot Rats Species from Myanmar Using *Mc1r* Sequence and Spectrophotometric Data

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In mammals, the melanocortin-1 receptor gene (*Mc1r*) is the major candidate gene for the melanism. In field collection in Myanmar in 2013 we obtained 14 specimens of three species of *Bandicota* (*B. bengalensis*, *B. indica*, and *B. savilei*) and found that one individual of *B. bengalensis* from Mandalay area possessed the melanistic coat color. To identify the mutation causing melanism we determined

the entire coding region of *Mc1r* in *B. bengalensis* and found a single nucleotide mutation from G to A at site 361 associating with the melanism. Notably heterozygous rats carrying the 361A allele did not have the melanistic phenotype, indicative of the recessive trait of the G361A mutation. We confirmed the trend of dorsal hair, by determining the brightness ( $L^*$ ) quantitatively with a spectrophotometer. Averaged values of  $L^*$  measured across a line perpendicular to median line in 5 mm interval were substantially similar between rats with the G/A ( $L^* = 28\sim 32$ ) and G/G ( $L^* = 28\sim 34$ ) genotypes. In *B. bengalensis* and *B. savilei*, we measured the  $L^*$  values represented by 10 plots randomly chosen in the ventral part and found that *B. bengalensis* with the G/G genotype ( $L^* = 35\sim 42$ ) was darker than *B. savilei* ( $L^* = 48\sim 59$ ), which is concordant with those described in literature. We also performed molecular phylogenetic analyses with the nuclear *Mc1r* sequences, together with the mitochondrial cytochrome b gene (*Cytb*) sequences. Here we discuss the evolutionary history of the three species of *Bandicota*, where few studies have been conducted till today.

## **216 Morphological and Cytogenetical Variations between Hokkaido and Honshu in the Japanese Wild Mice**

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The Japanese wild mice, *Mus musculus*, are distributed in most regions of the Japanese Islands. For the mice, molecular phylogenetical studies have been performed well and have revealed that the CAS and MUS haplotypes are dominant in Hokkaido and Honshu, respectively, as intraspecific variations of the mitochondrial DNA. However, other criteria except for molecular phylogenetical findings are still unclear. In this study, we researched morphological and cytogenetical criteria between Hokkaido (Hidaka area) and Honshu (Kanagawa area) in the Japanese wild mice, to evaluate geographic differentiations. First, four external body dimensions and 15 skull dimensions were measured and canonical discriminant analysis was done using these measurement indices. This analysis indicated that the mice from Hokkaido and Honshu were clearly discriminated morphologically. In particular, the individuals from Hokkaido showed longer tail than those from Honshu. In addition, all the individuals from Honshu carried white-bellied coat but a part of those from Hokkaido had non-white-bellied coat as typical European or Asiatic types. Second, we analyzed C-band patterns for their chromosomes. The number of chromosomes with positively stained C-bands was larger in Hokkaido than in Honshu. Such larger number of the chromosomes bearing the C-bands is not usual in the Japanese wild mice. Accordingly, in the Japanese wild mice, the morphological and cytogenetical differentiations were apparently confirmed between Hokkaido and Honshu. Considering previous studies and current results, we suggest that both differentiations have been established throughout geographical isolations and/or migrations of European or Asiatic mice into Hokkaido.

## **217 Impact of Ice Ages on the Genetic Population Structure of the Western Japanese Mole Inferred from Mitochondrial and Nuclear DNA Sequences**

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The western Japanese mole, *Mogera wogura*, is known to have four mitochondrial DNA (mtDNA) phylogroups lying in the geographic regions of central Honshu (I), western Honshu/Shikoku (II), Kyushu (III) and China/Korea/Russia (IV). Here we aimed to determine the geographic boundary between the phylogroups II and III on the western Honshu (Chugoku) and to elucidate factors shaping it. Phylogeographic analyses with mtDNA cytochrome *b* sequences of 125 moles from 93 localities clearly showed that the boundary of II and III located in the line connecting localities of Hamada (Shimane Prefecture) and Onomichi (Hiroshima Prefecture), whereas no apparent physical barriers exist there. The haplotype network pattern, together with the  $F_u$ 's  $F_s$  and mismatch distribution analyses, suggested recent population expansion in phylogroup II. Our analyses indicated further subdivision of phylogroup III into four local subgroups including that representing the westernmost part of Honshu (the western part of Chugoku region), showing evidence of recent sudden expansion in the local populations. These results thus suggest that the mtDNA boundary is a historical consequence of the occurrence of rapid population expansion events associating with the global warming after the last glacial period (e.g., 10,000 years ago). The phylogenetic inference with multiple nuclear gene sequences suggested the presence of three distinct geographic groups of central Honshu (I), western Honshu/Shikoku/Kyushu (II+III) and China/Korea/Russia (IV), revealing genetic similarities between the mitochondrial phylogroups of II and III in the nuclear gene level. These observations thus imply the complicated historical episodes of *M. wogura* occurring in the western Japan.

## 218 Paddling Motion of Japanese Water Shrew

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Japanese water shrew *Chimarrogale platycephala* (JWS) is a fine swimmer despite of its small body. JWS sometimes catches large aquatic preys compared to its size, and swim across swift streams to carry the prey to nest or resting place. This is probably a characteristic movement of JWS, but the precise motion analyses of the animal have not been carried out due to difficulties with videotaping the motions of JWS in the field. Recent technological developments enabled us to videotape JWS swimming motions with a high-speed camera in the field. In this study, slow-motion recording suggest that JWS rely on a paddling motion of the limbs to produce principal thrust of swimming, instead of using the undulations of the torso. Forelimbs were mainly used to paddle when JWS floated or swam underwater, like dog paddling. On the other hand, hindlimbs were mainly used for lateral paddling motion. JWS also used forelimbs to push riverbed or aquatic obstacles, although hindlimbs were kept paddled throughout the swimming behaviors. This paddling motion enabled them to carry large prey while breathing in a swift stream. The skeletal systems and muscles in JWS were also examined in relation to limb movement by using CT scanner and dissections, and were compared with other terrestrial shrews.

**219 Relationship of Masseter Internal Architecture with Middle Ear Enlargement in Two Desert Rodents, Egyptian Jerboas and Merriam Kangaroo Rats**

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In desert rodent, enlargement of the middle ear is recognized as an adaptation for predator avoidance. This characteristic may modify the architecture and direction of the masseter muscle, posterior part of which is located close to the middle ear. In the present study the architecture of the masseter was observed in two desert rodents, Egyptian jerboas (*Jaculus orientalis*) and Merriam kangaroo rats (*Dipodomys merriami*). Then, the influence by large middle ear was discussed on the basis of comparison with information about non desert-dwelling rodents previously studied. Remarkable differences between two desert species and non-desert rodents were recognized in shape of the medial zygomatic aponeurosis (MZAP) and the direction of corresponding fibers. In non-desert rodents, the MZAP is anteroposteriorly long and fibers from this aponeurosis run in parallel with each other. In *Jaculus* and *Dipodomys*; however, the strap-like MZAP posteroventrally extended and the fibers pinnately ran from this aponeurosis. Similar structure has been reported in another desert rodent, spring hares *Pedetes capensis*. The pinnation of the fibers from the strap-like MZAP seems to have relationship with the enlargement of the middle ear. The anterior shift of the posterior root of the zygomatic arch due to the middle ear inflation tends to shorten this bony structure. The strap-like MZAP is considered to compensate decrease of the area of the masseter origin by creating additional attachment site in the posteroventral direction.

**220 Establishment of Barn Owls (*Tyto alba*) as Biological Control of Rats in Oil Palm Plantations in Borneo Island of Malaysia, Sabah**

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Expansion of oil palm industry in Malaysia since the 70's, coupled with abundance of food sources for the rats in oil palm plantations, have paved way for the inclusion of Barn Owls, *Tyto alba*, as biological control agents for rats. The latter is known to have caused significant damage to oil palm bunches, fruitlets, and male inflorescences, subsequently causing substantial yield loss to the industry. *Tyto alba*, together with the application of first generation anticoagulant rodenticide, have been a synergistic approach for Sime Darby in controlling rodents at bay in the oil palm fields. With over 300 000 ha of oil palm in Sime Darby in the entire Malaysia, the absence of *Tyto alba* in East Malaysia (Borneo) had been noted. Therefore initiatives had been taken by Sime Darby to introduce *Tyto alba* in Borneo. This establishment is aimed to allow *Tyto alba* to flourish and to provide a balanced equilibrium in controlling rats. In addition to the *Tyto alba* population establishment, another aim is significant reduction in rodenticide application. In fields with introduced *Tyto alba*, increased number of occupied nest boxes have been noted, indicating successful establishment of these owls. Long term successful adaptation of these introduced owls, especially in oil palm plantations, is anticipated for natural control of rats in Borneo. Sime Darby has been introducing *Tyto alba* to Borneo since year 2009 and this model has been adapted by several other industry players with sizeable planted hectareage in the same region.

