Kyoto University

Research Activities

Vol. 5 No. 1 June 2015

Special Feature

Kyoto University Facilities throughout Japan

京都大学

Research Activities

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Ashiu Forest Research Station's Office
➡ p. 6

Message from the President

Our Scholars Venture in All Japan

KYOTO UNIVERSITY RESEARCHERS are active in vast range of fields spanning the humanities and social sciences to science and engineering, and ranging from fundamental science to applied science. Various university facilities, established in different areas throughout Japan play an important role in supporting these diverse research and educational activities, serving as bases for unique research and field science projects.

Kyoto University currently has forty-three such research facilities throughout Japan, each of which is advancing unique research projects. In the stations affiliated with the Field Science Education and Research Center, scholars have been conducting climate and ecological research for many years in different forests and coastal areas spanning the entire Japanese archipelago. The Disaster Prevention Research Institute has volcano, seismological, and flood observatories in various locations. Through these facilities, it actively engages in international research collaboration and produces vital information as the country's only joint-use center for disaster prevention research. The Research Reactor Institute, located in Kumatori, Osaka, is acknowledged as one of the country's best research centers in the field of Boron Neutron Capture Therapy (BNCT), a promising contender for a next-generation cancer treatment method. The Primate Research Institute in Inuyama, Aichi Prefecture, which dates back to 1948 when Kinji Imanishi began his field research on wild Japanese monkeys, is renowned both in Japan and abroad for leading the world in this field of research.

This issue reports on some of the research achievements of the university's facilities nationwide. Although the projects featured represent only the tip of the iceberg, reading this issue will give you a good overview of the many creative research and innovative initiatives going on at our different facilities. As a regular reader of *Research Activities* myself, even I am sometimes surprised at the accomplishments of our researchers! I hope that all of our readers will also find some surprises in this issue. I hope that you will gain a sense of how diverse and fascinating our various facilities are, as well as a sense of the passion and inventiveness of the researchers working at them.

This brochure is a "window," through which you can take a peek at our university's research and researchers. If you find something of particular interest, please knock on our door. We always welcome new opportunities to develop our academic exchange and research collaboration.

June 2015

Juichi Yamagiwa
President, Kyoto University

MAP

University Establishments in Japan

In addition to its three campuses, Kyoto University operates a number of diverse facilities at various locations throughout Japan. Kyoto University is renowned for the rich achievements stemming from its diverse fieldwork endeavors, and each of its facilities is a unique and valuable resource for the activities of its researchers. WEB www.kyoto-u.ac.jp/en/about/profile/facilities/japan

Field Science Education and Research Center

Hokkaido Forest Research Station Shibecha Branch, Hokkaido ····· 1
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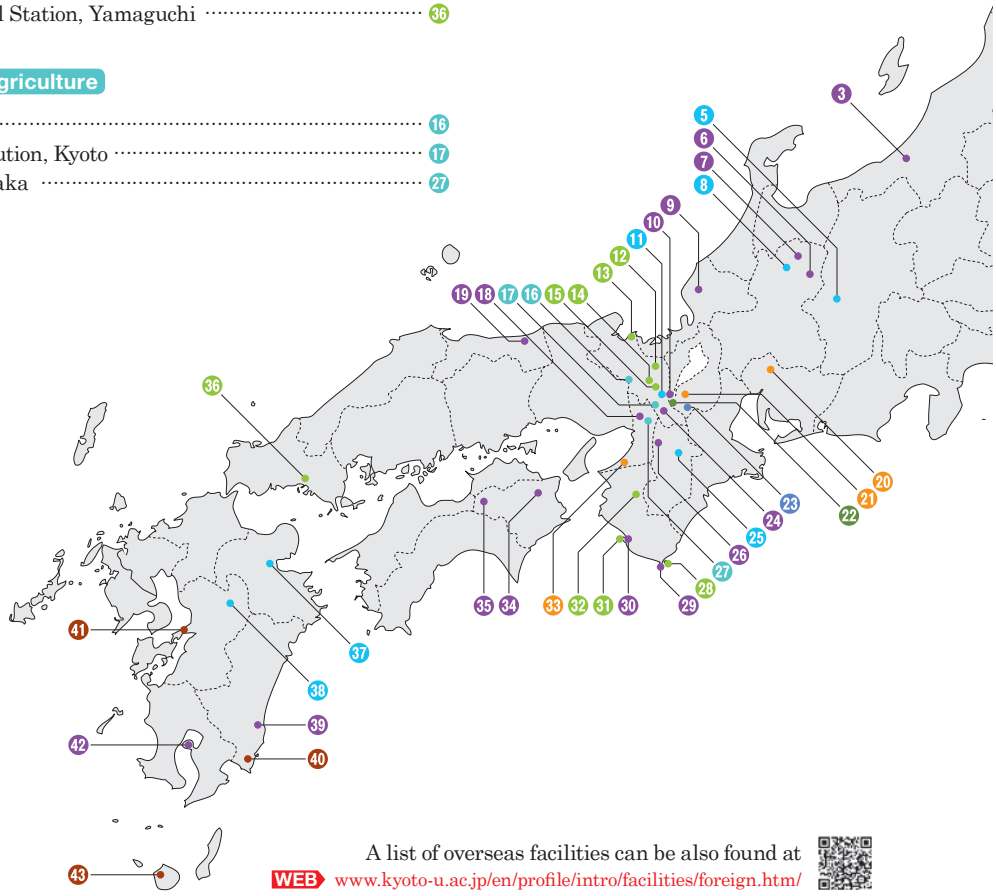
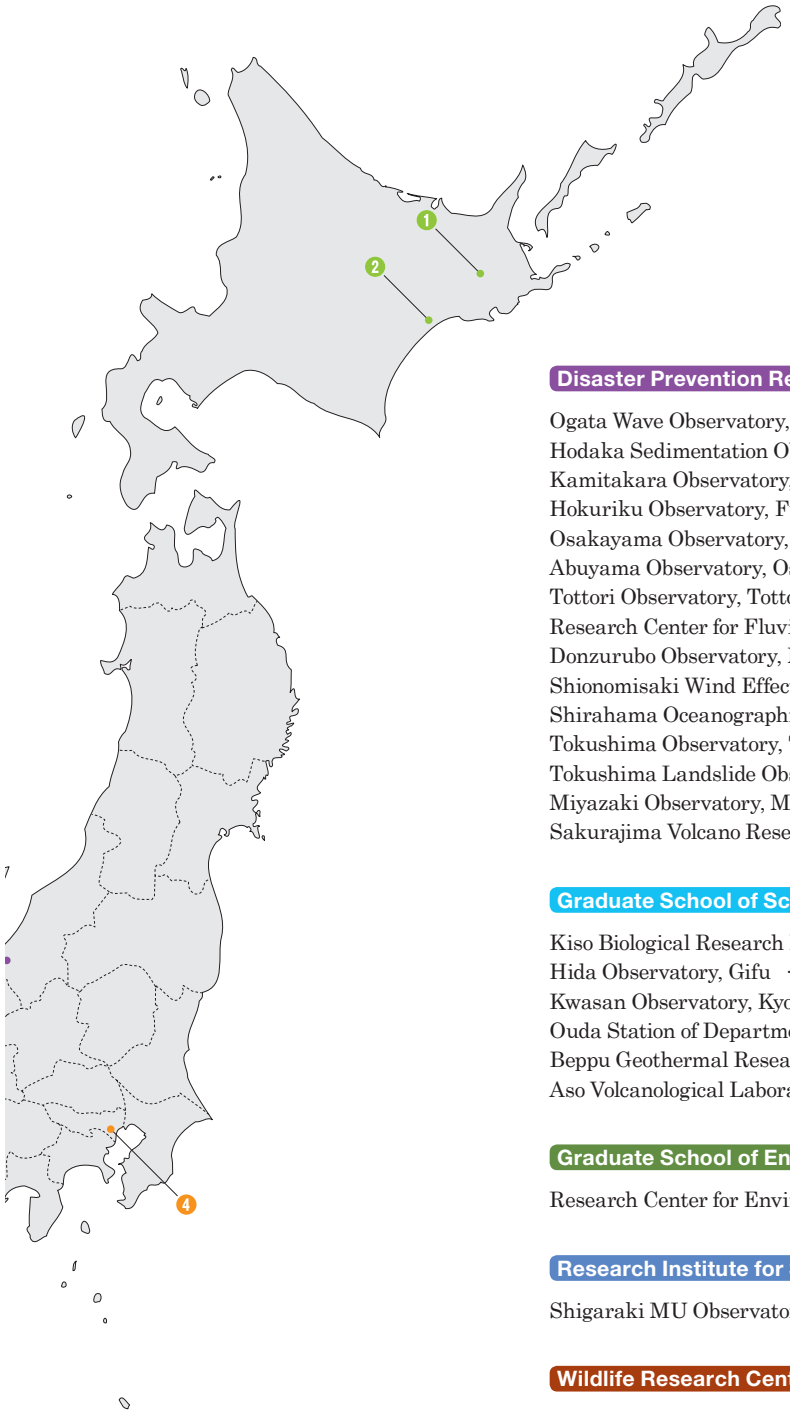


