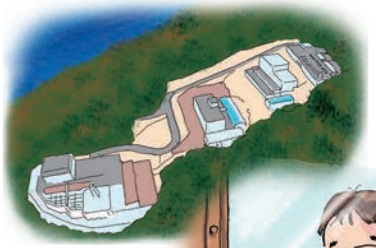
Wildlife

Research Center of Kyoto University

at a glance

Contents

Researching many species from land, sea, and sky – from rainforest to snow mountain, while connecting field and lab work.



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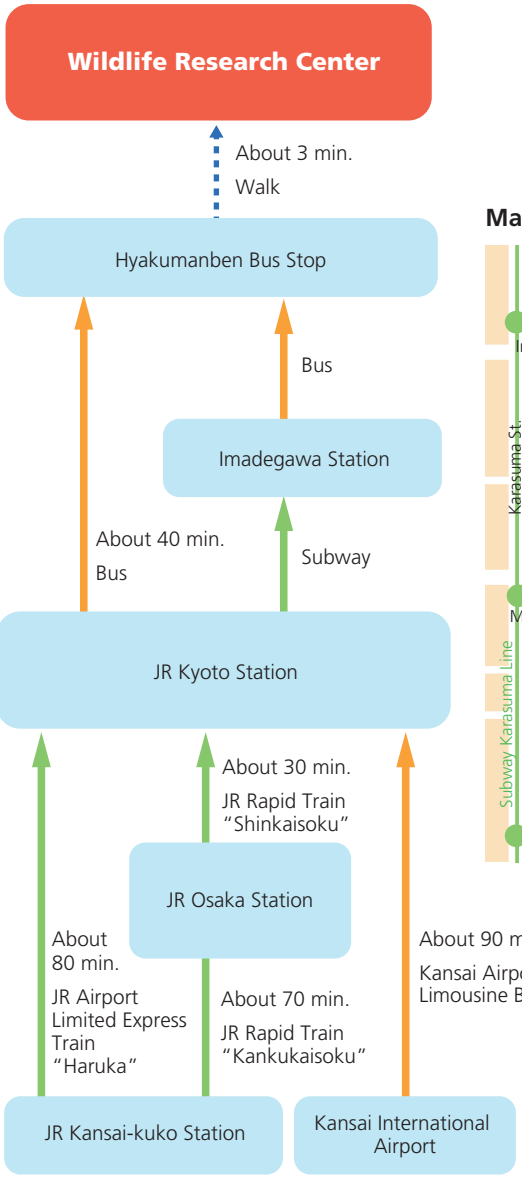

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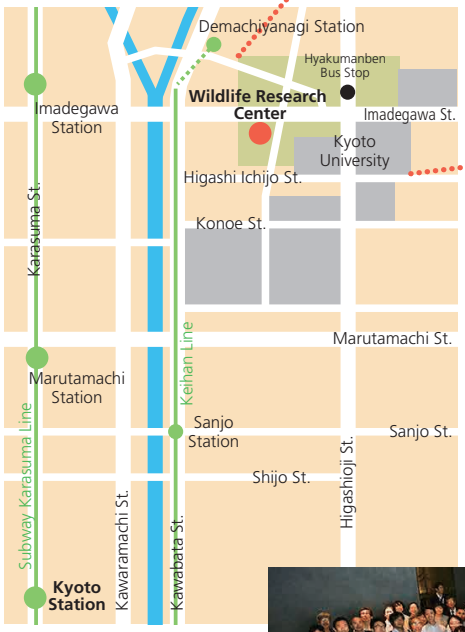

Hyakumanben Bus Stop to WRC

The Wildlife Research Center of Kyoto University collaborates with foreign researchers and accepts graduate students actively.

The 10th anniversary ceremony

Wildlife Research Center of Kyoto University at a glance

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Foreword

Indian Ocean Bottlenose Dolphin (Photo by Mikurashima Tourist Information)

The Wildlife Research Center of Kyoto University was established as the first university wildlife research institution in Japan in April 2008. In the past decade, we have expanded our network within the country and abroad, conducting research and education. This book introduces the activities of the center.

Currently, we collaborate with more than 20 zoos and aquariums to conduct ex-situ conservation. We conduct in-situ conservation research in cooperation with local research institutes at 7 overseas research bases. We accept graduate students of the Graduate School of Science to accomplish our education mission. Also, we participate in the leading graduate program, "Primatology Wildlife Science (PWS)". So far, more than 60 students have studied more than 38 species of wild animals in 13 countries.

Although we are still a small organization, we have created the new discipline, "wildlife science". At its inception, the center started with six full-time faculty members. Now, 36 professors work on special posts and concurrent posts, among other positions. This development would not have been accomplished without the dedicated cooperation of the professors and administrative staff of the institute.

In the next decade, we will pursue even greater possibilities in education and research, together with young researchers who have advanced to realize our mission of wildlife conservation. Again, I would like to express my gratitude to all our readers for your support, now and in the future.

Director

Miho Murayama

Declaration

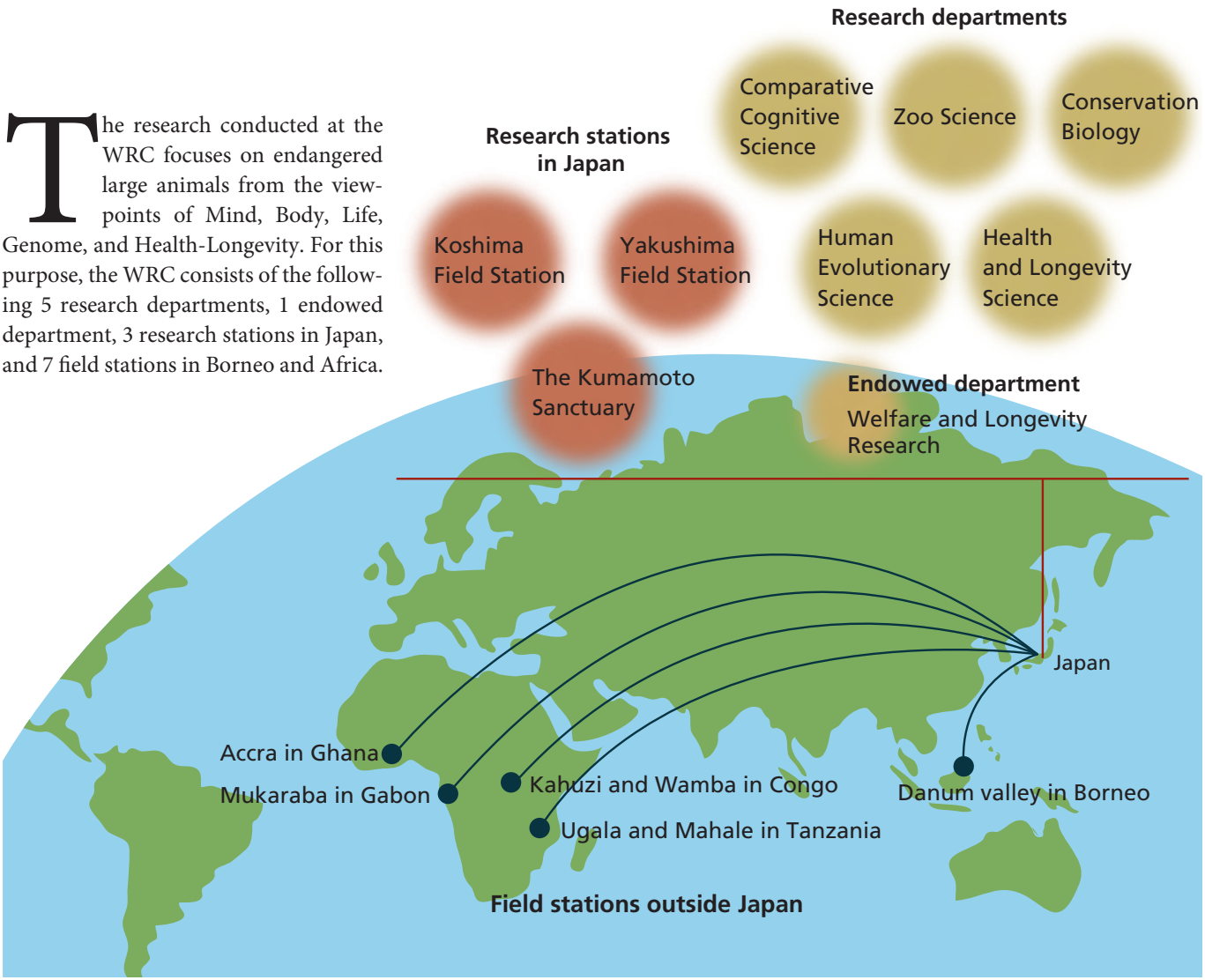
The Wildlife Research Center of Kyoto University aims to promote scientific research and education on wild animals, and to contribute to the peaceful coexistence of living organisms on planet earth. Our mission can be summarized in the following three points. First, the center carries out basic research on endangered and threatened species of wild animals to promote conservation in their natural habitat, to improve their health and welfare in captivity, and to encourage the fusion of scientific approaches to advance our understanding of human nature. Second, the center integrates different areas of science to create new disciplines applicable to field settings and to encourage international collaboration for the symbiosis of humans and other living organisms. Third, in collaboration with zoos, sanctuaries, aquariums, and museums, the center promotes youth environmental education by offering them unique experiences with nonhuman animals, providing young people with a deeper insight into all aspects of nature, including ourselves.

Giraffes at the Selous Game Reserve, United Republic of Tanzania (Photo by Hiroko SAKURAGI)

African elephant at the Selous Game Reserve, United Republic of Tanzania (Photo by Hiroko SAKURAGI)

Organization

The research conducted at the WRC focuses on endangered large animals from the viewpoints of Mind, Body, Life, Genome, and Health-Longevity. For this purpose, the WRC consists of the following 5 research departments, 1 endowed department, 3 research stations in Japan, and 7 field stations in Borneo and Africa.