## 221 Non-Invasive Measurement of Fecal Steroids in Spotted Hyenas

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Spotted hyenas (*Crocuta crocuta*) exhibit unique behavioral and morphological characteristics. Briefly, females are more aggressive than males, and females have external genitalia that closely resemble those of males. For these reasons, sometimes distinction of male and female is impossible from the appearance, and it will be a problem to breeding program at zoological gardens. Recently, it has been reported that androgenic hormones might mediate the expression of these traits. Therefore, androgens are of great interest in this species. The use of enzyme immunoassays (EIA) to measure metabolites of reproductive hormones in non-invasive samples is a useful technique to monitor reproductive activity in many mammals. The first objective of this study was to measure metabolites of steroids in fecal samples by using EIA in this species. The second objective was to establish a way to distinguish males and females by the results. Feces were collected from five males and three females in four zoological gardens in Japan. Metabolites of Testosterone (T), Dehydrotestosterone (DHT), Estrone conjugates (E1C) and Pregnanediol glucuronide (PdG) were measured by EIA in fecal extracts in the spotted hyena. These results showed that fecal E1C levels were higher in females than males. Also, fecal T and DHT levels were higher in females than males. However, fecal E1C levels of one female in Sapporo Maruyama Zoo were very low compared with other females, and her fecal T levels were low like males. These results were similar to the results in males. From this hormonal analysis we estimated that the individual in Sapporo Maruyama Zoo is male.

## 222 Analysis of the Sox3 Gene in a Y Chromosome-Absent Mammal, *Tokudaia osimensis*

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The *SRY* (sex-determining region on Y) gene located on the Y chromosomes is a sex-determining gene in placenta mammals. The Amami spiny rat (*Tokudaia osimensis*) which is endemic species in Japan, has lost the Y chromosome as well as the *SRY* gene. This species has odd number of diploid chromosomes:  $2n=25$  and an XO/XO sex chromosome constitution. Our previous studies suggest that the molecular pathway in downstream of *SRY* is conserved in this specie; however, a new sex-determining gene superseded *SRY* is unknown. In mice, it was reported that ectopically expression of *Sox3* (*SRY*-related HMG box-containing gene 3) in the bipotential gonad of mouse caused XX-male sex reversal. We speculated *SOX3* was involved in the sex-determining in this species. We obtained BAC clone including *SOX3* and determined the sequence. The coding sequence showed more than 95% identity with that of mouse, and the predicted amino acid sequence of the HMG box which is functional domain for DNA binding is completely identical with mouse. *SOX3* was mapped to a single X chromosome by FISH mapping. Southern blot analysis suggested no difference of copy number of the gene between male and female. Collectively, these results suggest the *SOX3* of the Amami spiny rat may work in the same manner as mouse *Sox3*.

## 223 Effective Time and Days for Trapping Invasive Alien Aquatic Species, Signal Crayfish

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American signal crayfish (*Pacifastacus leniusculus*), an invasive aquatic species invaded throughout Hokkaido of Japan, is a major threat to aquatic ecosystems in recent years. While various control methods have been proposed in Europe, little is known about a length and days that can be used to effectively trap nuisance populations. We used spring prawn traps to determine the length and time period of the effective control in the study area, Lake Toya. We counted number of catch and defined sex for each trap. The carapace size and weight of each crayfish were also measured for every 6 hours (0:00, 6:00, 12:00, and 18:00) continuously for 5–days period. Total of 215 crayfishes caught in this period. About 80% of crayfish were trapped during the night. To effectively trap signal crayfish for removal, we found that capture rates could be maximized in between 18:00 and 0:00. After the second day, catch only increase slightly. Rather than the increment, the escapes of 65 (30%) crayfishes were examined after 2 days. To determine the potential of trapping as management option for crayfish, these methods must be carefully implemented in local invasive aquatic species management practices. In this study, we need more discussions about less labor intensive trapping for the successful control of signal crayfish.

## 224 Revised Phylogenetic and Phylogeographic Views on *Mus* Species in Myanmar and Their Coat Color Variation

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The taxonomy and distribution of the genus *Mus* in Myanmar is poorly known, despite recent recognition of two extra endemic species. We performed molecular phylogenetic analyses on mice belonging to the subgenus *Mus* collected from Yangon and Pyay, southern part of Myanmar, using two gene markers of the mitochondrial cytochrome *b* (*Cytb*, 1140 bp) and nuclear melanocortine 1 receptor (*Mc1r*, 948 bp). Phylogenetic analysis with *Cytb* revealed that *Mus fragilicauda* occurs in Myanmar (Pyay) and is closely related to the conspecific individuals from Laos (PDR) with genetic distance of 1.4%. We discuss the factors that shape the distribution of *M. caroli*, *M. cervicolor*, *M. fragilicauda*, *M. lepidoides*, and *M. nitidulus* in Myanmar and explore population genetic structure and coat color variation (fawn and non-fawn colors) in a population of *M. nitidulus* from Pyay.

## 225 Nutrients and Toxic Substances in Crow Meat

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In Japan, crows are often considered harmful and are captured and disposed of without appropriate use. If crow meat is accepted as a source of food, crows may be adequately utilized. The aim of this study was to assess if crow meat is safe for human consumption in terms of available nutrients and toxic substances in the meat. Jungle (*Corvus macrorhynchos*) and carrion (*C. corone*) varieties of crows, caught in Nagano Prefecture in Japan, were used in this study. The presence of free amino acids, inorganic material, residual pesticides, antibiotics, and bacteria in the breast muscle was analyzed using high-performance liquid chromatography, inductively coupled plasma optical emission spectrometry, gas chromatography, liquid chromatography-mass spectrometry, agar medium. The results suggested that there were high quantities of taurine and iron in the meat from both crow species. The iron content in crow meat was 9 mg/100 g, which is more than twice that found in the liver of cattle. In addition, small amounts of dichloro-diphenyl-trichloroethane and arsenic were detected in a few individual crows of both varieties, but below levels that would indicate any health hazard. Thus, crow meat cannot be utilized as food, but can prove useful as a nutritional supplement; however, to promote consumption of crow meat to the general public, additional analyses of other harmful materials such as dioxin, in addition to other aspects, should be performed. This work was supported by the Center for Promotion of Integrated Sciences of SOKENDAI.

## 226 Identification of Avian Fauna of Bara Gali Summer Campus, University of Peshawar, Khyber Pukhtunkhwa, Pakistan

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Survey of avian fauna of Bara Gali Summer Campus, University of Peshawar situated in Abbottabad was conducted from April to October, 2013. A total of 21 species belonging to 5 orders and 15 families were recorded. Out of these, 6 were resident, 12 were summer visitor and 3 were rare. Order Passeriformes was represented by 16 species which are *Certhia himalayana*, *Megalaima virens*, *Phylloscopus trochiloides*, *Garrulax lineatus*, *Passer rutilans*, *Corvus macrorhynchos*, *Hypsipetes leucocephalus*, *Acridotheres tristis*, *Delichon dasypus cashmeriensis*, *Hirundo rustica*, *Muscicapa thalassina*, *Saxicola ferrea*, *Myiophoneus caeruleus*, *Parus melonolophus*, *Parus rufonuchalis*, *Parus monticolus*, belonging to 11 families. Two species *Dendrocopos himalayansis* and *Picus squamatus* belongs to only one family Picidae of order Piciformes. Among rest of the three orders each is represented by only a single species; Accipitriformes by *Accipiter virgatus*, Coraciformes by *Upupa epops* while order Psittaciformes has been represented by *Psittacula himalayana*. The distribution and abundance varied with season and maximum number of species were found during the monsoon season when most of the birds migrate for breeding. Some habits and behaviors like nesting, feeding, breeding and vocalizations were also studied which are very unique from other birds found on lower elevations. Among bird species adapted to diverse habitat in the field, Himalayan Jungle Crow, Common Mynas, Bulbuls, Barn Swallows, barbets were prominent.

Interesting feature of the avian fauna is its familiarity with flora, was also observed during the present studies that some birds are very quick and active in their movement on a tree surface.

## **227 Optimising Camera Trap Random Encounter Model Survey Effort: A Case Study Using an Invasive-Native Species Replacement Process**

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Camera trap surveys are increasingly used to enumerate animal populations. Most methods of estimating population densities required the identification of individuals to facilitate the application of capture-recapture models. The Random Encounter Model (REM) permits the estimation of density and abundance where individuals are not readily discerned. We used two medium-sized mammals, the invasive European hare (*Lepus europaeus*) and the endemic Irish hare (*L. timidus hibernicus*), to compare density estimates derived from the REM to those from traditional line transect Distance Sampling in three zones of invasion: native allopatry and invasive peripheral and core ranges. Patterns of change in population densities between zones were comparable between the REM and Distance Sampling, with both describing an invasive-native species replacement process; however, abundance estimates differed considerably. The REM was better suited to providing site-specific density estimates due to its inherent vulnerability to spatial variation and small sample sizes. Conversely, Distance Sampling failed to capture local variation in densities. We also describe a REM post-hoc bootstrapping optimization protocol which will allow subsequent (re-)surveys to minimize survey effort per site, thus maximizing the number of independent sites (sample size). This protocol should be widely applicable to all camera trap surveys using the REM. This study represents the first application of the REM to a lagomorph species and demonstrates its utility in elucidating fine-scale population dynamics.

## **228 Analysis of the XIST Gene in Genus *Tokudaia***

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X chromosome inactivation (XCI) is important for common mammals; however, the Amami spiny rat (*Tokudaia osimensis*) has only a single X chromosome and the sex chromosome constitution is XO/XO. XCI seemingly need not for this species, but it is unclear. On the other hand, the sex chromosome constitution of the Okinawa spiny rat (*Tokudaia muenninki*) is XX/XY. But, the X chromosome has acquired the "neo-X" region caused by fusion with an autosome. To check the conservation of the *XIST* (X-inactivate specific transcript) gene, mainly function on XCI as non-coding RNAs, among *Tokudaia* species, we obtained BAC clones containing the *XIST* gene. Each clone was mapped on the X chromosome in *T. osimensis* and *T. muenninki* chromosomes, respectively, by BAC-FISH. Northern blotting analysis and RT-PCR showed no expression in any male and female tissues of *T. osimensis*. This result suggested that the enough *XIST* RNA to induce XCI was not expressed in *T. osimensis*. In *T. muenninki* the expression of *XIST* RNA was observed only in female tissues like as mice. To identify of the XCI region, RNA-FISH was performed female chromosomes of *T. muenninki*.