A list of overseas facilities can be also found at
WEB www.kyoto-u.ac.jp/en/profile/intro/facilities/foreign.htm/



Disaster Prevention Research Institute

Graduate School of Science

Graduate School of Engineering

Research Institute for Sustainable Humanosphere

Wildlife Research Center

Other

FEATURE

Ashiu Forest Research Station

The university field site with distinctive climatic, geological, and ecosystem features.


Hitsukura-dani valley

University Forest Research Stations provide an important field for studies and educations in forest and ecosystem science. Results obtained from these study areas can contribute to our understanding of the problems of climate change and environmental degradation facing modern society.
Kyoto University has four Forest Research Stations, one each in Kyoto, in Wakayama and two places in Hokkaido. Of these, Ashiu Forest Research Station, formerly called Ashiu University Forest, is the biggest and the oldest, dating back to 1921. Currently under the management of the Field Science Education and Research Center, Kyoto University, this forest is used by national and international researchers for its distinctive environmental features and biodiversity. Other visitors are also drawn to the beauty of the forest.

THE ASHIU Forest Research Station (AFRS ⑫), Field Science Education and Research Center (FSERC) preserves a wide area of natural forest, protecting it from human activities. AFRS is located in a boundary area with Shiga and Fukui Prefecture in the northeast part in Kyoto Prefecture. The Yura-gawa River, which flows into the Japan Sea, has its riverhead in this area. The administrative office of AFRS is in Ashiu village. Although this village is only approximately 35 km by the linear distance or a 2-hour drive, from the center of Kyoto City, it is surrounded by unpopulated land. Ashiu has high precipitation and humidity throughout the year, due to being under Pacific climate in the summer and the Japan Sea climate during the winter.

The AFRS has an area extending to approximately 4,200 hectares, with altitudes ranging from 355 to 959 m above the sea level. The administrative is located at the lowest point, and the highest point is the summit of Mt. Mikuni-dake, the third highest mountain in Kyoto Prefecture. Two-thirds of the area is at more than 600 m above the sea level.

Japan's Leading Diversity of Vegetation

The AFRS has a wide diversity of vegetation, because this area includes zones from warm-temperate to lower cool-temperate, and contains plants suitable to the Pacific climate and the Japan Sea climate. So far, around 240 species of woody plants (including subspecies), more than 530 species of herbaceous plants, and eighty five species of ferns have been identified.

Broad-leaved plants grow according to the vertical distribution of the forest. At altitudes up to 600 m above the sea level, this area is mainly warm-temperate deciduous forest, whereas the areas above 600 m above the sea level are primarily cool-temperate deciduous forest dominated by Buna: Siebold's Beech (*Fagus crenata*) and Mizunara


Trunk of Siebold's Beech

1) Ashiu-sugi is famous for its asexual reproduction mechanism whereby a root originates from the tip of the branch that eventually touches the ground (e.g., branches drooped by the weight of snow or branches of a tree blown down by a storm). According to *Genshoku Nihon Jumoku Zukan*, edited by Shiro Kitamura and Shogo Okamoto (Osaka: Hoikusha Pub. Co., Ltd., 1959), Ashiu-sugi is a Japanese cedar variant, and its taxonomic name is attributed to Dr. Takenoshin Nakai.

(*Quercus mongolica* var. *grosseserrata*). Cool-temperate deciduous forest, which occupies a major part of AFRS, is dominated by Ashiu-sugi (*Cryptomeria japonica* var. *radicans*)[1], a variety of Sugi: Japanese Red Cedar specific to the Japan Sea side.