Undergraduate / Graduate Education

Education at the WRC aims to teach students wide research skills, in both laboratory and field settings. This encompasses all processes of wildlife scientific research, i.e., field sampling, laboratory analysis, data analysis, and presentations. For this purpose, the WRC offers the following lectures for undergraduate and graduate students.

Undergraduate

The Liberal Arts and Sciences Program
- Introduction to Wildlife Sciences
- Comparative Cognition-E2

ILAS Seminar
- Genetic study of wild animals
- Seminar on Comparative Cognitive Science

Faculty of Science
- Conservation Biology

Graduate

- Inter Lab Studies, Biological Science
- Introduction to Wildlife Research
- Fundamental Wildlife Genome Science
- Fundamental Animal Behavior and Ecology
- Fundamental Zoo Science
- Animal Welfare Course
- Basic Skills for Field Work: Non-snow season
- Basic Skills for Field Work: Snow season
- Field Training on Animal Behavior and Ecology
- Advanced Lectures on Wildlife Research
- Advanced training in field biology *
- Advanced laboratory skills in field biology *
- Advanced Studies of Primatology and Wildlife Research
- Seminar on Wildlife Research

* held as international field and laboratory course on page 9

Leading Graduate Program in Primatology and Wildlife Science (PWS)

The Leading Graduate Program in Primatology and Wildlife Science (PWS) strives to realize global well-being. The program aims to foster individuals with the ability to make quick judgements about environmental issues and to design a future global society, while at the same time nurturing leaders indispensable for global action.

Japanese primatology has played a leading role in this unique academic endeavor. During recent years, the field of "Wildlife Science", which targets endangered species research, has begun to emerge. With fieldwork as its foundation, the fundamental aims of this field are a comprehensive understanding of the human mind, body, life and genome, as well as hands-on activities that target the well-being of the world.

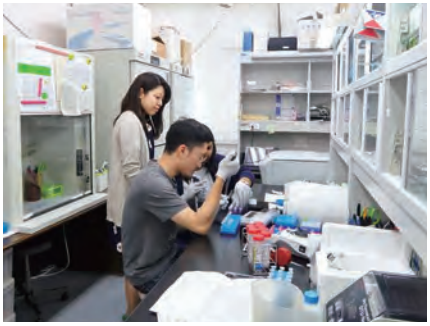
While on the frontlines of academic research, wildlife science in Japan lacks three important careers that already exist in the West: (1) Conservation specialists with international organization, such as the United Nations and other NGOs; (2) Curators of museums, zoos, aquariums, and similar institutions, particularly those that can develop and/or expand museums or zoos as a "Field Museums" in a specific habitat; and (3) Dedicated individuals that invest great lengths of time in outreach activities in specific countries and societies, the so-called "boots-on-the-ground" approach.

While providing a foundation for new research, education and hands-on experience, this program aims to nurture global leaders whose accomplishments grow hand-in-hand with the larger academic field. For further details on the program, please refer to our HP (http://www.wildlife-science.org/).

Group photo with President Juichi Yamagiwa. He is a founding core-member of PWS

Practical fieldwork in the Iriomote island: PWS provides a variety of field courses

International Field and Laboratory Course



Students analyzing the samples taken in the field

Every year, we successively hold an international fieldwork and laboratory course for graduate students. In the first week, we do field work on Yakushima Island, observing animals and taking samples. In the second week, we analyze the samples taken in the field. On the final day, students present their results in a workshop. About half of the students are invited students from foreign countries and half are master's course students of Kyoto University. Throughout the course, we use English as the official language.

For example, in the monkey genetics course, we collect fecal samples of monkeys from all over the island. When we find monkey feces, we wipe the surface with a cotton swab to retrieve the DNA of monkeys. We walk long distances for sampling, from lowlands to high mountains, every day. In laboratory work, we determine the sex of the monkeys from sex-related DNA and local variations of mitochondrial DNA. We find common genetic types all around the island and some local specific types in narrower areas.

In the deer course, we follow habituated wild deer and collect their fecal samples. Recently, in our field site, deer have become habituated to observers, and some individuals can be observed closely. In the subsequent laboratory course, we measure sex hormone levels. The contents of the courses are fundamental and applicable to many wild animals.

Students learn basic skills and gain a knowledge of field work and laboratory work. Working and living with students from all over the world is also an enriching experience. Most students are not so fluent in English, but they manage to communicate with each other. This also presents a good opportunity to experience and understand different cultures. Some students are vegetarian; Muslim students avoid pork; and Japanese like raw fish, called 'sashimi'.

We are very happy that some students in the course visit us later to learn more techniques or became students of our graduate school. We hope the friendships built in the course will lead to further cooperation in wildlife research.

Upper: Students observing wild deer on Yakushima Island

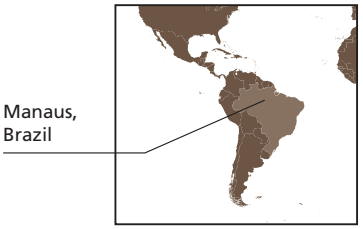
Lower: Students observing wild Japanese monkeys in Koshima Islet, another course field site

Studies on ecology and behavior for wildlife conservation

Shiro KOHSHIMA

Introduction of PIs I

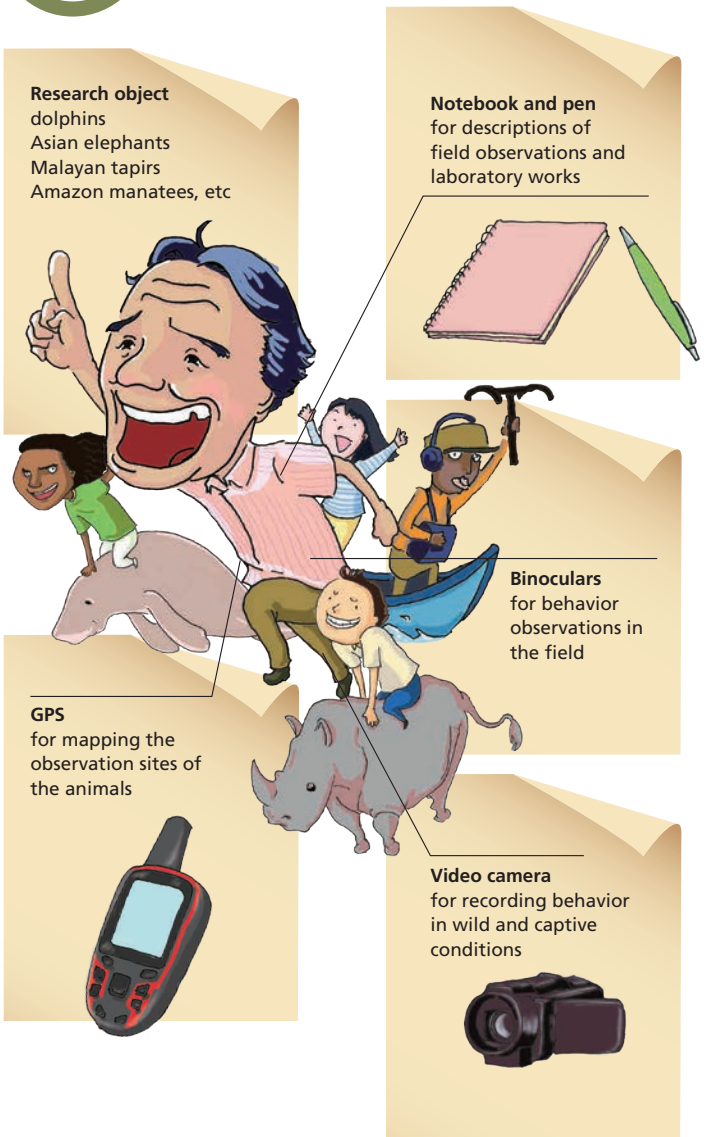
Keywords
behavior and ecology
Field Museum
relocation program
environmental education



We study the ecology and behavior of various animals, especially large animals that have not been well studied, because we believe that understanding the ecology and behavior of each animal species is essential for its conservation and the mitigation of its conflicts with humans. We focus on large animals because many of them are endangered species, umbrella species and flagship species, important for the ecosystem-scale conservation of their habitats. For example, Borneo orangutans and Amazon river dolphins can symbolize ecosystem conservation of Asian tropical rainforests and the Amazon River, respectively, and their conservation can contribute to the conservation of many other organisms.

Studies in the wild and captivity to understand animal ecology and behavior

We have studied the ecology and behavior of Asian elephants (vocal and chemical communication and mitigation of conflicts with humans), Malayan tapirs (salt-lick use, vocal communication, and social structure), orangutans (feeding ecology and social interaction), wolves (eye morphology and gaze communication), wild dogs (vocal and chemical communication), civets (feeding ecology and social struc-

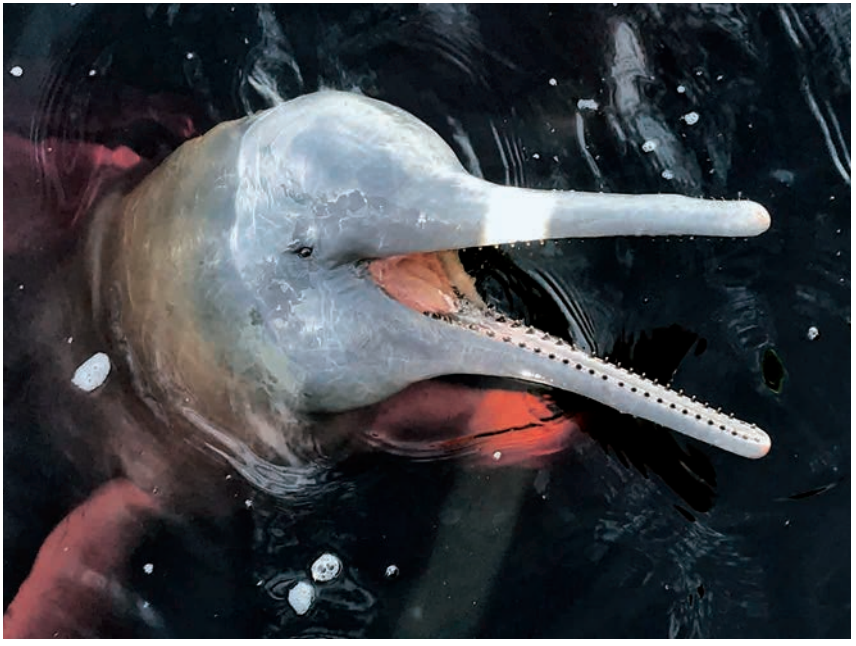


Malayan Tapir

Amazon manatee with a VHF transmitter and a bio-logger for behavior monitoring

ture), porcupines (social structure and reproduction), sloths (activity pattern and energy budget), otters (social interaction and chemical communication), sea otters (social interaction), Amazon River dolphins (activity pattern and habitat use), Ganges River dolphins (activity pattern and habitat use), and Amazon manatees (vocal communication and relocation program studies), as well as various dolphin species, including killer whales (activity pattern, sleep behavior, vocal communication, habitat use and social interactions) and seal species (vocal communication and social interactions). I have supervised many graduate students who have studied these diverse animals, though I have mainly studied the ecology and behavior of insects and microorganisms living in the snow and ice of the glaciers in various part of the world, such as Himalaya, Patagonia and Greenland.