The signals were only detected in the original X chromosome region in one of the two X chromosomes. This suggested that the neo-X region is not inactivated. We are determining the full sequence of the *XIST* RNA of both species to compare the sequence homology.

### **229 Age Structure of the Alien Raccoon (*Procyon lotor*) Population under the Trapping Pressure**

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The raccoon (*Procyon lotor*) settled in Kamakura city, Japan, around the late 1980s. Since 2000, municipal administrations have strengthened their trapping efforts, and 100 - 270 animals have been removed annually from the municipality area of 40 km<sup>2</sup>. For evaluating the impact of the removal effort on the population, the following variables of captured raccoons in 2001-2002 and 2012-2013 were compared: age by annual rings of canine teeth, litter size by placental scars, nutrient status by BMI, sex ratio, external and skull measurements. In 2001-2002 the average age of 85 specimen (♂37: ♀48) was 1.5±0.2 years old, 0 year olds made 47%, 1 year olds made up 13%, and 2+ year olds made up 40%. In 2012-2013, the average age of 116 samples (♂64: ♀52) was 1.0±0.1, 0 year olds up 49%, 1 year olds 25%, and 2+ year olds made up 26%. Although average age of female did not show any significant change, male average age decreased from 1.8±0.3 to 0.9±0.1 during the period. This might indicate that males were easier to catch by traps, but the reason is not clear. During the period, there were no significant differences in other variables including sex ratio, external or skull measurements, litter size or nutrient status.

### **230 Spatial and Temporal Patterns in Time Series of the Gray Red-Backed Vole: Nonstationarity and Clustering Results**

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The gray red-backed vole, *Myodes rufocanus bedfordiae*, gnaws the bark of woody plants from late autumn to winter. The vole is a dominant, widely-distributed native of Hokkaido, northern Japan, causing damage every year to planted forests with its extent from 466 to 4,763 ha for the last two decades. Current countermeasures against vole damage are mainly silvicultural operations and/or use of rodenticide, due to their cost-effectiveness; accordingly vole monitoring has been conducted in particular to enable the latter rodenticide application to be fitted to voles' abundance. There are thus substantial benefits arising from development of models that can accurately predict the voles' abundance. Here, we analyzed long-term monitoring datasets (1970-2012) taken from 13 areas across Hokkaido, thereby allowing analyses to examine patterns in different populations varied geographically. The changes of amplitude appeared to be sorted into three patterns: showing no trend nor larger changes; dampening during the recent two decades; and amplifying during the above decades. Of them, 4 populations are deemed to be non-stationary processes according to the KPSS unit root test. The spatial clustering of populations appeared to be divided into 2- to 7- groups according to the August vole abundance (logarithmic transformed). Such data-based evidence of spatio-temporal structure leads to the most appropriate model specification in year-to-year prediction.

### **231 Evaluation of Population Dynamics of Japanese Serow and Sika Deer by Using a Bayesian State-Space Model**

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The Japanese serow (*Naemorhedus crispus*) is an endemic ungulate, but the population dynamics might be changing because of the notable increase number of sika deer (*Cervus nippon*). The objectives of our study are to estimate the population change by using a Bayesian state-space model, and to evaluate the interaction effects on the population dynamics between two species. The study area was the eastern part of Aichi prefecture, central part of Japan, in which agricultural or forest damaged by sika deer has become notable in last few years. In our model, we used multiple abundance indices (seen per unit effort, pellet group count, and block count), numbers of hunted and culled deer in Aichi Prefecture, and land parameters (forest rate, agricultural field rate, altitude, slope). Estimated unit was 5 × 5 km mesh, and we evaluated total 11 meshes for three years (2010-2012). Estimation showed that averaged population density of sika deer and Japanese serow was 9.9 - 16.6 km<sup>-2</sup>, and 0.3 - 2.6 km<sup>-2</sup> (95% credible interval), respectively. Increase rate (IR) of sika deer was higher than that of Japanese serow. Especially, IR of sika deer was affected positively by agricultural field rate, and negatively by altitude. IR of Japanese serow was affected positively by altitude, and negatively by competitive pressure from sika deer. These results indicated that Japanese serow would move to high altitude mountain areas, in which sika deer tend not to increase. This would be the one of the niche partitioning between the two species in the increasing sika deer world.

### **232 Masting and Alternate Bearing of Tree Crops as a Synchrony Generated in Coupled Nonlinear Oscillators**

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Masting and/or alternate bearing are phenomena that seed or fruits production of plant population fluctuates between years with a large variance. Prediction of rich or poor seed production is very important subject for wildlife management, forestry and agriculture. For example, wildlife which feed off seeds conflict with human on poor seed production year, because they appear at villages to search for food. In forestry, seed production decides the natural regeneration of forests. Resource Budget Model (RBM) models plant's internal resource dynamics which is one of the proximate factors of masting. In this presentation, we propose two new models for masting and alternate bearing. One is a GIS based masting model. The other is a model which explains the alternate bearing of large population without pollen coupling mechanism.

**233 Different Growth Patterns in the Japanese Wood Mouse between Cohorts after Acorn Mast Years and Those after Non-Mast Years**

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Acorns are generally regarded as a staple resource during fall and winter for rodents in temperate forests. In the spring, after masting, plenty of acorns often remain in the forest. To elucidate the importance of such acorns as a spring food, I examined the effects of spring acorn use on growth patterns of the Japanese wood mouse (*Apodemus speciosus*) by comparing cohorts initiated after acorn mast years and ones after non-mast years. Studies were conducted in a secondary forest in Iwate, northern Japan, in which the konara oak (*Quercus serrata*) was dominated. The capture-recapture method was carried out at least once a month from April to November during 2010-2014. Gompertz growth curve was constructed for females born in spring using the history of individuals, whose age at first capture was estimated below four weeks. I analyzed growth curved to estimate growth rate ( $r$ ), asymptotic weight ( $A$ ), and the age at which maximum growth occurs (point of inflection,  $l$ ). The cohorts after mast years showed higher  $r$  and lower  $A$  and  $l$  than those after non-mast years. It indicates that females born after mast years grew rapidly, but slowed down its growth rate earlier, and consequently matured at lower weight. These features may enable rapid increase in population density of the wood mouse after mast years. This finding implies that wood mice can alter their life history traits in response to acorn abundance. It will broaden our understanding in the relationship between acorn crop and rodent population dynamics.

**234 Applying a Brown Bear Density Estimation Method Using Hair Samples and a Spatially Explicit Mark-Recapture Model to a Moderately Dense Local Population in Hokkaido**

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We present a population density estimation method optimized for the brown bear (*Ursus arctos*) population in the Oshima Peninsula region, Hokkaido with a work flow on microsatellite data handling and a spatially explicit mark-recapture model. The method was aimed at one of the highest density populations on Hokkaido. Different topographical features, vegetation and/or bear density could influence the density estimation. Thus, we applied the method to population density estimation in the central part of Hokkaido in which gentler topography and lower density than the Oshima Peninsula occur to the progress of brown bear management, as well as evaluate the effectiveness of the method. A hair-snagging study was conducted in the bear range of Furano city, central Hokkaido, from June 2014 to August 2014. Eighty-four hair-traps were installed in the around 20,000 km<sup>2</sup> study area and 8 weekly sessions were performed. Consequently, 652 hair samples were collected and DNA extraction was done on 404 samples consisted of 1-10 hair roots. Individual identification was performed on those DNA samples employing 9 microsatellite markers, while the amelogenin test was used for sex determination. Twenty-six individuals were identified by the analyses and an estimated population density of the study area was 0.118/km<sup>2</sup> with a relatively small confidential interval. Although the accuracy of the estimation was inferior to that of the Oshima Peninsula due to the small sample size, we consider that this method would be efficient and suitable for the population trend monitoring in Hokkaido.

### 235 Increase of Size and Separation of a Troop of Japanese Monkey in Its Northern Limit

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Separations of troops have been reported in increasing populations of Japanese Monkeys (*Macaca fuscata*). The troop separation might be density dependent mechanism and related to population dynamics. Relationships between troop separation, range, density, survival and fecundity of individuals; however, have been unclear. The estimated number of monkeys in its northern limit, Shimokita Peninsular, has increased from about 200 in 1980 to about 2000 in 2011 where its crop damage has been a local concern. The number of troops also increased from 7 to > 56 during this period. To explore relationships between the separation of troops and their population dynamics, we tracked the range and the size of a wild troop named A87. The troop size increased exponentially by the factor of 1.11 per year from 5 in 1987 to 83 in 2012 with slight expansion of the range. Age at first birth increased slightly (5.6 to 6.6 year-old) during this increase of the troop size. During the process of troop separation (Dec 2012 - Mar2013), 68% of 0~2-year-old disappeared. In Apr 2013, troops A (43 monkeys) and B (22 monkeys) ranged separately. Range of troop A seemed to be smaller than the original range of A87. Although it is difficult to make general conclusions, this case study nevertheless indicates that 1) Japanese Monkey has a potential of exponential population growth under suitable condition, 2) during separation of a troop infants might sometimes have lower survival, 3) troop separation might play some roles in population dynamics of Japanese Monkey.