Among herbs and ferns, Zenteika (*Hemerocallis dumortieri*), Ashiu-tennanshō (*Arisaema robustum* var. *ovale*), and Ryūkinka: Marsh-Marigold (*Caltha palustris* var. *nipponica*) should be noted for geographic distribution and scientific interest. Ashiu is believed to be the southern limit for Zenteika, a relict. The other two species are sparse and localized in a narrow range of distribution. In addition, Hime-komayumi (*Euonymus alatus* var. *microphyllus*), a species distributed in a very limited area, has also been found in the AFRS.

Animal Inhabitants of the Forest

Thanks to the rich flora, a various of animals inhabit the AFRS, with many of the large animals living in Honshu having been found there. In addition, Kurohōhigekōmori: Frosted Myotis (*Myotis mystacinus*), Mizuramogura (*Euroscaptor mizura*), and other endangered or valuable species have been identified.

To date, 111 species of birds belonging to thirty three families have been documented, including Kumataka: Japanese Hawk-Eagle (*Spizaetus nipalensis orientalis*) and Ōtaka: Japanese Goshawk (*Accipiter gentilis fujiyama*). For reptiles and amphibians, Ōsanshōuo (*Megalobatrachus japonicus*), a nationally protected rare species, was detected at the waterhead of the Yura-gawa River, as well as Hida-sanshōuo (*Hynobius naevius kimurae*), Moriaogaeru (*Rhacophorus arboreus*), and Kajikagaeru (*Rhacophorus buergeri*). Shiromadara (*Dinodon orientalis*), arguably the most beautiful among snakes native to Japan, has also been reported.

The AFRS is also rich in small animals including Gunbaitonbo (*Platycnemis foliacea sasakii*) and Moiwasanae (*Davidius moiwanus*) dragonflies, and Gifuchō (*Luehdorfia japonica*), Hisamatsu-midori-shizimi (*Chrysozephyrus hisamatsusanus*), and Ōmurasaki (*Sasakia charonda*) butterflies. Some of these are rare in other parts of Kyoto. Ants of both southern origin and northern origin have been observed, including rare species, such as Kebukatsuyaoari (*Camponotus nipponensis*). Many rare and precious Long-horned beetle species have also been observed in the AFRS.

Four Seasons

Along with Ashiu's rich diversity of species, some of which were mentioned above, the rotation of the four seasons contributes to the beauty of the scenery.

Early April every year, when the remnant snow patches start to disappear around the administration office, the AFRS hosts a ceremony to mark the first day of entering the mountains that had been locked with snow during the winter. In this ceremony, staff members pray for safety during their activities in the coming season. While the hilltops are still covered with snow, ridges show a terrain of snow-free land, due to the power of the sunlight. Snow starts to melt around the roots of trees and exposed rocks. Mountain streams, though covered with a thick layer of snow, carry forth gushing icy water, powerfully melting the frozen snow.

As the snow starts to retreat, flowers begin to bloom. Although many mountain flowers may seem unspectacular from afar, they are neat and appealing on a close look. In early spring, Tamushiba: Willow-leafed Magnolia (*Magnolia salicifolia*) displays white flowers around the ridges against a backdrop of needle-leaved trees such as Asiu-sugi, Momi: Momi Fir (*Abies firma*), Tsuga: Japanese Hemlock (*Tsuga sieboldii*), Hinoki: Hinoki Cypress (*Chamaecyparis obtusa*), and Akamatsu: Japanese Red Pine (*Pinus densiflora*), and evergreen broad-leaved trees such as Urazirogashi (*Quercus salicina*). Pretty yellow flowers belonging to Dankōbai (*Lindera obtusiloba*), Maruba-mansaku (*Hamamelis japonica* var. *obtusata*), and Kibushi (*Stachyurus praecox*) appear as well. Kinki-mamezakura (*Prunus incise*) produces pretty pinkish flowers, waiting to catch the eye of the careful observer. As the snow melts and disappears from the ground, San'in-shirokanesō (*Isopyrum nipponicum*), Nekonomesō: some species of genus *Chrysosplenium*, Iwanashi (*Parapyrola asiatica*), Iwauchiwa (*Shortia uniflora*), Ōiwakagami (*Shortia soldanelloides* var. *magna*), Miyama-kikeman (*Corydalis pallida* var. *tenuis*), Hime-enkogusa (*Corydalis lineariloba* var. *capillaris*), and many different species of Violet (genus *Viola*).

Siebold's Beech is among the trees with the earliest flush of new leaves in the spring. Its yellow-green leaves delight the observer. One may argue that early spring is the most colorful and vivid period within the year in the AFRS. Many species of Kaede: Maple (genus *Acer*), Shide: Hornbeam (genus *Carpinus*) and Nara: deciduous Oak (genus *Quercus*), and Katsura:

About the Cover

Ashiu Forest Research Station's Office

The cover of this issue features one of the most distinctive buildings of Kyoto University's Ashiu Forest Research Station. Located close to its entrance, the building is currently used as the station's office. It was originally built as a research laboratory in 1931, and a small railway starting in front of the office and leading into the forest serves as a popular hiking course.

Painter: **Kiyoko Yamaguchi, PhD**
Alumnae of Kyoto University kiyoko-yamaguchi.com/


Tochinoki


Nameko (*Pholiota microspora*)

Katsura tree (*Cercidiphyllum japonicum*) complete flushing of new leaves by early May, following Siebold's Beech. In mid May, Shakunage (*Rhododendron japonoheptamerum*) start to bloom along streams, and the mountains gradually turn a lush deep green.

The arrival of May heralds the beginning of full-blown research season with increasing numbers of researchers visiting the AFRS. Towards the end of autumn, undergraduate and postgraduate students of Kyoto University stay for days in the AFRS to participate in field training and education. Many former students have spoken of the experience as an unforgettable memory long after leaving school. During this lively period of the year, AFRS attracts a large number of visitors who participate in a variety of activities, such as field training programs for students from other colleges, extension courses for public audiences, open days for local families, and seminars and field tours for the private sector.