We study these animals in the wild and/or captive condition. We study wild animals using various advanced methods such as bio-logging, camera trapping and sound/image analysis. Precise analyses of the behaviors observed in captive environments, such as zoos or aquariums, are also important to understand the function and meaning of each behavior. We officially collaborate with 11 zoos and 7 aquariums in Japan to promote studies in captivity. We also collaborate with these zoos and aquariums to improve the captive condition of the animals and their quality of life, based on the scientific results.



Amazon River Dorphin

International program for Tropical Bio-diversity Conservation

We organize a five-year program (2017-2022), the JSPS core-to-core program "Center of Excellence for Conservation of Tropical Bio-diversity focusing on Large Animal Studies", which aims to promote international academic exchange for tropical bio-diversity conservation among Japan,

Education Program for local communities

India, Brazil, Malaysia, China, Indonesia and the UK. In this program, we promote collaborative studies on various large animals in each member country and conduct international training courses in Japan for field research and data/sample analysis with advanced technology to foster the development of young researchers of large animals from the member countries. Two young researchers from each member country (12 researchers in total) are invited to Japan every year to join the training courses.

We also organize international seminars and workshops to realize the "Field Museum", a new generation zoo/aquarium/botanical garden in the natural habitat of wildlife, which can contribute to research, conservation, education and ecotourism in each member country. The Field Museum is a network of nature reserves and observation facilities in the natural habitats of wildlife, where we can observe various organisms in captive, semi-captive and wild conditions, as well as conduct research and conservation activities. The captive and semi-captive facilities and nature reserves of the Field Museum are essential for the successful relocation program of large animals and useful for studies of various organisms. The Field Museum can contribute not only to study, conservation, and environmental education, but also to the local community through ecotourism and as a center for conservation of local ecosystems.

JST/JICA SATREPS Program for achieving the Field Museum in the Amazon

To realize a Field Museum in the Amazon, we organized a JST/JICA SATREPS Program (Science and Technology Research Partnership for Sustainable Development): Biodiversity Conservation in Amazon, based on the new concept of the "Field Museum" (2014-2019) and in collaboration with the National Institute for Amazon Research (INPA, Manaus, Brazil). SATREPS is a Japanese government program structured as a collaboration between the Japan Science and Technology Agency (JST) and the Japan International Cooperation Agency (JICA). ITOCHU Corporation also supports this program.

Tower for observation of forest canopy (ZF-2 Tower: 40m+10m)

In this program, we study various Amazonian animals and plants, some of which are endangered species, and we develop facilities for observation, such as a 40-meter tower for observation of the forest canopy and a new field station in the

Lodging house of
Quieiras Field Station

Captive facilities in INPA

primary forest along the Quieiras River near Manaus, where more than 60 people can stay (Quieiras Field Station). The Quieiras Field Station will be an important base for long-term research on various types of tropical rainforests in this area, including flooded forests and white-sand forests (campinarana). In this area, we can study various animals, including pumas, jaguars and Brazilian tapirs.

We also develop captive and semi-captive facilities for rescued Amazonian manatees to conduct a relocation program by the soft-release method, in which artificially raised manatees are released to the wild after training to feed on natural foods in a semi-captive condition. We have already released 19 manatees to the wild successfully and continue to monitor their behavior in the wild. We have also conducted environmental education about manatees in the local communities along the Purus River, where we released the manatees. At present, the monitoring of the released manatees is conducted by local people who hunted manatees until several years ago.

All of the facilities and nature reserves developed by this program will be used not only for study and conservation, but also for environmental education and ecotourism in collaboration with local communities. We plan to develop various programs of environmental education and ecotourism in the Field Museum, based on our scientific results in collaboration with people from local communities. For example, we will develop ecotourism programs in the Quieiras Field Station by collaborating with the communities of Quieiras River. We also plan to develop ecotourism programs in which tourists can see manatees and contribute to the relocation and monitoring program managed by local communities of Purus river.

Semi-captive facilities in Manacapul

Monitoring by local people
who were manatee hunters

For more information, visit
https://www.wrc.kyoto-u.ac.jp/satreps/english/outline.html

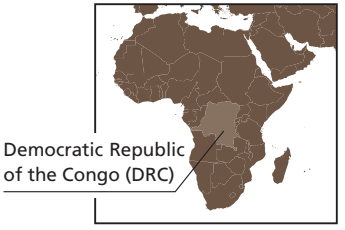
Fieldwork for African great apes in moist and arid areas

Gen'ichi IDANI

Introduction of PIs 2

Keywords
great apes
society
African vegetation

Tropical rainforest of the Congo Basin, Democratic Republic of Congo (DRC)



A variety of vegetation environments exist in the continent of Africa. I have conducted research that focuses on great apes in three main environments: tropical rainforest in the central part of the continent, lowland forest and grassland mosaic located at the periphery of the continent, and more arid Miombo woodland and evergreen riverine forest. My research objective is to elucidate the environmental adaptation and evolution of apes on the continent of Africa, and to clarify the society of the genus Chimpanzees.

Bonobo (*Pan paniscus*) studies in the Congo Basin

Tropical rainforest, covering to 3.7 million km^2, meanders through the Congo River Basin, spreading to a total extent of 4,700 km. In the central area of the Basin, at the Wamba Forest (Luo Scientific Reserve) in the Equator Province of the Democratic Republic of Congo (former Zaire), I have been conducting socio-ecological studies of bonobo since 1984. Bonobos play an important role as a seed disperser in the regeneration and preservation of forests, as they range through a wide home territory, while eating various fruits.

Left: Juvenile bonobo in Mbali River Basin, DRC
Right: Social grooming by bonobos in Wamba, DRC

Bonobos have a patrilineal society in which adolescent females migrate between unit groups, and the males do not depart from the natal group. Before emigration, the females become estranged from their relatives, such as mothers and brothers, and one day they suddenly disappear from the natal group. After the emigration, females are thought to travel across several groups. Immediately after immigration, the female has interactions with all females of the new group. She then selects one particular resident female, a 'specific senior female' (SSF), whom they frequently approach and follow. New females are established in the new group through the relationship with the SSF.

Interactions between unit groups of most primates are antagonistic or aggressive in nature. Even chimpanzees and gorillas are no exception. During such encounters in the bonobo society, however, various affinitive behaviors, such as genito-genital rubbing, copulation, and grooming, occur between members of different groups. Affinitive interactions between females of different groups are particularly prominent and appear to ease the tension caused by the encounter. These encounters may be triggered by the migration of young females. Bonobos have a regional society above the group level, in which the non-antagonistic coexistence between different unit groups is unique among nonhuman primates.

Mammalian studies in the Ugalla area, Western Tanzania

The Ugalla area covers 3,352 km^2 and is located about 100 km inland from Lake Tanganyika. The climate in the Ugalla area is characterized by a long dry season between May and October. I have been conducting studies of vegetation, mammalian fauna, and ecology of the chimpanzee in this field since 1994.

The vegetation of the Ugalla area is classified as "miombo forest" and includes three main vegetation types: woodland, evergreen forest and grassland. Most of the Ugalla area is composed of woodlands, 81.7% of the total area is dominated by deciduous trees of *Brachystegia* and *Julbernardia*, 9.8% is evergreen forest, and 8.5% is grassland. Such a specific vegetation is valuable in understanding the diversity of African vegetation, but the environment has been transformed by human activities such as deforestation and nomadism in recent years.

Miombo forest in the Ugalla area, Tanzania

Ugalla is a rare area where savannah-origin and forest-origin animals coexists. Namely, while inhabited by lion representatives of the savannah, chimpan-

An elephant in Ugalla, Tanzania

Feeding behavior of bonobos in savannah of the Mbali River Basin, DRC

zees, the main habitat of forests, also live in the Ugalla. 53 mammalian species are identified in the Ugalla area: 7 species of Primates, 1 of Chiroptera, 2 of Logomorpha, 4 of Rodentia, 19 of Carnivora, 1 of Tubulidentata, 1 of Hyracoidea, and 15 of Artiodactyla. In the past, many African elephants also inhabited the area, but the number has drastically decreased in recent years.

Ugalla is the most eastern and marginal known habitat of chimpanzees in Africa. The population density of chimpanzees (*Pan troglodytes schweinfurthi*) in the Ugalla, however, is lower than in other habitats of Tanzania at 0.13 animals/km^2. This density means that the total number of chimpanzees in the Ugalla area is around 200-300 individuals. If the size of a unit group is consisted to be 30-35 individuals, and the unit groups are all about the same size, then around 7-9 unit groups live in Ugalla. Moreover, if 7-9 unit groups divide the 3,352 km^2 Ugalla area, each unit group should have a huge home range of around 400-500 km^2.