### 236 Population Genetic Differentiation of European Rabbits along a Rural-to-Urban Gradient

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Once common in Germany and representing a popular game species, population densities of the European rabbit (*Oryctolagus cuniculus*) in rural areas are nowadays declining at an alarming pace. At the same time, the species reaches surprisingly high population densities in urban and suburban areas, where rabbits often cause wildlife-human conflicts, resulting in population management through hunting. In a project focusing on several aspects of the ecology and behavior of different rabbit populations, we asked how rabbits use highly fragmented urban landscapes and whether migration between rural and urban population is still continuing. A total of 129 rabbits were sampled along a rural-to-urban gradient in and around Frankfurt A.M. (Germany) for population genetic analysis based on ten nuclear microsatellites. We correlated pairwise genetic distances with an index expressing differences between sites in the degree of urbanity using a partial Mantel test. The degree of urbanity was derived from several variables related to anthropogenic disturbance and landscape alterations. We radio-tracked rabbits at one suburban and one urban study site. Genetic differentiation between populations was weak and pairwise genetic distances did not correlate with the index expressing differences in the degree of urbanity. Home range sizes were the smallest ever reported for European rabbits; however, radio-collared animals were regularly lost after few months. It seems that heterogeneous habitat structures in cities, arising from the diverse mosaic of buildings, parks and gardens, meet the habitat requirements of the European rabbit by providing sufficient

food and shelter in close proximity, and migration barriers appear to be absent. We discuss the importance of urban populations in the future conservation of European rabbits in Central Europe.

### **237 Age and Sex Differences in the Feeding Strategies of Sika Deer under Macaques Foraging in Trees**

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The Yaku sika deer (*Cervus nippon yakushimae*) and Yakushima macaque (*Macaca fuscata yakui*) are the only middle- and large-sized mammals inhabiting the island of Yakushima (505 km<sup>2</sup>) in southern Japan. In an evergreen broad-leaved forest, deer often gather under trees to obtain food dropped by foraging macaques in the branches above. By this gleaning, the deer may obtain many foods from tree canopies. However, at the same time, agonistic interactions among the deer such as biting and kicking may occur as they fight for the dropped food. Thus, under foraging macaques (i.e., macaque-food patch: MFP), the deer face a trade-off between feeding efficiency and competition. The competition ability should vary among the age-sex classes of the deer. We predicted that the foraging strategy of deer in an MFP changes with the age-sex class. We observed the feeding and social behaviors of deer in MFPs and recorded their residence time, amount of food intake and agonistic interactions. Adult males ( $\geq 5$  years old) tended to stay longer in the MFPs. The frequency of initiating attack increased and that of being attacked decreased with age classes in both sexes. However, the frequency of agonistic interactions involving 1- to 2-year-old males was low, because they tended not to enter the MFPs. In addition, the frequency of agonistic interactions changed with the conditions of the dropped foods (e.g., cluster of fruits or dispersed fruits), which will affect the feeding efficiency of the deer. The deer in the MFPs seemed to apply different feeding strategies corresponding to their own age-sex classes.

### **238 Effect of Experience Breaking Crop Protection Fence on Behavior of Wild Boar**

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An effective method for controlling the damage caused by Japanese wild boars (*Sus scrofa leucomystax*) is fencing cropland using wire mesh. However, occasionally wild boars break the fence, the cause of that is construction mistakes. We conducted the experiment using captive boars that had them break mistaken construction wire mesh fence, and showed that their behavior changes with experience of fence breaking. In this study, we conducted the same experiment with wild boars under natural environment. Test wire mesh fences enclosed squarely (W 2 m × D 2 m × H 1 m) were built in the forest. The experiment was started after opening one side of the test fence, and food was placed in fences, and feeding of boars was confirmed a week. Behavior of boars during three test periods was observed. (1) Wire mesh was constructed and anchored to the ground with pegs. (2) Wire mesh was constructed without pegs, and made a few gap between the ground (mistake period). (3) After boars broke fence, wire mesh was reconstructed in same (1). Sojourn time of boars on around the fence was no significant changes before and after mistake period. Intrusion trial behavior to mistaken side increased after the mistake treatment ( $P < 0.01$ ). One boar group, intrusion trial behavior to the fences other than mistaken side increased after the mistake treatment ( $P < 0.05$ ).

These results suggested that wild boars under natural environment also come to try intrusion persistent to the fence due to breaking experience.

### **239 Adaptation of Japanese Badgers for an Urban Environment in Tokyo Metropolitan Area**

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Japanese badgers (*Meles anakuma*) are found throughout Japan except Hokkaido and the Ryukyu islands, from suburban areas to forest area up to subalpine zone. Badgers are fairly common species; however, there have been no breeding records in an urban area. In 2008, badgers were identified in Mitaka City, in the middle of residential area of Tokyo, and breeding was recorded every year since then. As the ecology of badgers inhabiting urban area has never been reported, we studied the activity patterns, sett usage and food habit in urban badgers by using the camera trapping method and fecal analyses. Purpose of this study is to clarify the environmental and ecological conditions for continuous inhabitation of badgers in an urban area. The study area is approximately 62 ha and located in Mitaka City, an urban area of Tokyo, Japan. The buildings and roads in the area are surrounded by a mosaic vegetation consisted of broad-leaved and coniferous groves, and maintained green area. By the analyses of photographed time, badgers showed basically crepuscular activity pattern and activity time was slightly affected by human activities. Different from mountainous or suburban area, badgers were almost continuously active during winter. Twenty-six setts were found and the breeding setts were located at undisturbed deciduous tree forest areas. From fecal analyses, badger showed omnivorous food preference; however, they also ate cat food fed for stray cats by human. Japanese badgers were well adapted to urban environment. However, they seemed to need large natural forest area for breeding and foraging.

### **240 Ecology of Wild Middle-Sized Mammals in Kashiwa City**

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Recent decrease and aging of the human populace in Japanese urban areas have resulted in the tendency of wild middle-sized mammals to leave their natural habitats in forest areas for local urban neighborhoods in search of food. Some animals enter the homes of local populace, and cause sources of complaint and damage to the building, such as, smell, noise and excrements. Additionally, homegrown plants in gardens and crops are often spoiled by such animals. Further study is required to determine the lifestyle of wild middle-sized mammals in urban areas, in order to avoid intrusion of wildlife into the lives of humans. In the present study, ecology of wild middle-sized mammal species will be examined and compared in Kashiwa City, a city in Japan experiencing depopulation and urban development simultaneously. Specimens will include raccoon dog *Nyctereutes procyonoides*, masked palm civet *Paguma larvata*, and raccoon *Procyon lotor*. Research through observations with ten remote cameras placed in two urban green areas, and GPS collars attempting one fix per hour fitted on prospectively five specimens per species, captured by box trap, will shed light on the animals' behavior patterns and territories. Analysis of excrement found at the research sites will allow insight into their diet in urban settings. The present study is expected to provide a better understanding of the lifestyle of wild middle-sized mammals in a populated city area. The

findings will be applicable for urban programs such as those by local governments to prevent further conflict between humans and wildlife.

## [241-270]

### **241 Rapid Adaptive Behavioral Change in Native Species Induced by Multiple Invasive Predators**

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Invasive predator can induce not only population decline of native species, but also their adaptive behavioral response. Although it is often the case that multiple invasive species interact and synergistically induce demographic change of native species, previous studies on behavioral change focused on effect by only one invader. Understanding how native species respond to multiple predators offers important insight about the process complex community established, and conservation of evolutionary processes in islands. We compared anti-predator behavior among native frogs found in places with different historical impacts of invasive mongoose and feral cat in Amami Island, southern Japan. This area has been impacted by mongoose since 1979 and by feral cat since more years ago. We recorded the frog anti-predator behavior using Flight Initiation Distance (FID) and Distance Fled (DF). We used spatial regression models based on generalized least square (GLS) methods to test the effect of potential factors on the frog anti-predator behaviors. We found that historical impacts by mongoose and feral cat additively induced longer FID of native frog. The historical impacts by mongoose also induced longer DF. These results indicated that historical impacts by multiple invasive predators additively induce the rapid adaptive change of the escape behavior of native frog.

### **242 Evaluation of the Brown Bear Behavior toward Hair-Traps Using Trail Cameras: Does Trap-Happy/Shy Exist?**

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The brown bear (*Ursus arctos*) population estimation using a hair-snagging survey is based on the mark-recapture technique. Trap-happy/shy is pointed out as a bias of estimations. We analyzed the relationship among the staying time at the trap site, frequency of trap visits and bait availability for each individual using trail cameras to investigate the trap-happy/shy exists or not. We conducted bear hair-snagging survey with 53 traps in 2012 and 84 traps in 2014 in Hokkaido. Bait was hung at 3.5 meters high above the ground to be unreachable for bears. The staying time at each trap was calculated for every individual from video observation. The correlation was explored between the staying time and the visiting frequency of each individual with the Spearman's rank correlation test. Fifty-one visitations of 39 individuals in 2012 and 24 visitations of 14 individuals in 2014 observed from videos were used for analyses. The visiting frequency was not negatively nor significantly correlated with the staying time in both years ( $\rho = 0.16$ ,  $p > 0.05$ ,  $\rho = -0.12$ ,  $p > 0.05$ ). Therefore, it

cannot be considered that bears lose interest in traps (trap-shy), though they could not get bait. Meanwhile, five individuals tore off bait during surveys. Two of them were observed visiting traps again, but neither could access bait anymore. After they failed to get bait, the staying time got as short as before. It is suggested that keeping bears out of reach of bait can be minimize the influence for the behavior towards traps.