After the termination of the college field training programs, the atmosphere gradually becomes quiet, and the leaves of Tochinoki: Japanese Horse Chestnut (*Aesculus turbinata*) start to color. Autumn leaf color reaches the peak at the end of October. People driving along the hilly road may feel dazzled by the wide spectrum of colors from different types of trees, causing excessive visual stimulation. Those on foot may be able to enjoy the autumn leaf colors in a more relaxed manner. In the autumn, the forest provides a significant amount of fungi and other edible natural foods, such as Kuri: Japanese Chestnut (*Castanea crenata*) and Onigurumi: Japanese Walnut (*Juglans mandshurica*). Local people collect Japanese horse chestnuts and use them to make a type of rice cake called tochi-mochi through the painstaking process of removing their bitterness by drying, grinding, and rinsing them with running water for several days, before mixing them with mochigome, a short grained japonica glutinous rice. The bitter taste of Horse chestnut is specific to regional traditional slow food.

As December settles in, Ashiu sees the first snowfall, a sign to wrap up the mountain work of the year. During winter, the snow is generally one meter high at the administrative office, and two to three meters high at high altitude places. The AFRS remains locked under snow until early April.

Global Warming and Damage by Animal

Global warming is influencing the conditions of the AFRS, as for other forests worldwide. The mean annual temperatures in Ashiu were in the range of 11.0 to 11.3°C in the 70s and 80s, but rose to 12.7°C in the 90s. A 100-m difference in altitude is equivalent to a difference of 0.5 to 0.6°C in temperature. Therefore, a temperature increase of 1.5 to 2.0°C is equivalent to an elevation of 300 or more meters in altitude. The habitat of Siebold's Beech is currently located at altitudes of 600 meters and above. However, if the current trend in rising temperatures continues, Siebold's Beech will only grow at altitudes exceeding 900 meters a decade from now, and the proportion of Japanese beech forest in the AFRS will decrease sharply from the current level of


Winter season of the AFRS

80% to 1%. In fact, recently, large dead Siebold's Beech trees have been frequently observed, although the cause of the death remains unknown.

In addition to the long-standing problem of Tukinowaguma: Asian black bear (*Ursus thibetanus*) stripping the bark of Ashiu-sugi, Sika (*Cervus nippon*) have caused severe damage to Sasa: Banboo grass (*Sasa kurilensis*), Haiinugaya (*Cephalotaxus Harringtonia* var. *nana*) and other understory vegetation since mid-1990s. From around 2000, mass mortality of Mizunara trees was occasionally noted, which was attributable to a pathogenic fungus (*Raffaelea quercivora*) vectored by Kashinonagakikuimushi (*Platypus quercivorus*).

AFRS Activities Shift With Social Needs

Since its inception in 1921, the AFRS has supported research in a wide range of scientific areas including plant and animal ecology and taxonomy, forestry and forest science, meteorology, and geography. Noteworthy early works include the publication of the *University Forest Outline* (1928), which presented the results of investigation carried out to provide a basis for subsequent management of this area. This report provided detailed data on stand quality and growing stock of the entire field, and is an important asset in simulating the course of development of this natural forest. Dr. Tomitaro Toyama, former research associate who stationed at the site from 1934 to 1944, published his research on the genetic profiles of Ashiu-sugi. His work triggered a stream of study on the distribution of cedar in Japan.

In recent years, research on the plant damage caused by Sika and its prevention gradually increased in volume due to the reasons mentioned above. Ongoing projects include the large-scale and long-term study of the dynamics of natural forest tree species that was initiated in the 1990s and the monitoring study of acid rain and other environmental pollutants, a joint research project with other experimental forests across Japan.

◆

Two academic and twelve administrative staff members are routinely stationed at the AFRS for forest research, management, and conservation. In 2014, 1,808 and 2,149 individuals (faculty and students) visited for research and education purposes, respectively, in addition to 7,045 visitors for non-research purposes. One of Japan's early leading taxonomists, Dr. Takenoshin Nakai[2)] praised the AFRS, saying that "Ashiu Experimental Forest (now, AFRS) is a must visit for every botany student" in 1941. More than seventy years after this remark, the AFRS continues to attract the attention of domestic and international scientists and the general public.

(This article was prepared by the Editorial Department of *Research Activities* based on the interview with Assoc. Prof. Makoto Ando. Most picture in this article are presented by Dr. Hiroyuki Watanabe, Prof. Emeritus of Kyoto University)

From the Editor AFRS has a lodging facility that can accommodate a maximum of forty four visitors. The research station also has a Museum, with displays explaining the vegetation, geography, and climate of this area, along with a collection of Asian black bear, Japanese serow (*Capricornis crispus*), and other large-scale animals. AFRS is a fascinating place to visit for anyone interested in Japan's forest environment.

WEB fserc.kyoto-u.ac.jp/asiu/ (AFRS web site, Japanese only)

2) Takenoshin Nakai (1882-1952), plant taxonomist and former professor at Tokyo Imperial University, served as the director at the Koishikawa Botanical Garden (Tokyo, Japan), the Bogor Botanic Garden (Bogor, Indonesia), and the National Museum of Nature and Science (Tokyo, Japan).

POINTS OF INTEREST 1

Historic Photograph Database of Kyoto University's Forest Research Stations

Kyoto University's Field Science Education and Research Center manages a database of historic photographs including pictures of the Ashiu Forest Research Station (see Link 1), Kitashirakawa Experimental Station, Kamigamo Experimental Station, and the former Karafuto Experimental Forest Station (see Link 2). Another university database, the Kyoto University Digital Archive System (KUDAS) holds various historic photographs and 16-mm film footage, including experimental forests in Taiwan, Korea, and Karafuto (now, Sakhalin) that the university owned prior to 1945 (see Link 3: Kyoto University Forests Collection, 1928-1986). By accessing these two databases online, users can browse through many historic images of the university's earlier days.

The Ashiu Forest Research Station in 1951

LINK 1 fserc.kyoto-u.ac.jp/zp/archive/asiu1950/ LINK 2 fserc.kyoto-u.ac.jp/zp/archive/ LINK 3 das.rra.museum.kyoto-u.ac.jp

Feature

Fish Collection and Ichthyology at Kyoto University

For more than half-century, Maizuru Fisheries Research Station have obtained and kept enormous specimens.

Fig.1 Dr. Kiyomatsu Matsubara (second right) and his students.

The first registration book of the FAKU collection, started by Dr. Matsubara.