The Ugalla area is one of the driest habitats supporting a stable population of chimpanzees. The research in miombo forest environments is important for understanding the variety and flexibility of chimpanzee adaptation and to illuminate models of early hominid behavioral ecology.

Bonobo studies in the forest-moist grassland area

The bonobo has been thought to inhabit only tropical rainforests of the Congo Basin, but recently, a new population of bonobos have been found to survive in the western region of the Democratic Republic of the Congo. This area corresponds to the southwestern limit of the region of bonobo distribution. Tropical rainforests are diverse evergreen forests established under moist environments, but vegetation in the southwest area is an environment where forests and moist-grasslands (savanna) lay in a mosaic pattern.

I have been researching the inhabitation and socio-ecology of bonobos in the Mbali River Basin since 2013. 4 bonobo groups have been confirmed in this area, and 2 of them have advanced to the stage of habituation and individual identification: 16 animals of the Mpelu group and 14 animals of the Nkala group. They frequently use not only forests but also savannas, and the home range of a single group is much larger than those of forest-dwelling bonobos. There is also the possibility of unique characteristics in the feeding ecology of bonobos in this habitat.

This area is adjacent to distributions of the central chimpanzee (*Pan t. troglodytes*) and the western gorilla (*Gorilla g. gorilla*) across the Congo River. As this field site enables the comparison of different adaptations to the environment and the evolution of three African great apes who inhabit similar vegetation types, we will also deepen and develop research on human evolutionary theory in the future.

Forest-moist grassland in the western region of DRC

Molecular approaches for wildlife conservation

Miho MURAYAMA

Keywords
database, genetic diversity, personality, management

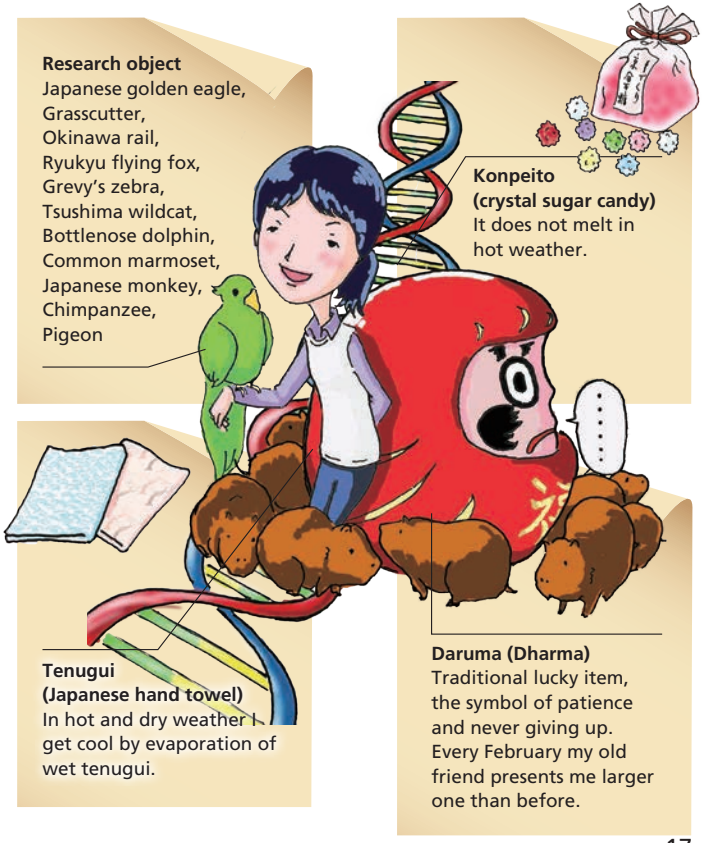
There are several approaches to learn more about wild animals. Among them we use molecular approaches, such as genome and cell analysis. Even in wild conditions, where direct observation is difficult, non-invasive samples, such as feces and feathers, bring us useful information, such as genetic diversity and individual genotypes of functional genes, for target animals. The results of our research will not only benefit reproduction of captive animals, but it can also be applied to the conservation of species in the wild.

International networking for molecular methods

We have been collaborating with foreign laboratories, where researchers are using molecular methods for wildlife study. The project entitled "International Coordination for Endangered Animal Conservation Based on New Post-Genomic Techniques" was funded by the Supporting Program for Interaction-based Initiative Team Studies (SPIRITS) of Kyoto University (2016-2017). Many zoos in Europe and the USA have research departments where the staff members have ready access to biological samples from zoo animals. In addition, the scientific output from these samples can be fed back to the animal rearing and management strategies of the zoo from which they came. Inspired by such activities, the Wildlife Research Center has launched a program to coordinate scientific cooperation and networking between many zoos and aquaria in Japan, including the Kyoto City Zoo. The cooperation between researchers, veterinarians, and keepers is mutually beneficial to all individuals involved. Such cooperation will yield scientific findings that will help the promotion of many research projects across the globe.

A DNA cell database for further understanding species

Understanding the range of genetic diversity within species requires obtaining and genotyping many samples for each



Japanese golden eagle resting its wings. They use the same tree for resting (Photo by Taku MAEDA)

Collecting samples by rubbing the inside of a dog's mouth with a cotton swab.

species. We collected DNA samples from over 27,000 individuals representing 200 species each of mammals and birds. Since some animals are difficult to capture, and thus blood samples are not always available, we devised methods for efficient DNA analysis using noninvasive samples, such as feces and hair. We stored these in a DNA database (the DNA Zoo), which also includes information on the geographical region in which the sample was collected and characteristics of the individual. Using the DNA Zoo, we identify subspecies/populations/kinships by genotyping polymorphic markers, such as microsatellites and mitochondrial DNA. Moreover, by analyzing genes on the sex chromosome, we can identify the sex of some bird species in which males and females are difficult to distinguish by observation alone. Also, we are planning to develop a cell bank and are trying to prepare iPS cells. We are studying the conditions for cryopreservation of germ cells, such as sperm and immature oocytes. A part of our database is open to the public through National Institute of Environmental Studies (http://www.nies.go.jp/time_capsule/). In 2018, WRC signed an MOU with the San Diego Zoo in the USA, where they have been banking frozen cell cultures, collected from almost all the animals kept there.

Genetic basis of animal personality

We are also surveying individual differences in functional genes related to personality traits (e.g. stress susceptibility) and reproduction. Individual humans and other mammals display unique personality traits, which we believe are influenced by both their genetics and their environment. Personality traits appear to be mediated by genes that regulate neural and hormonal transmissions. The personality traits of a human strongly influence his or her health condition. This led to the idea of conducting genetic studies of wild animals to identify their personality. I expected that knowledge of the individual animal's personality would be useful for predicting their health status and mate choice, which are important factors for successful wildlife breeding and conservation. Our studies include wild animals, such as primates, elephants, dolphins, zebras, and raptors, as well as domesticated animals, such as dogs, cats, horses, and chickens. For example, we found that genotypes of vasopressin receptor and mu-opioid receptors affect personality and cortisol hormone level in captive marmosets (Inoue-Murayama et al. 2018).

Genetic management of captive populations

In view of future re-introduction, appropriate management for reproduction and maintenance of captive populations is important. Therefore, not only in-situ, but also ex-situ, conservation is needed. For example, Japanese golden eagles are estimated at 500 in the wild and are endangered. We developed microsatellite primers from genome sequencing and genotyped both wild and captive Japanese golden eagle populations. The results revealed that there was no big difference in genetic diversity between wild and captive populations and that there was no evidence of inbreeding in either population. However, subsequent population viability analysis (PVA) to examine the demographic and genetic future of the captive population demonstrates the severe effects of existing repro-

the Republic of Ghana

Practice of DNA analysis in the University of Ghana

Laboratory meeting in the Wildlife Research Center

ductive skews, suggesting that this population is not sustainable without intensive genetic management. As a solution, we devised appropriate conditions to maintain the captive population for 200 years (Sato et al. 2017).

Domestication of new livestock for wildlife conservation

University of Ghana in the Republic of Ghana, West Africa, is one of our most important research bases. Prof. Kayang, a counterpart collaborator from the University of Ghana, stayed at WRC as a post-doctoral researcher in 2008-2009. We then accepted a PhD student in WRC from 2010 to 2014. After graduation, Dr. Adenyo returned to work as a Research Fellow at the University of Ghana. So far, we have accepted 11 Ghanaian students in Japan to study genetic diversity, infection, and the probiotics of wildlife and livestock, for around 2 months each. Also, Japanese researchers visited Ghana to conduct research with local researchers. In 2017, Kyoto University and the University of Ghana signed an MOU for more collaboration.

One of the main topics of our collaboration is domestication of the large rodent named grasscutter (Thryonomys swinderianus) as a new livestock species (Adenyo et al. 2018). The northern part of Ghana is facing a severe food shortage. In particular, due to insufficient animal protein supply, the physical development of children is greatly delayed compared with children in the southern urban area. The harsh climatic conditions in that region are not suitable for rearing cattle and pigs. Our project therefore aims to support the domestication and breeding of grasscutters, a species indigenous to that area. Since hunting wildlife is likely to adversely impact the ecological balance and involves the risk of zoonotic infection, we are promoting grasscutter domestication to secure safe animal protein for the local people. This grasscutter project was sponsored by the Japan International Cooperation Agency (JICA), KAKENHI and JSPS Bilateral Joint Research Project (2018-2019). Also, we launched a new NGO, Grasscutter Initiative for Rural Transformation (GIfT), to continue the mission of the grasscutter project through the support of the Ajinomoto AIN grant (2018-2021). As a result of our four-year activities, the number of captive grasscutters in the target area increased from 0 to 250 (see more on this project from Prof. Kayang)

Aiming to develop new molecular techniques

We plan to actively work on wildlife conservation by using new molecular techniques. For example, to prevent illegal trade of poached wild animals, DNA profiling is used to identify species, sex, and origin of the seized samples. Such 'wildlife forensics' is needed more and more in the future (Ogden et al. 2009). Based on our DNA database we will develop a standard for DNA profiling.