#### **243 Japanese Macaques Change Food Patch Use on the Periphery of the Home Range**

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Territorial defense is important for group-living animals because its success leads to feeding success, and in turn, enhances survival and reproduction. Meanwhile, animals avoid aggression with other groups owing to the potential risks such as injury. For example, animals communicate with neighboring groups by using visual, auditory and olfactory signals on the periphery of the home range, which contributes to avoiding intergroup interaction with physical fighting. However, it remains unclear whether animals without such signals change behavior according to the location within the home range. We investigate effects of the location of a food patch on patch use behavior of Japanese macaques (*Macaca fuscata yakui*). We selected four adult females in a group as subjects and recorded their behavior via focal animal sampling. Patch use behavior was compared between the periphery and non-periphery using generalized linear mixed models. Macaques stayed with a larger number of co-feeding individuals in a patch on the periphery. Patch residency time, patch feeding time and vigilance rate of each individual did not vary between the periphery and nonperiphery. Since the outcome of intergroup aggression is determined by the relative group size, it may be effective to stay with many group members for defending cooperatively the home range. Alternatively, although the vigilance rate of each individual did not vary according to the location of a patch, the vigilance rate of the group may increase on the periphery. This would enable to detect neighboring groups quickly and avoid encounters with them.

#### **244 Foraging Strategy of Harbor Seals in the Set Nets at Cape Erimo, Hokkaido**

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In the 1970's, the number of harbor seals (*Phoca vitulina stejnegeri*) in the pacific coast of Hokkaido decreased because of overhunting and environmental degradation. Recently population of this species has been recovering. Accordingly, damage to salmon set nets by the seals has also increased, and it has become a serious problem; however there is no report on foraging behavior of harbor seals. In this study, using bio-telemetry (acoustic-telemetry) methods and stomach contents analysis, we aimed to examine the foraging strategy of the seals in the set nets at Cape Erimo. Acoustic receivers were attached to twenty set nets around Cape Erimo and transmitters were attached to 16 seals. The data from acoustic receivers were collected from June to November 2014. Additionally we have collected from 65 seal's stomach contents bycatch at set nets in 2014. The stomach contents showed that some of the seals over 40kg had salmon in their stomachs, but no seals under 40kg had salmon in their stomachs. Also, adding from the result on bio-telemetry, we considered that harbor



seals over 40kg had learned to use the set nets as foraging sites, because of coming to the same nets to forage many times at night as against randomly for under 40kg.

#### **245 Monogamy in Large Rodents: An Example of the Long Tailed Porcupine**

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Porcupines are one of the largest rodents in the world. Although there have been sporadic reports to indicate that some porcupine species form monogamous pair groups, such claims have rarely been based on detailed behavioral observations. Thus, we studied the long-tailed porcupine (*Trichys fasciulate*), whose social structure is minimally understood, in the Kabili-Sepilok Forest Reserve, Sabah, Malaysia. From July 2012 to May 2014 we radio-tracked five porcupines to observe their range use and behaviors. We also conducted a burrow census to detect their den sites in the study area of about 1 km<sup>2</sup>. From the home range analyses of the five radio-tagged porcupines, it was found that an adult male and an adult female had similar home ranges. As we continuously followed them, we observed a newborn of the pair in 2012 and another in 2013 near by the entrance of the den. Thereafter, the pair and the two offspring stayed in a same den. Because the pair was maintained throughout the study period, and bred successively, the long-tailed porcupine is considered to form a monogamous pair family. Eleven burrows were found in the family's home range, of which they actually used five as dens. The family frequently changed their dens, and all of the family members, including two offspring, contributed to maintain the five dens, e.g., by collecting nest materials. We discuss such use and maintenance of multiple dens in relation to the species' monogamous social structure.

#### **246 Underwater Vocal Communication by Captive Bearded Seals**

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Bearded seals (*Erignathus barbatus*) produce complex sounds underwater mainly in breeding season. It has been speculated that these sounds are important signals for the solitary seals to find their mates or keep territory. However, little is known about the behavioral context of the vocalization, mainly because behavioral observation is difficult in the wild. In this study, we recorded behaviors and sounds of an adult male and two adult female seals in captivity to estimate the function of vocalization. Underwater sounds were continuously recorded in Otaru aquarium, Japan, between March 2012 and May 2013, using a hydrophone and a linear PCM recorder (frequency range: 20 Hz to 20 kHz). Behavioral observation was conducted in the daytime to identify the caller of sounds, and to record social behaviors. The adult male vocalized from December until April with a peak in March, while the two females vocalized only in March, breeding season reported in the wild. In order to examine whether they conduct "vocal exchange" following some temporal rules, we analyzed the intervals of vocalization between two seals that vocalized sequentially. The frequency distribution of the intervals had a sharp peak at approximately 4.0 sec., and significantly different from that expected from the assumption that seals independently vocalized at their own pace ( $P < 0.01$ , Kolmogorov-Smirnov test), suggesting that two seals vocalized for "vocal exchange". No social

behaviors were observed except muzzling by females against the throat of vocalizing male in March, which might be a signal to advertise their estrus. Our findings provide the first evidence that bearded seals use underwater sounds for vocal exchange that might be useful for long-range communication to advertise their reproductive status.

#### **247 The Evaluation of the Method for Fecal Sample Preservation in the Field for Hormonal Analyses**

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Social behavior and physiological status of animals are largely related to hormonal changes. In order to understand the physiological condition, monitoring of hormonal status is essential. Non-invasive method of measurement of fecal hormones is widely established. However, drying, and preserving of feces are difficult in the absence of electrical equipment. We developed and evaluated a practical method for drying and preserving of feces using silica gel. For the evaluation of the method we used feces of captive Japanese macaques (*Macaca fuscata*). Feces were collected and divided into two portions. The first portion was frozen in freezer (-30 °C) as soon as collect, and then dried in the oven (50 °C). The remaining portion was stored on silica gel in a 50 ml plastic tube at room temperature. After both feces dried completely, we extracted hormones: Estrone-3-Conjugate (E1-Sufate, E1-Glucuronide) (E1C) and 5 $\beta$ -Pregnane-3 $\alpha$ ,20 $\alpha$ -diol-3-Glucuronide (PdG), and analyzed them using enzyme immunoassay. Values of E1C and PdG measured from feces dried on silica gel were E1C: 131.3  $\pm$  53.4 % and PdG: 112.7  $\pm$  28.0 % ( MEAN  $\pm$  SD ) as percentage of the values measured from frozen feces. They were significantly correlated with matched frozen feces values (r=0.97 E1C, r=0.97 PdG ). We concluded this method using silica gel is a simple and practical method for monitoring endocrinological status for wild animals.

#### **248 Eating of Paper Mulberry by Wild Mammals**

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The inner bark of current branches of paper mulberry (*Broussonetia kazinoki*  $\times$  *B. papyrifera*) has been used to make Japanese paper, Washi, which is recognized by UNESCO as an intangible cultural heritage. The paper mulberry was eaten by wild mammals in our study site. It is important for the stable paper mulberry production to clarify the actual conditions of the wild mammals that eat the paper mulberry; however there is little information about mammals causing damage to paper mulberry. We identified the wild mammals eating the paper mulberry in this study. We placed two automatic sensor cameras and investigated field signs of wild mammals in June 2014 and September 2014 on a paper mulberry field in Mino, central Japan. In June, we obtained twenty pictures of a sika deer (*Cervus nippon*) and confirmed field signs of the paper mulberry by sika deer. In September, we obtained three pictures of a wild boar (*Sus scrofa*) and confirmed field signs of the paper mulberry by wild boar. In both cases the pictures of the sika deer and the wild boar that tore off the paper mulberry were taken. These results indicated sika deer and wild boar consumed paper mulberry. Eating the current branches by wild mammals causes serious damage to the production of paper mulberry, it is important to prevent eating damages for the production of paper mulberry.

## 249 Laterality of Social Touch in Dolphins of the Genus *Stenella*

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Studies on behavioral laterality in nonhuman species are important, because laterality suggests functional asymmetry of the brain. Previous studies suggested that dolphins show behavioral laterality. For example, Indo-Pacific bottlenose dolphin (*Tursiops aduncus*) and Commerson's dolphin (*Cephalorhynchus commersonii*) tended to use left pectoral fin during social touch. To discuss whether this left asymmetry is common among dolphins or not, we investigated the laterality of flipper use during social touch in genus *Stenella* in captive and wild condition. We observed 4 pantropical spotted dolphins (*Stenella attenuata*) and one striped dolphin (*Stenella coeruleoalba*) in May 2013, at Taiji Whale Museum. We observed 635 episodes of flipper rubbing (one dolphin rubs the body of another with its flipper). Three individuals of spotted dolphins showed significant left fin bias. A striped dolphin did not show significant bias during flipper rubbing. We also investigated the laterality of flipper rubbing in wild Atlantic spotted dolphins (*Stenella frontalis*) at Bimini, Bahamas from 2003 to 2009. The rubber used the left fin in 263 episodes (53%) and the right fin in 236 episodes (47%). In 307 episodes of flipper rubbing conducted by 39 identified rubbers, there was no significant difference between flipper use. Of 18 dolphins for which more than five records as the rubber were available, two individual showed significant left-side bias, while no dolphin which showed significant right-side bias. This research was supported by JSPS KAKENHI Grant Number 24•40161.