The Scientific collections of museums are important resources for the study of natural history, including taxonomy and phylogenetics. Kyoto University holds more than 300,000 fish specimens, the second largest fish collection in Japan. The collection is housed at both the Maizuru Fisheries Research Station ⑬, Field Science Education and Research Center (FSERC) and the Kyoto University Museum and has significantly contributed to the study of the world's fishes (ichthyology). Because of the high quality and quantity of the fish collection of Kyoto University, many research biologists come from various countries to examine the specimens. During the last decade, for example, we hosted biologists from Australia, China, France, Korea, Russia, Thailand, and the USA, as well as from Japan. We also lend many specimens to interested biologists for taxonomic and phylogenetic study. There are currently over 1,000 specimens on loan. Over twenty scientific papers are published every year on the basis of Kyoto University's fish collection.

The collection can be traced back to 1947, when Professor Kiyomatsu Matsubara (1906-1968: Fig. 1) was posted to Kyoto University. Matsubara was a pioneer in phylogenetic studies of the fishes. In his doctoral thesis "Studies on the scorpaenoid fishes of Japan. Anatomy, phylogeny and taxonomy," Matsubara presented a phylogenetic tree on the basis of an extremely thorough analysis of skeletal and other characteristics. The work is acknowledged as pioneering model of systematic analysis. Although it was published in 1943, it is still referred to in many recent systematic studies of scorpaenoid fishes (scorpionfishes or rockfishes). Throughout his career, Matsubara studied not only scorpaenoid fish, but also various other kinds of fish. His remarkably broad knowledge of ichthyology was comprehensively summarized in "Fish Morphology and Hierarchy" published in 1955, covering most of

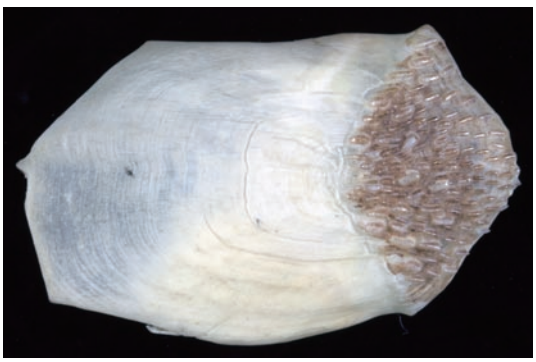


Fig. 2 The first coelacanth specimen scale what donated by Dr. James L. B. Smith.

Fig. 3 The main building of the Department of Fisheries, formerly utilized by the Imperial Japanese Navy. Photograph taken in 1957. The building was demolished in 2003.

the Japanese fishes known at that time. He provided keys to the identification of families, genera, and species, and comparative morphology and phylogeny of representative families. The book contains over 1,600 pages and 530 figures, and is the work of Matsubara alone. The work established him as legend in the field of ichthyology.

Matsubara started his professional career in 1929 in Imperial Fisheries Institute (now, Tokyo University of Marine Science and Technology). In that year, a famous world-leading ichthyologist, Carl L. Hubbs (University of Michigan), visited Japan to collect fishes, and Matsubara was chosen by the Institute to serve as his assistant. The field trip collecting fishes with Hubbs was a significant development in Matsubara's career in ichthyology. Despite the advent of World War II from 1939 to 1945, the relationship between the two scientists lasted until Matsubara passed away in 1968. Although Matsubara's doctoral thesis was published during WWII, it was written in English, and it was sent to Hubbs on 8 October 1946, soon after the war ended. In Matsubara's obituary, Hubbs wrote, "I have always regarded him as one of my outstanding students, and he has publicly acknowledged me as his teacher."

Matsubara had good relationships with several ichthyologists around the world before and after WW II. Albert W. C. T. Herre, a professor at the University of Washington, and Hubbs always supported Matsubara in obtaining literature about fishes from all over the world. In the study of taxonomy, literature, including descriptions of new species, is very important, but the bulk of such works were published in Europe and the USA in the 18th to early 19th centuries, and were difficult to obtain in Japan at that time. During WW II, Matsubara put his collection of academic literature in wooden boxes and buried them in his garden in order to protect them from fire bombs. After WW II, James L. B. Smith, a famous South African ichthyologist who discovered the coelacanth species, also donated literature to Matsubara. Those works have been very valuable to Japanese ichthyologists. They are currently held by the library of the Faculty of Agriculture (see the column, p. 17), to the supporting the taxonomic study of fishes at Kyoto University. Together with the academic literature, Smith gave Matsubara a scale from the first coelacanth specimen found off the east coast of South Africa in 1938 (Fig. 2). The scale is now preserved at the Maizuru Fisheries Research Station.

In July 1947, when Matsubara was transferred to Kyoto University's Faculty of Agriculture, he took his fish collection with him and started to expand it under the acronym FAKU (Faculty of Agriculture, Kyoto University). The Faculty of Agriculture, established the Department of Fisheries in 1947, in order to contribute to overcoming the post-war food shortage. The Department of Fisheries was established in Maizuru, 60 km northwest of central Kyoto City, in buildings that were formerly used by the Imperial Japanese Navy

Kiyomatsu Matsubara (1907–1968): Graduated from the Imperial Fisheries Institute in 1929. Dr. Matsubara was the first professor of the Department of Fisheries of Kyoto University, and served as a professor of the Faculty of Agriculture for twenty years. He made distinguished contributions to the early stages of ichthyology, and was elected an honorary member of the American Society of Ichthyologists and Herpetologists.

Fig. 4 Aquatic Natural History Museum at the Maizuru Fisheries Research Station (left) and the Collection room (right)

(Fig. 3). Although the research situation at that time was not favorable, Matsubara and his students took part in many trips throughout Japan, collecting fish and expanding the university's fish collection.

It is said that Matsubara's enthusiasm for study was astonishing. He always brought two lunchboxes in order to work until late at night, always dashed down the hall to increase efficiency by saving time, and would not notice a phone ringing when he was busy preparing a manuscript. He was also known as a great educator. He inspired many students in their studies of ichthyology, and his academic traditions were carried to Hokkaido University, Kinki University, Kochi University, Miyazaki University, and the University of the Ryukyus (collection now transferred to the Okinawa Churashima Foundation): to this day, each of those institutions contains an excellent collection of fishes under the acronyms, HUMZ, KUN, BSKU, MUFS, and URM, respectively. A second generation of students, taught by Matsubara's students, have also carried on his tradition in various universities and public museums, and many of the major streams of ichthyology in Japan can be traced back to Matsubara.