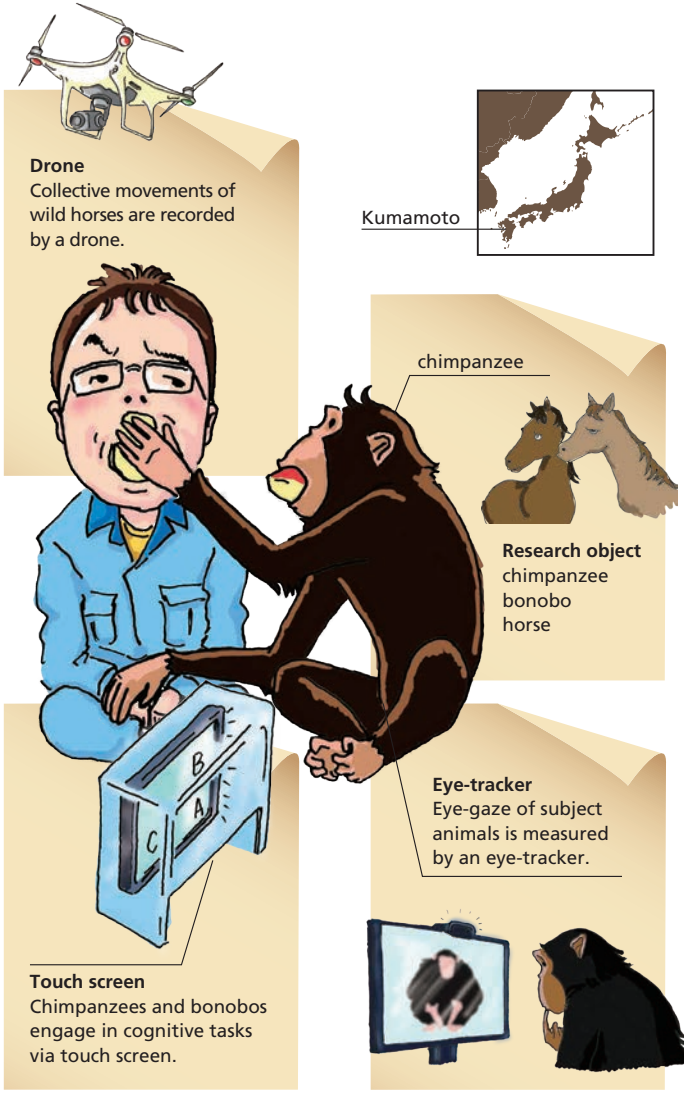
For animals with a long lifetime, such as elephants, apes and some birds, estimation of age composition in the population is important for creating a conservation strategy. We are developing new molecular techniques to estimate the age of wildlife by DNA methylation (Ito et al. 2018).

For more information, visit
http://miho-murayama.sakura.ne.jp/

Understanding humans by studying nonhuman animals

Satoshi HIRATA

Keywords
comparative cognitive science, understanding human nature, state-of-the art technologies

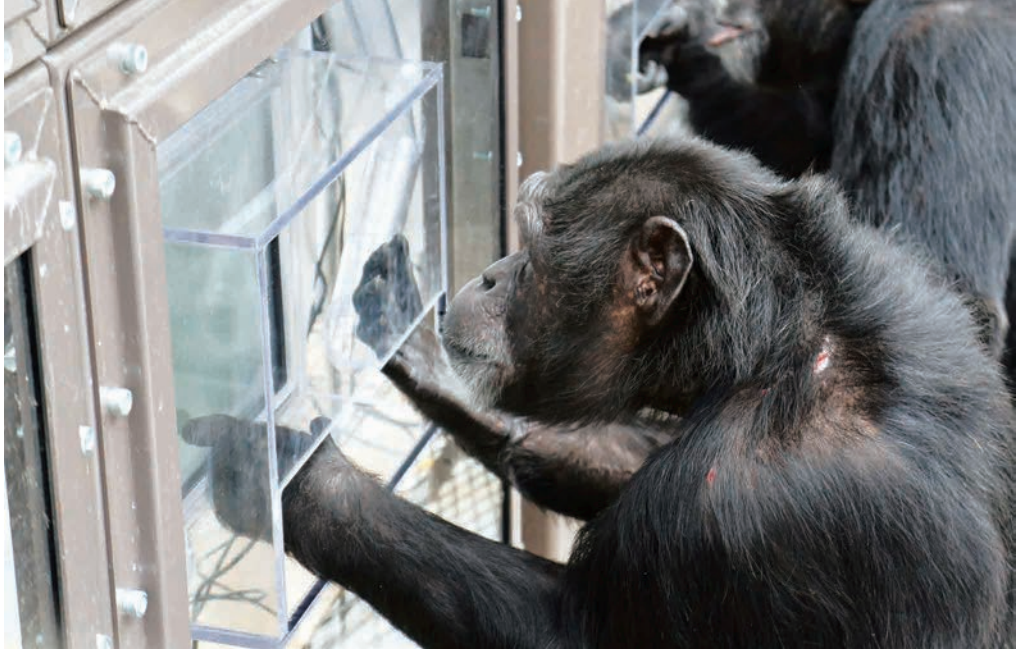


What are human beings? What is in the minds that inquire about human beings? Starting with such questions, I entered into the academic world to study nonhuman primates from comparative cognitive perspectives. Since graduate school, the main target of my research has been the chimpanzee, one of the closest living relatives of humans. I aim to explore the evolution of the human mind through the investigation of the social intelligence in great apes.

The first and only sanctuary for chimpanzees and bonobos in Japan: Kumamoto Sanctuary

My study site for work with chimpanzees and bonobos, the great ape species, is Kumamoto Sanctuary (KS). KS is the first and only sanctuary for chimpanzees and bonobos in Japan. It is located in Kumamoto prefecture, approximately 800km southwest of Kyoto University's main campus. The facility was originally owned by a pharmaceutical company that was involved in Japan's biomedical research project using chimpanzees. The facility, chimpanzees, and other properties of Kumamoto Sanctuary were then transferred to Kyoto University on August 1st, 2011. KS is now officially part of the Wildlife Research Center. The KS staff, around 10 members, are passionately committed to enhancing the physical and psychological well-being of the chimpanzees and bonobos housed

Kumamoto Sanctuary, Kumamoto, Japan



Chimpanzees engaging in a touch-screen task

at the Sanctuary. In Japan, no chimpanzees whatsoever are used in laboratory research. All of the chimpanzees formerly involved in biomedical research have now been retired and are housed comfortably at Kumamoto Sanctuary. The last three chimpanzees that still remained in another biomedical research facility were transferred to KS on May 15th, 2012, which marked the end of housing chimpanzees in biomedical facilities in Japan.

Using comparative cognitive science for animal welfare

After Kumamoto Sanctuary was established in 2011, external research grants funded some facility renovations, namely the construction of two sets of outdoor and indoor spaces, as well as a 155m-corridor that connects three different holding buildings. These outdoor spaces function not only as the apes' living environment, but also as places to conduct behavioral and cognitive studies. Two indoor rooms were also built as study areas. Using these environment, our research has revealed the apes' long-term memory of single events, implicit false-belief comprehension, attention to conspecific pictures and videos, and skin temperature changes in response to emotional videos. One innovative study method we developed is to make movies for the apes. In one of these movies, we wrote a scenario that we believed would attract and excite the apes. In it, I played the role of a King-Kong character by wearing a King-Kong suit. The apes were indeed excited when watching the story of King-Kong. In this way, the study succeeded. As mentioned above, we could prove that the apes remembered the storyline of the movie and that the apes showed some level of understanding about the mental states of the characters who appeared in the movie.

Using state-of-the-art technologies plays an important role in conducting these types of studies. We have used computer-controlled touch screens, eye-trackers, and infra-red thermography, among other methods, to investigate the minds of chimpanzees and apes. Before using such technologies, however, the most important method is to establish a good relationship with the chimpanzees and bonobos. Each individual ape has a different personality; thus, we need to thoroughly understand each individual's characteristics by close and patient observations of everyday life behavior before we can conduct a good study.

Other scientific studies, focused on ape welfare, have included the evaluation of hair cortisol as an indicator of stress, the change in hair cortisol levels in different housing conditions and social situations, the relationship between the fre-

Vijay, a male bonobo at Kumamoto Sanctuary

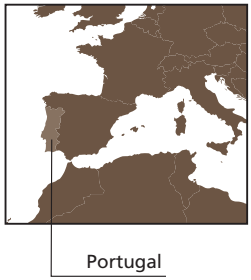
quency of social play and social tension, and the diagnosis and care of a blind chimpanzee with Down syndrome. Through this research, I hope to contribute to the understanding and captive welfare of our closest living relatives.

Aiming to better understand human beings: the study of feral horses at the Portugal Field Station

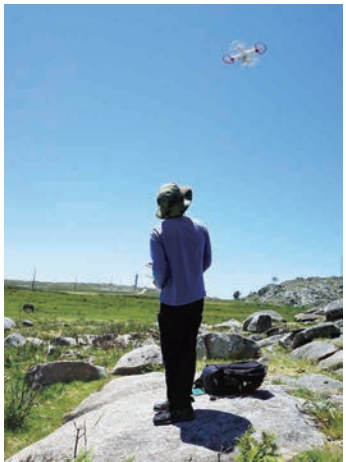
In addition to the study of chimpanzees and bonobos, I have also started to investigate the behavior of feral horses. After exploring several alternatives, we arrived at Serra D'Arga, Northern Portugal in October 2015, deciding to set up a field station to study feral horses there. The breed of horses living there is called "garrano". Horses have become extinct in the wild in a strict sense, but there are some places across the world where once-domesticated horses live in natural environments, outside of human control. By studying horses, we can broaden our understanding of the evolution of the human mind and human behavior. Horses are terrestrial and evolutionarily distantly related to humans, while apes are arboreal and evolutionarily closely related. Because of this contrast, comparative studies of these different animal species will shed new light on the understanding of human nature.