## 250 Intra-Specific Variation in the Territoriality of Japanese Serow (*Capricornis crispus*) in Central Japan

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We studied the spatial use, intra-sexual relationships, population density, and home range size of Japanese serow (*Capricornis crispus*) at Mt. Asama, central Japan. The results were compared with the previous studies at Akita and Shimokita in the northern Japan. Seven adult serows (3 males, 3 females, 1 gender unknown) and 3 lambs were found and individually identified from April 2012 to May 2014. Average home range overlap rate for adult males was three times higher (26.6 %) than Akita (8.3 %). Adults were quite tolerant of other adults of the same sex, though the sample size was only seven (5 male-males, 2 female-females). Agonistic behavior was never observed during the 200-hour observation period. This was quite different from the northern populations where all intra-sexual encounters were agonistic. Population density in the study area (3.5 individual / km<sup>2</sup>) was 6 times lower than the other populations. Consequently, the home range size of adult males was 4-5 times larger (70.7 ha) than Akita (15.2 ha) and Shimokita (16.6 ha). These results suggests that territoriality of the Japanese serow is more variable than previously believed. It is likely that habitat conditions including topography and plant biomass would affect it.

## 251 Behaviors and Group Size of Sika Deer in Alpine Area in Minami Alps National Park

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An overabundance of Sika deer (*Cervus nippon*; hereafter, deer) has caused dramatic increases in agricultural and forestry damage, and has severely affected natural vegetation and ecosystems in national parks and nature reserves by heavy foraging pressure. In a previous study, deer were tracked traveling a sub-alpine area of a.s.l. 2500-2800 m during summer with VHF radio and GPS tracking survey (Izumiyama et al., 2008, 2009). But it is not clear what the deer were doing there, and a causal linkage between the presence of deer and heavy vegetation damage could not be confirmed. In this study, we observed the behavior of deer in a cirque where deer appeared frequently mostly in alpine area. The study site was Kosenjyo cirque which is located immediately below Mt. Senjyo (elevation, 3033 m) in central Japan. The mountain is a part of Minami Alps National Park. The deer were observed from where they appeared in the cirque until they disappeared from the view, using binocular for 5 days during summer (July to September). Grazing and resting behavior and location of the focal deer were recorded at 1-minute intervals. The necessary data was not collected in July due to bad weather. The deer did not appear at all in September. In August, deer were confirmed on all observation days, and the mean group size was  $10.2 \pm 0.8$  (9-11 deer). All the confirmed deer were stag. Total time spent grazing and resting in the cirque were 42% and 52%, respectively. Particular deer trail did not confirm but it was spread on the mesh, and the deer used the whole in the cirque.

## 252 Vocalization as Short-Distance Communication in Wild Malayan Tapir

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Tapir has a long flexible proboscis, and good sense of smell and hearing. Tapirs utilize smell and voice, and touch by proboscis in their communication. Few studies have focused on communication behavior in tapir because it is basically solitary. Especially, few reports are available on its vocalization. Previous study reported that captive Malayan tapir (*Tapirus indicus*) utilizes whistling-type sounds (“whistle”, “whine” and “squeal”) and non-harmonic sounds (“burp” and “hiccup”). However, little is known about the function of vocalization in tapir in its natural habitat. To study behavior and vocalization of wild Malayan tapir, we set infrared sensor cameras in video mode and collected 1-min video shots at salt licks, where tapir visits frequently, in Belum-Temengor Rainforest Complex, Perak, Malaysia from February to November in 2014. Malayan tapirs were observed in 133 days; during this period, male-female pairs were observed in 36 days. Tapirs’ voice was recorded in 58 video shots. All vocalization in tapir was observed only between a pair of male and female. Series of a few “whistling-type sounds” and “hiccup” were observed. Most of vocalizations occurred while tapirs were in locomotion or leaving from the salt lick. It is suggested that a male-female pair utilize vocalization for short-distance communication to keep moving together. In other situation, a female tapir uttered “whistling-type sounds” at frequent intervals during pairing with a male. It appears to be used for “appeasement” during reproductive season, reported in previous study on other species of tapir.

### **253 Who to Follow? Collective Decision Making in Wild Bonobos**

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Group-living animals need to coordinate their activity to maintain cohesion. Although each individual has their own nutritional needs and social and reproductive strategy, they have to reach consensus to decide where and when to travel. Collective movements are considered to be the outcome of one individual's departure followed by other group members. We investigated the initiation of departure in wild bonobos (*Pan paniscus*) at Luo Scientific Reserve, DR Congo. If three or more bonobos started moving more than 20m, we determined the individual who moved first initiating the movement. We observed 173 departures. No matter how long the movement was or the purpose of the movement, adult females initiated the departures more often than expected and adult males and immature individuals seldom initiated the departures. At an individual level, three females initiated more often than expected. All of these three females were categorized as old females. This pattern of initiation may suggest that their decision making style is partially shared, and old females are "key individuals" in bonobo society.

### **254 The Sebaceous Gland Developed in the Back Skin of Adult Male Brown Bear (*Ursus arctos*) in the Wild during the Mating Season**

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In the brown bear (*Ursus arctos*), tree rubbing behavior was frequently observed during the mating season and it is supposed that odors left on tree may play a role in olfactory communication. In a previous study, we showed that male adult brown bears kept in captivity have developed sebaceous glands of back skins in pre-mating (April) and mating season (May and June). Male adult bears can communicate with other bears by the secretion from the sebaceous glands of the back skin. The aim of this study is to clarify whether wild brown bears also have the developed sebaceous glands during mating season or not. Seven wild bears hunted in Hokkaido were used in the present study. The skin samples were collected from three adult males (hunted in May, July and August), one adult female (June) and three subadult males (two in July, one in October). To observe the skin glands, histological analysis was performed. Two adult males hunted during mating season (May and July) had larger sebaceous glands in back skin compared with one adult male hunted in August. In female and subadult males developed sebaceous glands were not observed. The results showed that sebaceous glands in the back skin develop during mating season not only in male bears under captivity but also in wild. Adult male brown bears may use the secretion from developed skin glands in the back skin as an olfactory communication tool during mating season.

## 255 Den Site Nocturnal Activity of a Diurnal Predator, Tibetan Fox, Related to Prey Diurnal Activity: A Preliminary Study

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The Tibetan fox (*Vulpes ferrilata*) of the Tibetan Plateau is regarded as an obligate predator of the Plateau pika (*Ochotona curzoniae*) from recent studies of its site-occupancy modeling and its specialized feeding habits. Also, the Tibetan fox is generally acknowledged to be active in the daytime, especially in the morning and evening, because its primary prey, the Plateau pika, is diurnal. Nevertheless, no evidence shows a close mutual association of their activity patterns. We investigated these species' activity patterns and those of a comparable nocturnal sympatric carnivore, Asian badger (*Meles leucurus*). We assessed their mutual temporal overlap using two camera traps installed near the fox den entrances on the eastern shore of Qinghai Lake during July-October in 2014. During 84.8 camera-days trapping, we respectively detected 37, 36, and 11 active events of foxes, pikas, and badgers. The percentages of nocturnal activity were high (90.9%) for badgers and moderate (63.9%) for foxes, but low (0%) for pikas. Moderate temporal overlaps were found between foxes and badgers ( $\Delta=0.64$ , 95%CI=0.44-0.82) and between foxes and pikas ( $\Delta=0.40$ , 95%CI=0.27-0.55), but low temporal overlap was found between badgers and pikas ( $\Delta=0.15$ , 95%CI=0.04-0.31). Furthermore, four instances of foxes carrying prey to the den were observed only at night. These results suggest that the Tibetan fox adjusted its nocturnal activity to get more nocturnal prey for bringing back to its den while keeping sufficient opportunity to prey on its primary diurnal prey: pikas.

## 256 Size of Entrance Which Japanese Marten Can Pass Through

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Japanese martens (*Martes melampus*) cause damages to farm products and houses. They can enter fenced farms and houses through narrow openings. They may cause damage to roofs, insulation, and electrical wiring in houses. The opening should be covered to prevent their intrusion into house. However, there is no information about how small a size of an opening the Japanese marten can pass through. Therefore, we investigated the size of entranceways that the Japanese marten could pass through. Three male martens (2 years), which were born in the wild, were studied in captivity in July 2013. We made an experimental box (40 cm x 60 cm x 35 cm) with interchangeable front panel having a square entrance of a certain size. We changed the length of one side of a square (hereinafter square size) from 7.0 cm to 4.0 cm at intervals of 0.5 cm. We put sweet popcorns as a bait in the box. Behaviors of martens were recorded by video camera for 10 minutes for each trial. All individuals could pass through the entrance when the square size were 7.0 cm, 6.5 cm 6.0 cm, and 5.5 cm. Two individuals (the smallest and largest ones) could pass through the 5 cm square size entrance. This result suggest that factors other than body size may influence the result. No marten could pass through the 4.5 cm square size entrance, although two individuals could put the head into the entrance. It seemed that shoulder rather than head was the limiting factors to pass through the narrow opening.

**257 Development of Energy Saving Algorithm for GPS Collars of Japanese Black Bear Using Activity Data**

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Mass movement of Japanese black bear (*Ursus thibetanus*) to areas populated by humans has happened year where beech harvests has been poor becoming a serious social problem. Although we are developing a GPS collar for acquiring real time positioning data by using the 3G communication, suppressing the power consumption of the GPS collar is important for the extension of the data acquisition period. In this study, we developed the algorithm for detecting sleeping behavior of captive and free-ranging bears in order to rest the data recording during sleeping periods. Self-made 3 axis acceleration collars were attached on 4 captive bears for 1 or 2 days and about 45% of whole data recording periods were taken by video. One of the 4 bears were wearing a GPS collar with activity sensor (Tellus2D, Followit Inc.) at the same time. Same GPS collars were attached on four free-ranging black bears from 2012 to 2013 and 2 GPS collars data were collected. It is possible to determine the "sleep" and "other activity" by the logistic regression analysis of the coefficient variance (CV) of three-axis acceleration data from captive bears with misclassification of 20% or less. We analyzed the characteristics of activity data during sleep or other activities in a captive bear and present the results estimated sleeping time of free-ranging bears by using activity and GPS positioning data.