One student of Matsubara, Dr. Izumi Nakamura, was succeeded as curator of the FAKU. Because he was a specialist in the taxonomy and phylogenetics of tuna and billfish, Nakamura participated in numerous research surveys by Japanese vessels chartered by the Fisheries Agency of Japan. Thanks to Nakamura, specimens collected in distant countries, including Argentina, Chile, New Zealand, and South Africa, were added to the collection. Some of the specimens were taken from waters in which trawling by foreign research vessels is no longer allowed due to sea conservation laws, and they are therefore very valuable. In 1972, the Department of Fisheries was moved to the main campus of Kyoto University and the Maizuru Campus became the Maizuru Fisheries Research Station, a research facility of the Faculty of Agriculture. In 1984, a new building, containing two large collection rooms, was built in the Maizuru Fisheries Research Station (Aquatic Natural History Museum: left of Fig. 4). The fish specimens were then sorted by species, put into bottles, and arranged systematically on shelves, making the access to specimens easy (right of Fig. 4).

When Nakamura retired as curator of the FAKU and was replaced by the author in 2004, the faculty had begun collecting tissue for genetic analysis. Because the majority of the specimens at Kyoto University have been kept in formalin for a long time, they are not suitable for DNA analysis using current techniques. The tissue collection is a library of small tissue samples taken from fish before the fixation in formalin. The tissues are stored in alcohol and used for population genetic study, molecular phylogenetics, and "DNA barcoding." DNA barcoding is a taxonomic method that uses a short genetic marker in order to identify it as belonging to a particular species. Now, many DNA barcodes of fishes developed using the FAKU collection have been

Fig. 5 Main building of the Misaki Marine Biological Institute. Photograph taken in 1958.

Fig. 6 A rockfish, *Sebastes kiyomatsui* (Kai and Nakabo, 2004) (left) and its closely related species, *Sebastes scythropus* (Jordan and Snyder, 1900) (right). The former was named after Dr. Kiyomatsu Matsubara by the author and Dr. Tetsuji Nakabo, both inheriting Matsubara's tradition. The two species were considered to be color variations within a single species by Dr. Matsubara, but our research team found clear distinctions by genetic and morphological analyses.

deposited at the DNA Data Bank of Japan (DDBJ), GenBank of USA, and European Molecular Biology Laboratory (EMBL).

In 1997, the Kyoto University Museum was newly established on the main campus of Kyoto University. The museum holds historical materials relating to natural, cultural, and technological history. Since the Department of Fisheries was moved to the main building of the Faculty of Agriculture in 1972, the fish collection has also been established there under the same acronym, FAKU, as the Maizuru Fisheries Research Station. The fish collection in the Faculty of Agriculture was moved to the Kyoto University Museum in 2001, when the new museum building was constructed. The fish collection in the Kyoto University Museum was managed by Prof. Tetsuji Nakabo until his retirement in March 2015. The museum has an excellent collection of fishes of the East China Sea. Now, specimens catalogued as FAKU 60000-100000 and FAKU 200000 or later, and FAKU P series are deposited in the Kyoto University Museum, and other specimens are in the Maizuru Fisheries Research Station.

Small, but important fish collections are also housed in Kyoto University. Seto Marine Biological Laboratory 31, which is located in Shirahama, Wakayama, was a research facility of the Faculty of Science, which is now merged into the Field Science Education and Research Center. The laboratory had a fish collection under the acronym "SMBL." The collection of SMBL was developed by Assistant Prof. Chuichi Araga, and mainly contained specimens collected from southern Japan. Now the most of the fish specimens of SMBL have been transferred to FAKU. Otsu Hydrobiological Station (OHS) of the the Faculty of Science (now, re-established as the Center for Ecological Research 21) also holds a small collection of freshwater fishes, mostly collected from all over Japan, Korea, Taiwan, and mainland China. A large part of this collection was built by Drs. Denzaburo Miyadi and Tamezo Mori before WWII, making it the oldest fish collection in Kyoto University. The oldest specimens were collected

A postdoctoral research biologist at FAKU investigating an oarfish, *Regalecus russelii*. The oarfish is a very rare species, but FAKU has one of the largest collections of oarfish in the world, containing over twenty specimens. Accordingly, many biologists come from various countries to examine the oarfish specimens.

Prince Akishinonomiya Fumihito and Princess Akishinonomiya Kiko visited the Maizuru Fisheries Research Station on 24 July 2014. At the research station, they viewed the aquaculture building (photo) and the collection room of FAKU, particularly the goby specimens. Prince Fumihito's father, Emperor Akihito, is a famous goby taxonomist. In a recent research project, the Prince and the Emperor collaborated on a paper, titled "Evolution of the Pacific and the Sea of Japan populations of the two gobiid species, *Pterogobius elapoides* and *Pterogobius zonoleucus*, based on morphological and molecular analyses," published in *Gene* **427**(2008):7-18, doi:10.1016/j.gene.2008.09.026.

in 1910, but are still preserved in good condition. This collection was also transferred to the Kyoto University Museum in 2001, when its new building was constructed. Misaki Marine Biological Institute (note: as distinct from Misaki Marine Biological Station of the University of Tokyo) was established on 20 March 1958 under the sponsorship of the Nankai Electronic Railway (Fig. 5). The institute was located in Misaki-Koen, in southern Osaka, and housed a small fish collection under the acronym MIKU. Although no detailed records or documents concerning the MIKU fish collection exist, it contained the specimens collected during the Amami (Kagoshima) Expedition undertaken in 1958 by Matsubara and his colleagues. After the death of Matsubara in 1968, the institute seems to have closed around 1970. Due to student activism at that time, the transfer of specimens was difficult. Unfortunately, most of the MIKU specimens have been lost, but some were transferred to FAKU by Prof. Tamotsu Iwai, who later became the director of the Faculty of Agriculture.

These scientific collections serve as important sources of "raw" biological data for biologists and educators. In particular, voucher specimens in museums are the basis for zoological nomenclature, and provide the foundation for assigning new scientific names. Furthermore, the utility and value of collections to the scientific community has increased owing to the recent development of bioinformatics and new technologies, such as stable isotope analyses, massive parallel sequencing, and CT-scan tomography. Bioinformatics at the global level educes the potential value of scientific collections for future research in fields such as biodiversity, extinction, invasive species, and climate change. Next Generation DNA Sequencers (NGS) will enable to determine the sequences of historical specimens, which are not suitable for traditional sequencing because of the fragmentation of their DNA (Fig. 6). The fish collection of Kyoto University and its associated data have diverse histories and benefit a wide variety of scientific studies. They often serve as the basis for the successful management and conservation of populations, species, and ecosystems, and are expected to do so well into the future.