We have identified over 200 individual horses at Serra D'Arga, which belong to over 30 different groups. Utilization of the method of individual identification in the study of animal behavior was initiated by Japanese researchers in the 1940s, through observations of feral horses in the southern part of Japan. They later shifted their attention to wild monkeys, with whom they similarly used the method of individual identification. Through this work, we track the history of animal study in Japan from horses to primates.

Feral horses viewed from a drone at Serra D'Arga, Portugal



As stated above, horses are phylogenetically distant from primates, but considerable behavioral links exist between the two. The sociality of horses, characterized by group stability, is similar to that of primates, but different from that of many other ungulates. Therefore, one research goal in our study of horses is to explore the evolution of human and non-human animal societies. New technology helps us conduct this research, as illustrated by the work at Kumamoto Sanctuary. At Serra D'Arga, we started to use drones, or unmanned aerial vehicles. There is a clear advantage in using drone surveys for horses, as they live on relatively flat ground without many obstacles, and one can easily observe entire groups from the sky, remotely. The Serra D'Arga is particularly interesting because the horses there are preyed upon by wild wolves. This activity is important for nearby villagers because wolves' predation on horses protects the villagers' precious livestock, such as cows, sheep and goats. This type of coexistence between wildlife and humans is also one of the focuses of our investigations.



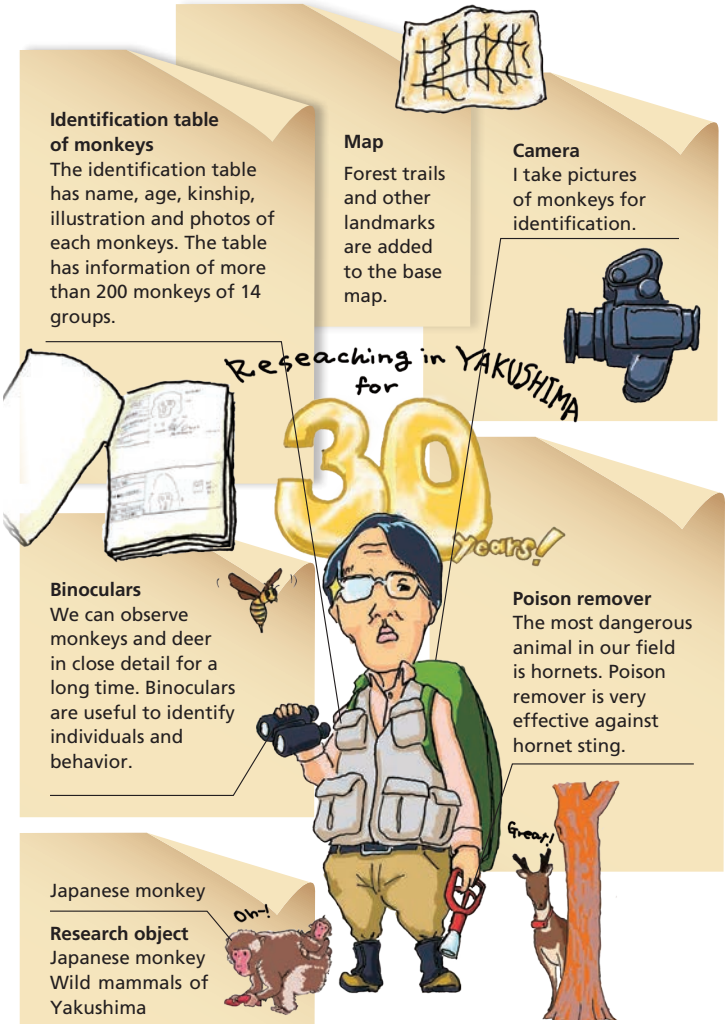
Use of a drone to record horse behaviors from the sky

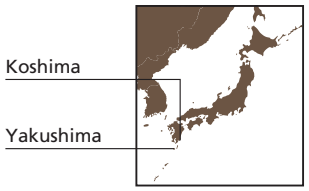
Introduction of PIs 4

Observation of Japanese monkeys to understand their behavior and ecology

Hideki SUGIURA

Keywords
long-term study (of wild monkeys), behavior, ecology, field station, education, eco-tourism





I study the behavior and ecology of Japanese monkeys, endemic species of Japan. Japanese monkeys have been studied since 1950's in the wild and are one of the longest-studied animals in the world. WRC has two field stations in long-term Japanese monkey study sites, Koshima and Yakushima. In these sites, we can observe monkey behavior in detail in the wild, which tells us how and why they present their behaviors. We can also observe where and how they live, which tells us about the important habitats and resources they need.

Observing monkeys in the long term, we can see that their number changes over the time. Such changes may be more rapid than we imagine, probably because their habit changes rapidly due to human influence. During long-term observation, we sometimes come across a rare event. For example, in an unusual food shortage, monkeys eat unexpected foods and range further than we normally see. In such severe conditions, we can learn about their potential to adapt to their environment. In other words, we can learn the extent to which natural conditions change and how animals respond to the changes.

Koshima Field Station: the first for primate observation

The Japanese monkeys in Koshima Islet have been studied since 1948, for more than 70 years. The Koshima Field Station was founded in 1967 by the Primate Research Institute, Kyoto University and was succeeded by WRC in 2008. At present,

Students observing Japanese monkeys at Koshima Islet

A female washing sweet potatoes on the shore of Koshima Islet (photo by T. Suzumura)

we have about 100 monkeys on the islet, and we have identified and named every individual for more than 50 years.

At Koshima Islet, we have had many important findings, especially in the early stages of primatology. An important and famous finding is "culture" in animals. A young female began a new behavior of washing potatoes. This unique behavior gradually spread into the other group members. This finding surprised the world, because people do not believe that animals learn things from the other individual or that they share a specific behavior in a group or populations. We can still watch the "potato washing", retained by this group for more than 60 years.

In Koshima Islet, we have provisioned food to the monkeys. Monkeys were habituated to human observers, and we can observe them closely. These conditions have allowed for some experimental studies. An example is a study of parasites of monkeys. Sarabian and MacIntosh (2015) displayed wheat in three ways: wheat on sand (the usual condition of provisioning), on a model of monkey feces, and on real feces. The subject monkey ate the food on the sand quickly, but she hesitated to eat the food even on model feces. In addition, she looked around and scratched her body, a typical behavior in a controversial situation. She wanted both to eat and to avoid the feces, indicating that the monkeys tend to avoid "dirty" things and thus displaying a sense of hygiene.

Provisioning is useful for observation; however, we also came to know its negative impact on wild animals. For example, it improved their nutrition to bring about a population expansion. Now we try to minimize such a negative impact. We allow our technical staff only to provide a regular amount of food to monkeys at regular intervals. We also reduce the overall amount of food we provide, watching the body condition and population parameters, carefully.

Koshima Islet is a very suitable place for education. We hold field practice courses for master's students every year. Students observe monkeys in their natural habitat and collect behavioral or ecological data. They also learn basic skills in the field, such as map reading and first-aid treatment. We also hold a course for citizens, in which people observe monkeys on the island and take a lecture on monkeys and nature. In addition to our own courses, we cooperate in the education programs of the local schools and universities, providing guidance and lectures.

Japanese monkeys in Yakushima. They often groom in cool places near the stream in summer

Japanese deer in Yakushima. The female in the left side is attached to a radio collar for location and individual identification

Yakushima Field Station: monkeys in the World Heritage forest

Since 1973, intensive study of wild Japanese monkeys started on Yakushima Island, by graduate students of Kyoto University. Yakushima Field Station was founded in 1988 by the Primate Research Institute, Kyoto University and was succeeded in 2008 by WRC.

Japanese monkeys in Yakushima have been studied without any provisioning. Students habituated monkeys to human observers and have succeeded in observing them at close distances in the forest. Various topics of behavior, ecology, and population genetics have been studied, mainly by young researchers.

The density of monkeys is quite high in the lowland forest of Yakushima, our main field site on the island. Monkey groups in this area are hostile to each other, probably because the competition for food resources is severe between groups. We sometimes see aggression when two groups encounter each other (Sugiura et al. 2000). Both groups face the opponent group, forming a line of monkeys in the front. When some monkeys rush to the front, the monkeys of the other group chase them away. Such interactions may continue for more than 30 minutes. In this study site, we have observed some groups go extinct. Some groups became very small in size and finally fused to the adjacent group (Sugiura et al. 2002). In contrast to the hostility against the other groups, monkeys appear relatively tolerant of their own group members. Group members stay close to each other, e.g., when they are grooming. They may need to make friendships within the group to fight together against the opponent group.

Field excursion for local residents in our study site in Yakushima

Other animals, such as Japanese deer and insects, as well as plant ecology, have been studied actively at this site.

Yakushima Island was designated as World Natural Heritage by UNESCO in 1993, the first time in Japan. Since then, eco-tourism has grown to be a major business on the island. Not only professional guides, but also local citizens have developed more interest in nature on the island. We launched a Society of Yakushimaology, meaning of the study of Yakushima, together with local people, local government and scientists. We have an annual meeting and publish an annual society journal. Currently, we are trying try to share traditional and scientific knowledge of Yakushima Island between local people, local schools, local organizations and scientists.