**258 Movement Paths of Japanese Squirrels in Canopy**

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Canopies are an important habitat for arboreal mammals. It is necessary to clarify the movement paths in order to prevent habitat decline. The movement paths of terrestrial mammals tend to remain as clear trace; however tracing the movements of arboreal mammals is a difficult task. From February 29 1984 to September 1 1986, I recorded each trees as used for movement paths of 12 Japanese Squirrels (*Sciurus lis*, 6 male and female) by direct observation method. These squirrels were introduced on a trial basis to Shinjuku Gyoen National Garden (Ministry of the Environment) on Feb. 22 1984. 372 trees were used in 112 movement paths, of these, 96 trees (25.8%) were used more than once. In 78 movement paths out of 112, individual squirrels using movement paths can be identified by color-marked collars. In addition, 56 movement paths (71.8% of 78 movement paths) included the same trees or consecutive trees. Different individuals used same movement paths; therefore, squirrels shared the same movement path regardless of sex differences.

**259 Potential Link between Herbicide Utilization in Agricultural Area and Immunosuppression in Natural Population of the Rice Frog**

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Herbicides (atrazine, glyphosate and paraquat) have been intensively used in many areas of Thailand, especially in Nan Province. Previous studies indicated that herbicide contamination and adverse health effects were observed in natural population of the rice frog *Fejervarya limnocharis* at Nan

Province. Since these anthropogenic factors may influence disease emergence by acting upon the immune system of amphibian, it is interesting to investigate potential effects of herbicide utilization on immune response of the frog living in agricultural area. *F. limnocharis* as well as water samples were collected every three months in 2013 from a "contaminated" agricultural area with intensive herbicide utilization, and a "reference" agricultural area with no history of herbicide utilization for more than 10 years. Water samples were analyzed for background levels of herbicide residues by enzyme-linked immunosorbant assay, while frogs were subjected to specific immune response (delayed-type hypersensitivity: DTH) investigation. In addition, a separate group of frogs was subjected to a single immunization and evaluation for specific immune function afterward. DTH responses of male and female rice frogs in 3 seasons (cool dry, hot dry and wet seasons) were compared between sites. Major findings showed that DTH responses of frogs from the contaminated site were significantly lower than those of the reference site frogs, suggesting that intensive herbicide utilization in agricultural ecosystem could potentially suppress immune function of the populated frogs. Observations on amphibian's immune response provide further evidence for cautionary impacts of herbicide on non-target organisms in agricultural ecosystem and its role in amphibian declines.

#### **260 Health Monitoring Based on Hematological Parameters of the Blyth's Giant Frog at Lanta Island, Krabi Province, Thailand**

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Blyth's giant frog (*Limnonectes blythii*) is the largest frog in Thailand. According to the IUCN Red List of Threatened Species, *L. blythii* has been listed as near threatened due to significant population decline. Health status of this frog is unknown in nature, and basic knowledge on its hematological parameters is crucial for the assessment. For this purpose, blood samples were collected from 31 wild caught frogs at Lanta Island, southern Thailand in May 2013. Blood sample was smeared and Giemsa-stained for microscopic study including cytomorphometry. The result showed that erythrocyte has oval-shaped cell and nucleus. Mean cell length and width are  $18.08 \pm 1.69$  micrometers and  $11.68 \pm 1.20$  micrometers, respectively. Leukocytes were observed and classified into 1) large lymphocyte containing basophilic large spherical/oval nucleus with mean diameter of  $12.82 \pm 1.60$  micrometers; 2) small lymphocyte containing basophilic large spherical nucleus with mean diameter of  $9.36 \pm 1.10$  micrometers; 3) monocyte containing u-shaped nucleus with mean diameter of  $11.24 \pm 1.91$  micrometers; 4) neutrophil containing multi-lobed nucleus and cytoplasmic basophilic granules with mean diameter of  $12 \pm 1.96$  micrometers; and 5) eosinophil containing bi-lobed nucleus and cytoplasmic acidophilic granules with mean diameter of  $10.51 \pm 1.36$  micrometers. Moreover, thrombocytes were found in spindle-shaped with central oval nucleus. Mean cell length and width are  $14.77 \pm 2.12$  micrometers and  $7.50 \pm 1.09$  micrometers, respectively. In this study, blood parasites, including microfilaria and *Hepatozoon*, were observed in 3 frogs (9.67% prevalence). These data on blood cell morphology will be useful for further hematological study and health monitoring for the conservation of this frog population in the future.



## 261 Health Status Based on Hematological Examination of Wild-Caught Rice Field Frog in Thailand

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The rice field frog (*Hoplobatrachus rugulosus*) is a common anuran species found in wetlands throughout Thailand. At present, the wild population of *H. rugulosus* is likely to decline, and data on its health status is very limited. Our project aims to assess the health status of this frog using hematological methods. Thirty-three adult frogs (17 male and 16 female frogs) were collected from a wild population in Nan Province, northern part of Thailand during wet season 2014. Blood samples were subjected for packed cell volume (PCV) estimation and leukocyte count from Giemsa-stained blood smears. The result showed that mean PCV and mean total leukocyte count of male frogs (30.7±16.07% and 32.24±13.94 cells/300 erythrocytes, respectively) are significantly higher than those of the female frogs (25.09±4.85% and 23.81±10.70 cells/300 erythrocytes, respectively). Mean number of lymphocyte, monocyte and neutrophil also indicated significant sex-related differences. Interestingly, 12 frogs (36% prevalence) were found to be infected by blood parasite, *Hepatozoon* sp. The infected female frogs showed significantly higher number of large-lymphocyte, monocyte, neutrophil and eosinophil compared to the non-infected females. Since parasite infection is thought to be one of the potential threats of population declines in many amphibians, the *Hepatozoon* infection in wild *H. rugulosus* population should be monitored closely. Overall, hematological parameters obtained from this study could be regarded as the first report and the crucial baseline data of wild *H. rugulosus* in Thailand that can be used for monitoring of the health status of this anuran in the future.

## 262 Finding of a Free-Ranging Indo-Pacific Bottlenose Dolphin with Cataract of Left Eye

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Cataracts or ocular diseases are common lesions of wild and captive pinnipeds, but rarely reported in cetaceans. To know the potential causes or contributing factors of cataracts in zoological settings, it is important to know how many wild dolphins have cataract. Here we first report on one free-ranging Indo-Pacific bottlenose dolphin (*Tursiops aduncus*) off Mikura Island with a cataract in his left eye. At 14:58 on 30th June, 2014, we observed and photographed one adult male dolphin (#055: Mach) with a cataract in his left eye by an underwater video system (Sony HDR-XR550V in a NTF underwater housing) during our daily survey for the acoustic & behavior study. The dolphin was estimated to be more than 24 years old. About 120 individuals were identified off Mikura Island in 2014, but we have no reports of cataracts so far. The rate of cataracts (1/120) seems to be comparable to the report of one cataract out of 97 stranded bottlenose dolphins in South Carolina over 13 years. This research was supported by JSPS KAKENHI Grant Number 23220006.

**263 Characterization of Sarcocystis in an Isolated Population of Hokkaido Sika Deer (*Cervus nippon yesoensis*) on Nakanoshima Island**

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*Sarcocystis* is a parasite that has a two-host life cycle, usually between herbivores as intermediate hosts and carnivores as definitive hosts. *Sarcocystis* in Hokkaido sika deer (*Cervus Nippon yesoensis*) has been proven to have canines as definitive hosts; however, there is an isolated population of Hokkaido sika deer on Nakanoshima Island where no canine species inhabit. The purpose of this study was to determine the prevalence of *Sarcocystis* and identify them in this population by comparing them with samples from deer found in other regions in order to predict the possible definitive host. We collected diaphragms and tongues from 20 deer culled on Nakanoshima Island. Five consecutive paraffin-embedded sections from each of them were cut, and the first, third, and fifth sections were stained with hematoxylin and eosin to distinguish the presence and location of *Sarcocystis* cysts. Based on these microscopic observations, each cyst was extracted from either the second or fourth section for molecular analysis. Then, PCR amplification, sequencing of partial 18S rRNA, and phylogenetic analysis of *Sarcocystis* were performed on these cysts for identification. Because at least one cyst was found in all 20 deer, a high prevalence of *Sarcocystis* on Nakanoshima Island was suggested. The results also suggest the existence of different hosts other than canines. The molecular analysis of *Sarcocystis* is still in progress; however, this study will be the first step on the elucidation of a possible new life cycle of *Sarcocystis* in Hokkaido sika deer.

**264 Vector-Control Pesticides Disseminating via International Waterways to Accumulate in Free-Ranging Freshwater and Marine Fish Species**

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The Stockholm Convention controls use of various persistent organic pollutants. Mozambique, South Africa and Swaziland use DDT and other pesticides to reduce mosquitoes in areas with malaria, usually by indoor residual spraying (IRS). Water from these countries enters the Indian Ocean at Maputo Bay. This study aimed to sample both freshwater and marine fish to assess current levels of organochlorine pesticides. Representative fish were purchased from local fishermen and markets in the Maputo province, Mozambique. Liver and muscle samples were analyzed for 22 organochlorines - using Soxhlet extraction, activated florisil clean-up and GC-ECD analysis. DDTs were the predominant organic pollutant detected (mean  $\Sigma$ DDTs 118ng/g lipid weight), with the most abundant being p,p-DDE (mean 123ng/g lipid weight). Accumulation patterns differed between species. Presence of the parent compound p,p-DDT confirms recent release of DDT into the environment. DDT is applied to buildings but persists in the environment, entering waterways and bioaccumulating in marine life. Insects and crustaceans are most susceptible to effects of DDT. In fish, the nervous and reproductive systems are most affected, with high mortality of newly hatched fry.