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WEB www.maizuru.marine.kais.kyoto-u.ac.jp/en/

POINTS OF INTEREST 2

Matsubara's Collection

Special collection of academic literature.

Academic works collected by Dr. Matsubara for his research on ichthyology taxonomy, including literatures given by Dr. J. L. B. Smith, are currently stored in the library of the Faculty of Agriculture. Please access the following library website if you would like to know more details.

WEB www.agril.kais.kyoto-u.ac.jp/guide/index-e.html#search

Facilities are Enhancing Research Quality

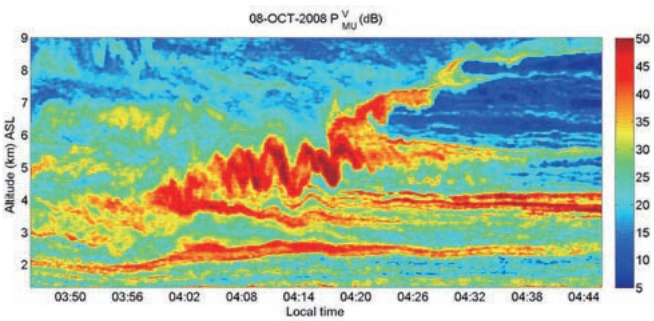
One of the key elements of the internationally lauded accomplishments of our researchers is the university's state-of-the-art laboratories and research facilities.

Meteorology

MU Radar Observations Atmospheric Turbulence 23

In collaboration with a French research group, we conducted an extensive study on the small-scale dynamics of the lower atmosphere. The study aims to characterize atmospheric turbulence, its sources and its interactions with large-scale dynamics and clouds by means of remote sensing and in situ observations.

The Middle and Upper atmosphere (MU) radar of the Research Institute for Sustainable Humanosphere (RISH) is one of the most suitable instruments for detecting turbulence and stable interfaces throughout the entire troposphere at any time, irrespective of clear or cloudy conditions. In turbulence observations, excellent spatial and temporal resolutions can be achieved through a range-imaging technique using frequency diversity.



In recent years, all the measurement campaigns have involved the MU radar in range-imaging mode with complementary instruments (e.g. radiosondes, Rayleigh-Mie lidars, ultra high frequency [UHF] and meteorological radars) for validating the technique in turbulence studies. The bottom figure shows an example of a time-height cross section of echo power obtained using the MU radar in range-imaging mode on 8 October 2008. We found Kelvin-Helmholtz (KH) braided-like structures along the slope of a cloud base gradually rising with time at an altitude of approximately 5 km, and vertical air motion oscillations exceeding ±3 m/s with a period of approximately 3 min above and below the cloud base.

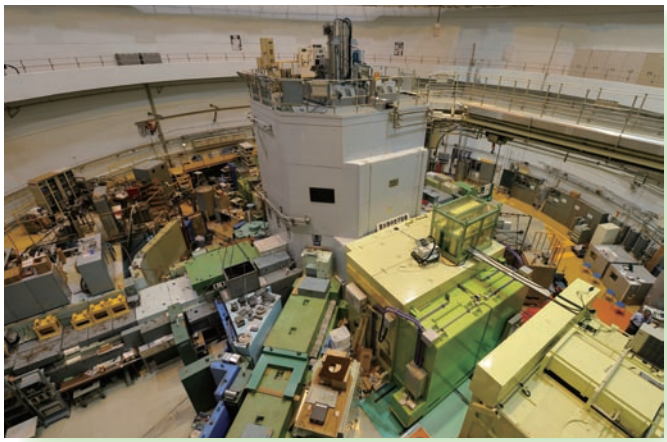
From the Editor The MU radar has been presented with an IEEE Milestone by the Institute of Electrical and Electronics Engineers (IEEE), the world's largest academic society. The award ceremony took place on 13 May 2015 at Kyoto University.

Author: **Hiroyuki Hashiguchi, PhD**
Associate Professor, Research Institute for Sustainable Humanosphere
WEB www.rish.kyoto-u.ac.jp/

NUCL MED

KURRI Promotes the Next Generation of Cancer Treatment

A new center to be established in 2019 will aim to enhance the Institute's collaborative activities on the Boron Neutron Capture Therapy for Cancer Treatment. 33



To promote the practical use of Boron Neutron Capture Therapy (BNCT), a joint-use medical center tentatively named the Kansai BNCT Medical Research Center is scheduled to be established in Osaka in 2019. The new facility will promote collaborative research between hospitals and universities, including Osaka Medical College, Kyoto University Research Reactor Institute, Osaka Prefecture University, and Osaka University.

BNCT is a form of radiotherapy that selectively destroys cancer cells through the administration of boron compounds which accumulate in cancer cells, irradiating the cancerous region with neutrons. The treatment uses heavy particle beams generated by the nuclear reaction of boron and neutron that travel only the distance of one cell's diameter. BNCT can selectively destroy cancer cells with little damage to adjacent healthy cells, and shows promise for the next generation of cancer treatment as it is anticipated that it can be used for cancers which have been difficult to treat with conventional radiotherapies.

As of May 2014, the Kyoto University Research Reactor Institute (KURRI) had administered 510 BNCT treatments for target cancers including malignant brain tumors and head and neck cancers using neutrons produced by the Kyoto University Research Reactor. BNCT clinical studies using reactor neutron sources have shown that, as a new radiotherapy modality, BNCT can be effective for the treatment of locally recurrent tumors after radiation therapy. Such tumors have been difficult to treat with conventional radiotherapies. To facilitate the wider use of BNCT, KURRI has successfully developed a BNCT irradiation system using small-scale accelerator-driven neutron sources which can be installed in existing hospitals. The institute began

KURRI

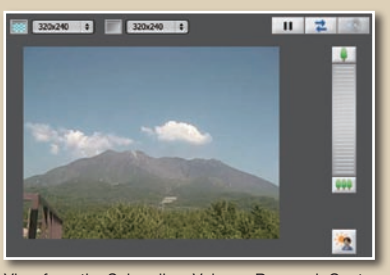
POINTS OF INTEREST 3

Kyoto University Webcams

Kyoto University Webcams are installed at a number of the university's campuses and facilities. Members of the general public can view live streaming images of the locations listed below.