We visited an old village built in the mountain about 60 years ago as an excursion of the Society of Yakushimaology

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Conservative physiology in wildlife study:
Hormonal approaches to conserve endangered species

Introduction of PIs 6

Kodzue KINOSHITA

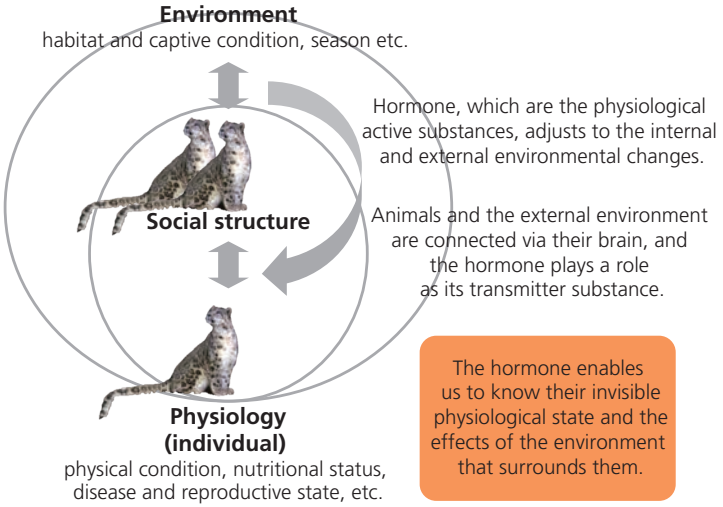
Keywords
reproduction, comparative physiology, non-invasive hormone assay

Thus far, behavior observations, camera trapping, genetic study, and other methods have provided abundant information on the ecology of many species. Although monitoring approaches using these techniques have estimated the diet and populations of species, few studies have focused on internal changes. Hormones, which are physiologically active substances, adjust to the internal and external environmental changes experienced by animals. Hormones enable us to know the invisible physiological states of animals and the effects of their surrounding environment. One such presumed response is the physiological "stress response".

Recently, stress has become a study focus in conservation biology. Animals experience two kinds of stress: acute stress, such as predator attacks that typically last only a short period of time, and chronic stress, such as long-term climate change and/or starvation that last a long period of time. Usually, stress can be monitored by the adrenocortical hormone concentration in scat, which we can obtain non-invasively from animals. However, in scat, hormones accu-

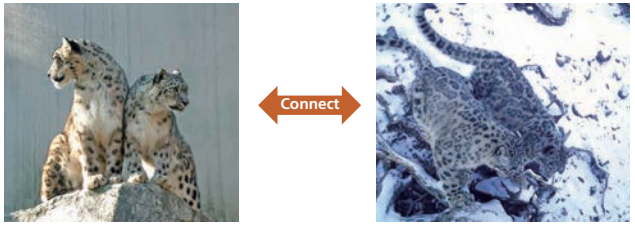
Scat of snow leopard

Role of hormones



The hormone enables us to know their invisible physiological state and the effects of the environment that surrounds them.

My research objective



Housing condition
(climate, social group etc.)

Habitat condition
(Habitat distraction, Human-conflict etc.)

Captive individuals who enable a high sampling frequency and provide fresh samples for valuable data collection.

Through hormonal analysis, I estimate the snow leopard's physiological state and the effects of the environment that surrounds them.

mulate until evacuation, and acute hormone elevations are masked. Hence, we mainly focus on chronic (prolonged), rather than acute stress in the hormonal study of wild animals.

Non-invasive hormone monitoring in captivity provides valuable data for wildlife study

Hormone research began in the 20th century. It has evolved from the research of laboratory animals to endangered animals in zoos, and it presents the opportunity to use noninvasive and indirect samples (ex. animal feces, urine, and hair). Such noninvasive analytical methods have been applied to wild animal research since the 21st century. However, hormone analysis is an analytical method that digitizes physiological phenomena invisible to the eye. Of course, studies to investigate the relationships of these data with visible changes, such as estrus behavior, pregnancy state and other morphological changes, do exist. But as mentioned above, hormones are physiological trace substances that regulate the internal environment. In hormone studies focusing on wild animals that are difficult to directly observe, it is extremely difficult to correctly examine what the obtained hormone values mean. Therefore, it is important to obtain information about the monitoring result in hormone concentrations in the study animal and to compare it with other results as much as possible. Furthermore, it is difficult to set a reference value for hormone analysis. For example, there are individual differences in stress level, and even if values deviate compared to other individuals, they are not necessarily abnormal values. To accurately evaluate the value, it is important to obtain information on how hormone concentrations change in captive individuals.

Captive individuals enable a high sampling frequency, and fresh samples provide valuable data. I have been collaborating with more than 8 Japanese zoos for a study on the physiological monitoring of snow leopard (*Panthera uncia*). For over five years, I have monitored in detail the stress level (cortisol) and the reproductive state (estrogen, progesterone, and testosterone) in captive snow leopards by fecal hormone analysis. My study suggests that the environment surrounding captive snow leopards (housing condition) can effect a change in their stress levels and that stress can suppress female estrus levels. From these results, I have confirmed that the measurement of fecal hormone concentration is a useful tool in estimating the physiological state of snow leopards.

Field site in Kyrgyz Republic (Shamshy Wildlife Sanctuary)

The challenge of hormonal analysis for wildlife conservation

An animal is connected to the external environment (e.g., social environment, habitat environment) via its brain, and hormones play an important role as transmitter substances. In other words, when the external environment changes, hormones are secreted to adjust the internal environment in response. Therefore, hormone analysis is a useful tool that enables researchers to know an animal's physiological state under various environments. Recently, I have tried to apply hormonal analysis to wildlife conservation by monitoring the stress level of wild snow leopards to estimate the conditions of their external environment.

Snow leopards inhabit highlands with rugged terrain in 12 Central Asian countries. In such places, it is thought that they have a wide home range, e.g. from 20 to 400 km^2 depending on prey density, and the density of snow leopard is estimated to be ca. 1 to 8 individuals per 100 km^2 (though, in fact, a basic understanding of their ecology remains unclear). As one of the supposed reasons for why they have such a wide home range, it is suggested that the diversity and abundance of prey animals are generally low due to the barren nature of most snow leopard habitat. In Kyrgyz Republic, it is estimated that snow leopards inhabit about 89,000 km^2 and that the population is around 300–350 individuals. This population estimate decreased from an earlier number of ca. 650 due to widespread poaching in the 1990s following the breakup of the Soviet Union.

The main threat to snow leopards is poaching, and the poaching of ungulates (i.e. argali and ibex) also indirectly contributes to lower snow leopard densities because these ungulates are their main prey animals. In some nature reserves and national parks of Kyrgyz Republic, the hunting of ungulates is limited and only allowed in assigned areas under a new hunting law established in 2014. Community-based hunting conservancies have aimed at rehabilitating ungulate populations through the regulation of subsistence hunts and trophy hunts. On the other hand, outside of nature reserves, hunting is ongoing, and there are concerns about its negative effect on snow leopards. For sustainable human activity (hunting), it is imperative to estimate the effects of the hunting of snow leopard prey animals on snow leopard conservation. As mentioned above, I have confirmed, based on results from captive snow leopards, that the measurement of fecal cortisol concentration is a useful tool to estimate stress level. Hence, I surmise that the method is also useful for monitoring the physiological state of wild snow leopards, and I have been collaborating with NPOs (The Snow Leopard Foundation in Kyrgyzstan and the Snow Leopard Trust) in this regard. This study will contribute to measuring the effect of established conservation plans and sustainable hunting activities.

Footprints of a snow leopard

Networking for the conservation and sustainable use of Ghanaian native livestock and wildlife

From Visiting Researchers I

Boniface Baboreka KAYANG

In April 2008 I had the opportunity to conduct research at the Wildlife Research Centre (WRC) of Kyoto University as a Japan Society for the Promotion of Science (JSPS) post-doctoral research fellow. In 2009, we signed our first MOU between WRC and my College at the University of Ghana and began research activities that attracted interested researchers from other universities within Japan to join the collaboration. The expanded network of collaborators made it possible to successfully execute a JICA-sponsored project called the "Ghana Grasscutter Project" aimed at enhancing livelihoods of poor rural farmers through grasscutter production. Because of our remarkable achievements and the tremendous support received from the leadership of both institutions in Japan and Ghana, the MOU was finally upgraded from Center-College level to Kyoto University-University of Ghana level in 2017.

Why is the conservation of Ghanaian wildlife and livestock needed?

Ghana has a population of about 28 million people that is growing at a rate of 2.5% per annum, and nearly half of the people depend directly on livestock for their livelihood. However, livestock products account for only 35% of the meat consumption as many people depend heavily on bushmeat. The rising hunting pressure and decline in original habitat, exacerbated by human population growth in settlements near forests, have triggered a continuous decrease in wildlife abundance and diversity. The hunting methods used include bush burning and poisonous baits which cause environmental degradation and wildlife destruction. Native livestock breeds are also disappearing. Though well-adapted to the local climate and feed and resistant to diseases and parasites, native breeds are characterized by low productivity, so farmers prefer to keep more productive exotic breeds to satisfy the demands of an ever-increasing population. If we can increase the efficiency and availability of native livestock, we can preserve our wildlife. In this regard, we are working on three promising livestock species notably grasscutter (*Thryonomys swinderianus*) and guinea fowl (*Numida melagris*), which are native to Ghana (and indeed West Africa), and local chicken (*Gallus gallus*). Although we have done some work to characterize the genetic diversity of Ghanaian local chicken and guinea fowl, in this presentation I will focus on the grasscutter.

Collaborative efforts to improve grasscutter production in Ghana

The grasscutter is a hystricomorph rodent that inhab-

Local chicken (*Gallus gallus*)

Guinea fowl (*Numida melagris*)

its mainly Sub-Saharan Africa and its meat is a delicacy among most people in this region, making it the highest consumed bushmeat. It is hunted in the wild using techniques that are sometimes detrimental to the environment. Due to its short history of domestication, a lot of research in the fields of genetics, nutrition, physiology, husbandry and health still needs to be carried out on this species in order to make it fully amenable to rearing in captivity.

In our research we developed microsatellite markers and SNPs. We then analyzed the genetic diversity of grasscutters from various agro-ecological zones of Ghana based on our microsatellites and mitochondrial D-loop sequences, finding the populations to be highly diverse. We also sequenced the digesta of wild grasscutters to determine the species composition of plants eaten in the wild and confirmed that Poaceae (grasses), which formed the major component of all digesta samples, was the most preferred diet of grasscutters. We are currently screening for possible pathogenic and probiotic bacteria in grasscutters as well as conducting genome sequencing to find loci for economic traits, such as tameness and litter size.