Aquatic bird species are particularly vulnerable to toxicity. Destabilization of multiple aspects of ecosystems may result - including food chain effects, and changing predator/prey relationships. There is obvious conflict regarding use of DDT, between human health concerns and risks to wildlife. Further studies will assist our understanding mechanisms of action and aid in limitation of adverse effects.

#### **265 The Urban Fox Population and the Risk Assessment of Echinococcosis in Sapporo, Japan**

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Alveolar echinococcosis is a severe, sometimes fatal parasitic disease caused by *Echinococcus multilocularis*. This parasite was introduced with infected foxes (*Vulpes vulpes*) from the Kurile Islands to Hokkaido, Japan for fur farming since the 1920s. Then the disease has extended its range throughout Hokkaido by the 1990s, and about 20 new patients have been reported annually in recent years. Red fox is the most important vector of this disease, and the urban fox populations have been rising in Sapporo, the capital city of Hokkaido, since the 1990s. We tried to assess the trend of the risk of echinococcosis in Sapporo in this study. We have examined all road-killed foxes collected by Sapporo City Environment Bureau to assess the prevalence of *E. multilocularis* among foxes since 2001. We compared the trends between the number of road-killed foxes, the number of complaints about foxes from the citizens to the city office, and the number of informations about fox breeding in the city. Because these three trends were similar, it seemed reasonable that the number of road-killed foxes was considered as an index of the urban fox population. Then we defined the risk index of echinococcosis as multiplying the number of road-killed foxes by the prevalence of *E. multilocularis* among them. As a result, the risk of echinococcosis in Sapporo decreased from 2001 to 2004, but increased from 2008, and the risk index in 2013 was the maximum. The more aggressive measure like anthelmintic baiting should be taken in Sapporo.

#### **266 Wide Prevalence of Tick-Borne Blood Parasites in Wild Sika Deer Captured at a High Population Density Area**

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Recently, populations of sika deer (*Capreolus capreolus nippon*) has been increasing in Japan. This may cause increases of tick population distribution in the environment, along with global warming; hence, the prevalence of tick-borne diseases in deer is a matter of great concern. We collected blood samples from sika deer captured at an area overpopulated by deer in Fukui prefecture, and tested the prevalence of hemoplasmas, piroplasmas and anaplasmas by using end-point and real-time PCR. Of 16 samples, five (31.3%) deer were positive for *Candidatus M. heamocervae* and six (37.5%) deer were positive for *Ca. Mycoplasma erythrocyticum*. In the same way, 13 (81.3%) deer were positive for *Theileria* sp., three (18.8%) deer were positive for *Anaplasma phagocytophilum*, 13 (81.3%) deer were positive for *Anaplasma* sp. In consequence, the high prevalence of tick-borne hemoparasites was indicated. Phylogenetic analysis of *Theileria* sp. detected in this study showed a close relatedness to other *Theileria* sp. sequences detected in sika deer previously, and created an

individual branch in the phylogenetic tree, suggesting a novel theileria species enzootic among sika deer. Likewise, phylogenetic analyses of *Anaplasma* sp. sequence obtained in this study showed a close relatedness to other *Anaplasma* sp. sequences detected in Japanese cattle and wild ruminants, and created independent branch in the phylogenetic tree, suggesting a prevalence of enzootic anaplasma species in Japan.

#### **267 Formosan Ferret-Badger a Potential Reservoir Species for Rabies in Taiwan**

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Rabies re-emerged in Taiwan in 2013 after 52 years with no detection. The Formosan ferret-badger (*Melogale moschata subaurantiaca*) is the only species known to suffer from infection besides one case each reported in a dog, shrew and gem-faced civet. Genetic analysis shows that the virus strain has been isolated in Taiwan for about 100 years. In order to reveal the epidemic characteristics of rabies, from Oct to Dec 2013, a total of 32 nights of capture using 400 traps at 20 randomly selected sites in each of one rabies-free and two rabies-prevalent counties was done. All captured ferret-badgers were kept in captivity for six months. Of the 230 ferret-badgers and 34 other small carnivores collected, 12 ferret-badgers were found to be infected with rabies. Prevalence rates were zero, 5.3% and 50% in the three studied counties. All infected individuals survived 1-7 days after symptoms appeared while nine of them exhibited symptoms in traps. One individual survived 165 days before dying the day symptoms began. Results showed that individuals exhibiting symptoms could be captured, making the estimation of prevalence reliable. Since most infected individuals exhibited symptoms and died within 10 days after capture, infection may have a peak period. The existence of a latency period of over five months makes it possible for ferret-badgers to reserve the virus in the population with a minimum of two infected individuals per year. The ferret-badger is therefore a potential reservoir species for rabies in Taiwan.

#### **268 Radiocesium Concentrations of Body Part-Specific Comparison and Annual Change of Radiocesium in Small Mammals after the Accident of the Fukushima Daiichi Nuclear Power Plant**

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Radioactive materials released by the accident of the Fukushima Daiichi Nuclear Power Plant after March 11 in 2011 deposited mainly in forests in terrestrial ecosystem. It is necessary to monitor change and dynamics of radioactive materials in wildlife inhabiting these forests. We captured small mammals by traps for 3 years in two areas with different spatial dose rates: middle-dose area (3.6uSv/h) and low-dose area (0.2uSv/h). We measured radiocesium concentration in skeletal muscles including skeleton (hereinafter referred as muscles) of all individuals using Germanium

semiconductor detectors. We also measured concentrations of radiocesium separately in muscles, furs, and livers of the large Japanese field mice, *Apodemus speciosus*, captured in the middle dose area in 2011. Values of Bq/kg mean Becquerel per fresh weight in kg. Radiocesium concentration in muscles was highest (mean = 5.2kBq/kg, n = 12) among those in the other parts of body (furs: 58% of muscles, and livers: 45% of muscles, n = 12). Concentration of radiocesium in muscles after 3 years of *A. speciosus* in middle-dose areas were almost the same values as in the first and second years (mean = 5.7kBq/kg, range = 1.6-10.6kBq/kg, n = 29 in 2013). In addition, in the low-dose areas, radiocesium concentration of *A. speciosus* after 3 years were also the same values as in the first and second years (mean = 0.7kBq/kg, range = 1.8-0.2kBq/kg, n = 23 in 2013). Therefore, there was almost no annual change in concentration of radiocesium in the first 3 years after accident. It is necessary to continue monitoring small mammals as index animals in forests in terrestrial ecosystem.

## 269 Prevalence of Multiple Subtypes of Influenza A Virus in Japanese Wild Raccoons

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Raccoons (*Procyon lotor*) have been reported to be infected with influenza A virus, which has recently caused problems including highly pathogenic avian influenza (HPAI); however there is not enough information about relationship between raccoons and influenza A viruses. We investigated the actual state of influenza A virus infection in raccoons in Japan. A total of 634 raccoons captured in 19 towns from 2009 to 2012 were tested using agar gel precipitation tests, and 1.89% (12/634) raccoons in 3 towns (A-C) had influenza A virus antibodies. Detected HA and NA subtypes were H1, 3, 4, 5 and N1, 6, 8. H3 and N8 antibodies were detected from 75% (9/12) of the positive raccoons. Sixty-seven% (8/12) of all positive raccoons were captured in town A in 2009 and 2010, and all 5 positive raccoons captured in 2010 had H3 and N8 antibodies, suggesting that transmission of the subtype might occur among the raccoons. Two raccoons captured in town A had H5 and N1 antibodies, in addition to H1 antibody. Virus neutralization tests showed that antigenicity of the infected H5N1 seems to be closer to the HPAI virus (HPAIV) H5N1 of clade 2.5 and clade 2.3.2.1 than to the HPAIV of clade 2.2 and low PAIV (LPAIV) H5N3. Viral M genes were detected by real-time RT-PCR from rectal and/or nasal swab of 4 raccoons, although the virus was not isolated from the samples. This is the first report demonstrating that raccoons in Japan were infected with multiple subtypes of influenza A virus, including H5N1. It is needed to clarify the possible role of raccoons in persistence of influenza A viruses in nature and as mixing vessels.

## 270 Management of the Interaction between Wildlife and Livestock in South Central Spain

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The use of extensive farm resources by wild ungulates (mainly wild boar *Sus scrofa* and red deer *Cervus elaphus hispanicus*) is frequent and widespread in South Central Spain (CSE). Habitat, big

game management, farm practices and species-specific behavior, determine the use. Interspecific interactions are relevant because they determine the transmission and persistence of infectious diseases (such as tuberculosis) in zones of contact (the so called interface) between wild ungulates and livestock in CSE. The adequate management of these interactions can contribute to reduce the transmission of infectious diseases in such contact zones; therefore, the development and implementation of planned mitigation actions to reduce the risk of contacts and therefore, human/wildlife conflict, is key. Here we present protocols to mitigate the risk of interaction and disease transmission between livestock and wild ungulates in CSE. In this study, a protocol based on selective aggregation of ungulates at aggregation points substantially reduced direct and indirect contact between cattle and wild ungulates in a single farm, serving to reduce the potential for diseases, namely tuberculosis. Secondly, we applied integral plans in 20 study farms for protecting or segregating the use of a variety of resources between and wild and domestic ungulates. We present in this communication the risk assessment of contacts between wildlife and wild ungulates, and the description of the biosecurity measures. We discuss our results in terms of effectiveness and practicability.