In 2014 we launched the Ghana Grasscutter Project titled, "Enhancing Livelihoods in Ghana through Improvement in Native Livestock Production", to promote domestication and rearing of grasscutter under the support of JICA. The concept of the project was that improving livestock production could be an alternative to wildlife consumption and would be useful for sustainable food production and natural resource management in the Upper-West Region, the poorest region of Ghana. Beneficiary farmers were supported with breeding grasscutters, cages and technical skills for rearing. By adopting the "pass-on the gift" approach, some offspring from successfully reproduced grasscutters were retrieved and given to new farmers. Livelihood surveys were conducted on selected households to ascertain the impact of the project and community schools were educated on the importance of good nutrition and environmental conservation. Through

Grasscutter (*Thryonomys swinderianus*)

workshops, farmers were equipped with skills for various methods of processing to enable them add value to their grasscutter meat product. In addition, basic research involving genotyping, grasscutter nutrition, and health was carried out with the participation of graduate students to build capacity for the future. Women were also empowered by giving them grasscutters to rear. Through this project, the number of grasscutters reared in this region increased from zero to over 300.

To ensure sustainability of the project beyond the JICA funding period, an NGO named **G**rasscutter **I**nitiative **f**or Rural **T**ransformation (GIfT) was established in 2016 to oversee critical aspects of the project. GIfT successfully won its first grant, awarded by Ajinomoto Foundation International Nutrition (AIN). The AIN project aims to improve livelihoods of resource-poor smallholder farmers through sustainable grasscutter rearing based on a three-fold benefit: 1) supply of readily available gamey meat to satisfy animal-source protein requirements of resource-poor rural households and curb malnutrition; 2) serve as a source of regular income; and 3) contribute to environmental and wildlife conservation through reduction in hunting. This project will further train and monitor more beneficiary farmers, continue offering education on balanced diet, conduct livelihood surveys, and sequence the grasscutter genome.

The next step of our project in Ghana

Our joint collaborative efforts have led to a successful uptake of grasscutter production in the Upper West region of Ghana. However, there is the need to expand to other communities. In the near future, a collaborative effort for comprehensive breeding programs for local livestock species, especially the grasscutter, will be necessary to increase animal protein supply. The author gratefully acknowledges Kyoto University for providing a congenial platform, as well as JSPS, JICA and Ajinomoto Foundation for the needed funding, to undertake this work.

Antimicrobial properties of Tanzania honey in relation to vegetation types

Victor Alexander Mwijage KAKENGI

Plate 1: Stinging (*Apis melifera*) (upper) and Stingless (*Trigona melaponini*) (lower) honeybees

Apis mellifera and *Trigona meliponini* (stinging and stingless honeybees) (Plate 1) provide ecosystem services by pollinating flowers of plants that eventually result in the food that we eat every day. Through this provisioning of ecosystem services, they gather plant nectar, then modify it, store it in the comb, and transform it into honey by the processes of regurgitation and evaporation.

For thousands of years (since 2100 BC), ancient Greeks used honey as a traditional food and healing agent.

Honeys contain carbohydrates, enzymes, hydromethyl furfurals (HMF), proteins, minerals, amino acids, vitamins and antioxidants, including phenolics and flavonoids. Its health benefit is associated with the presence of these valuable nutrients and phytochemicals.

Medical properties of Tanzanian honey

The overarching objective of this research was to determine the medicinal properties of Tanzanian honey collected in various areas with different vegetation types.

The sugar and water content of each honey was determined, and antimicrobial activities were tested using four pathogenic microorganisms, namely *Staphylococcus aureus*, *Salmonella typhi*, *Escherichia coli* and *Candida albicans*. Results showed that all honeys were acidic with pH

Plate 2: Microbial growth inhibition zone by Tanzania stinging honey collected from various areas

ranging from 4.05 to 4.8. Area, vegetation type, and their interactions significantly (df = 47, F = 454, P = 0.0001) affected the antimicrobial activities of honey. Gairo honey, made by bees who foraged on *A. digitata* and *A. malvaceae*, significantly inhibited the growth of both bacteria (*E. coli* 26.5mm, *S.aureus* 35.5mm and *S. typhi* 27.5mm) and fungus (*C. albicans* 30.5mm) (Plate 2).

Honey quality and composition depend on vegetation types

Similarly, honey from Manyoni (*Baphia massaiensis, Baphia burtu, Raphia pruinoides and pseudoprosopsis fischeri*), Morogoro (Eastern Arc forests), Kisarawe (*E. bicompacta*), Itigi (*Baphia massaiensis, Baphia burtu, Raphia pruinoides* and *pseudoprosopsis fischeri*), Dodoma (*Brachystegia spp., Julbernadia spp* and *Isoberlinia spp.*), and Dodoma (sunflower and *A. digitata*) resisted bacteria and fungus growth. It was concluded from the study that honey quality and composition highly depend on the vegetation type available in an area. Human activities that results in deforestation for any reason affect honey composition and quality.

The authors are very grateful to Kyoto University, through the Japanese Society for the Promotion of Science (JSPS), for financial support of the study. The cooperation of beekeepers and their permission to collect samples is exceptionally appreciated. Gratitude goes to Ms. Josephine Mapunda (NM-AIST) for excellent microbiology work and to Theodora Ngowi and Winni Makata for sample preparation.

Introduction of The Tanzania Wildlife Research Institute (TAWIRI)

The Tanzania Wildlife Research Institute (TAWIRI) has an overall responsibility of **CARRYING OUT**, **COORDINATING** and **SUPERVISING** wildlife research in Tanzania. The mission of the Institute is to conduct and oversee wildlife research in the country, provide quality data and information that will enable the management authorities and the Government to better manage and conserve wildlife, and to raise public awareness of the same. To fulfill its mission, TAWIRI collaborates with various institutions, both nationally and internationally. The Wildlife Research Centre (WRC) of Kyoto University in Japan is among the collaborating international institutes. In the course of collaboration, I had an opportunity to visit the WRC and conduct research for a period of 90 days.

Collaboration between India and Japan on wildlife research

Raman SUKUMAR

Dhole (Indian wild dog) (photo by Shuta SAWAGURI)

The collaboration between Kyoto University (KU), Japan, and the Indian Institute of Science (IISc), India, on wildlife research and training began in 2012 with funding from the Japan Society for the Promotion of Science (JSPS) and co-funding from various sources, especially the Ministry of the Environment and Forests, to IISc. The two main departments involved were the Wildlife Research Centre (WRC, KU) and the Centre for Ecological Sciences (CES, IISc). The major goal of the collaboration was to provide a platform for student exchange on field and laboratory research on large mammal ecology, behaviour and conservation.

While the Indian Institute of Science is India's oldest major research institution, established in 1909, the Centre for Ecological Sciences was established in 1983 as the first Centre of Excellence of the Ministry of Environment and Forests. Since then it has grown into a premier centre for high-quality research and teaching in the disciplines of ecology and evolution, encompassing diverse aspects of animal behaviour, tropical forest ecology, plant-animal interactions, molecular ecology, mathematical ecology, marine ecology, human ecology and climate change. The present strength of the centre is 12 academic faculty and over 60 doctoral students.

Students of IISc visit Kyoto University and the Yakushima Field Station

Over this period of seven years, 14 students from the Indian Institute of Science have visited Japan for training in field and laboratory methods at Kyoto University and its field site at Yakushima Island. They have described their experience as a good mixture of serious work and fun.

Highlights of the joint research

The research carried out by students from India and Japan under the joint programme has focussed on two wildlife species, the dhole (*Cuon alpinus*) and the Asian elephant (*Elephas maximus*).

Shuta Sawaguri was the first student to take advantage of this programme by conducting a study on vocalization of the dhole in the tropical dry forests of Mudumalai. Their calls could be divided into 13 call types, including the "Whistle" call, which has the highest sound pressure. When captive dholes hear the Whistle call, they point to the call direction and/or whistle back, but only to the Whistle calls from invisible pack members. In the observation of the wild animals in Mudumalai Tiger Reserve, whistle calls were only recorded when the pack stayed in the bush with poor visibility. These results suggest that the whistle call is a type of medium- to long-distance contact call among

The Asian elephant (*Elephas maximus*)

From Visiting Researchers 3

pack members.

Kaori Mizuno executed a short-term study on decision-making by elephant social groups in risky situations, carried out during road-crossings at Mudumalai National Park in India. This study found that experienced, older individuals (adult female elephants) entered the road first to protect and guide the less experienced subadult and juvenile individuals on busier roads with heavy traffic.

Nachiketha Sharma is pursuing work on characterizing various types of vocalization by Asian elephants and their possible behavioural context. The study mainly aims to understand short-distance communication in Asian elephants, with a special emphasis on the use and role of 'rumbles' (low-frequency sounds) among wild Asian elephants.

Additionally, we have been pursuing joint research on the genomics of Asian elephants with Dr. Takushi Kishida (KU) and Dr. Yoshihito Niimura (Tokyo University), with a special focus on understanding olfactory genes in elephants using whole genomic sequencing.

Annual meeting: a place to enhance partnerships

One of the most enjoyable aspects of the collaborative programme has been the annual symposium of all the partner countries (Japan, India, Malaysia, and Brazil initially, followed by the addition of Indonesia, China, Tanzania and the U.K.). The partners have taken turns in hosting the annual symposium. It has been a fantastic experience to visit the institutions and field research sites of the various partners and learn about their work and successes. At the same time, the personal friendships built among the principal investigators from the partner countries, as well as among the students who participated in the program, have enriched our lives immensely.

The meetings at Kyoto have invariably provided a rich cultural experience in this unique city. The visit to INPA at Manaus, Brazil, was accompanied by an unforgettable cruise along the mighty Amazon, sighting the botos (dolphins) and witnessing the confluence of the black and the white waters. In Malaysia, the trip to Taman Negara was a nostalgic reminder of my earlier visit to this great national park over three decades ago. Perhaps, the best was reserved for the once in a lifetime experience in Tanzania – spending an hour with the chimpanzees at Gombe, the site of Jane Goodall's pioneering research. I personally look forward to more engagements with the partners of this productive collaboration initiated by the Wildlife Research Centre of Kyoto University, and I wish the centre success and growth as it goes beyond the first decade of its establishment.