Viewable Sites

- Hida Observatory, Gifu
- Primate Research Institute (KUPRI), Aichi
- Research Reactor Institute (KURRI), Osaka
- Shirahama Oceanographic Observatory, Wakayama
- Sakurajima Volcano Research Center, Kagoshima
- Tokyo Office, Tokyo
- Yoshida Campus, Uji Campus, and Katsura Campus, Kyoto



View from the Sakurajima Volcano Research Center

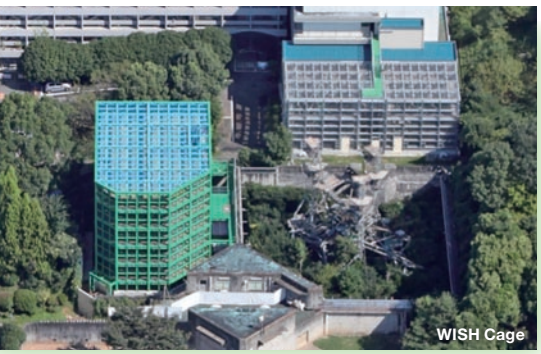
WEB www.kyoto-u.ac.jp/en/about/profile/campus_scenery/webcams.html

clinical trials of BNCT for recurrent malignant brain tumors in 2012, and for head and neck cancers in 2014. The establishment of the new joint research center will enhance collaboration with Osaka Prefecture University, promoting boron compound research and development, and also with Osaka University, which has advanced capabilities in PET examination. Such collaboration will accelerate efforts toward the practical use of BNCT.

Author: **Minoru Suzuki, MD, PhD**
Professor, Particle Radiation Oncology Research Center, Kyoto University Research Reactor Institute (KURRI)
WEB www.rri.kyoto-u.ac.jp/BNCT/

PRIMATOL

In the WISH Cage and the Research Resource Station, Chimpanzees are Moving and Foraging Freely 20


WISH Cage

The Primate Research Institute, Kyoto University (KUPRI) was established in 1967 and has for the past five decades been promoting basic research on primates including humans.

WISH Cage

At the KUPRI, 2 cages, called "WISH (Web for the Integrated Studies of the Human Mind) Cage(s)", have been constructed. The WISH cages have a space of 20 m^2 that are fifteen meters high*. Because of the facility, the chimpanzees at the KUPRI have been living more of a natural style from the academic year of 2011.

*The setup financially supported by Japan Society for the Promotion of Science.

Although wild chimpanzees often live in large, fifteen to one hundred or even more member groups, not every member facing at each other all the time. In the aim to simulate the life style of wild chimpanzees, fission-fusion emulation was made possible by connecting the WISH cages and the outdoor enclosure for our chimpanzees at KUPRI. With this setup individual chimpanzees can freely choose their "habitat" (cage/enclosure) and be with several group members (or stay alone if they prefer) at any given time, like chimpanzees in the wild.

A computer-operated system set up in the WISH cages enables ad libitum feeding. Any one chimpanzee of the group can come to any of the several touch-screen monitors at any preferred time and operate the computers at their will. Thus, they can obtain food rewards by doing a cognitive task at any time of the day during the 24 hour period. Using the automated face recognition system, we can automatically run personalized tasks for every chimpanzee. Additionally we can keep and accumulate record logs of all chimpanzees' tasks automatically. There is also WISH Cage at Kumamoto Sanctuary, Wildlife Research Center, in Kumamoto Prefecture (WEB langint.pri.kyoto-u.ac.jp/ai/en/kumamoto-sanctuary.html).

Research Resource Station

In 2006, the KUPRI also set up ten hectares facility to keep Japanese monkeys in an environment close to their natural habitat, and elucidate their behavioral characteristics. It is named Research Resource Station (RRS) and located about 2 km east of the KUPRI, Inuyama, Japan.


RRS

The institute contributes to National Bio-Resource Project (NBRP)† "Nihonzaru," supported by Ministry of Education, Culture, Sports, Science and Technology (MEXT), which provides purpose-bred Japanese monkeys to research institutes all over Japan.

†The jurisdiction was transferred to Japan Agency for Medical Research and Development (AMED) from MEXT 2015.

The RRS staffs keep trying to improve monkeys' welfare in captivity, providing various types of enrichment to encourage their natural behavior, such as climbing, leaping, resting, foraging and social interactions.

Monkeys in the enclosure

From the Editor Via following URL or QR code, you can meet the chimpanzees at KUPRI. https://www.youtube.com/user/TheFriendsAndAi (You Tube)

Author: **Hirohisa Hirai, PhD**

Director and Professor, Primate Research Institute (KUPRI)

WEB langint.pri.kyoto-u.ac.jp/ai/en/about/facility.html (KUPRI)

WEB www.pri.kyoto-u.ac.jp/sections/chemr/index.html (RRS)

POINTS OF INTEREST 4

Shirahama Aquarium 31

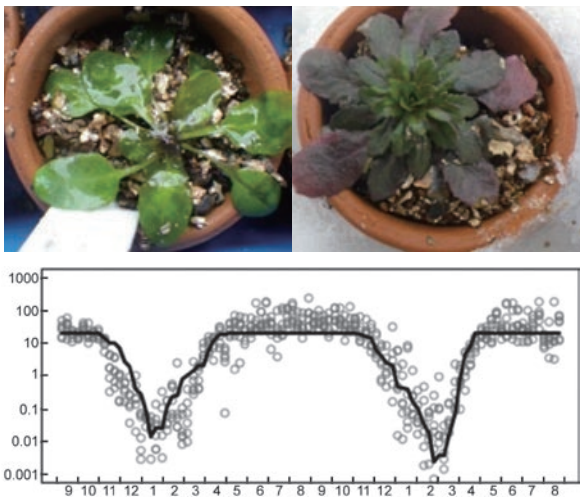
Shirahama Aquarium opened to the public in 1930 as a part of the marine biological laboratory One of the few university-operated aquariums in Japan, it features exhibits of invertebrates and fish found in the Nanki Shirahama area. The aquarium holds one of the largest invertebrate collections in Japan, with over 500 species on display throughout the year.

WEB www.seto.kyoto-u.ac.jp/aquarium/aquarium-E-top.html

Cutting-Edge Research at Kyoto University Facilities

MOL-ECOL Molecular Phenology and the Seasonality of Genes

Genome-wide gene expression analysis in natural plants.



Arabidopsis plants under snow cover (top left) and exposed conditions (top right) during winter, and a seasonal pattern of two-year gene expression in a gene that controls flowering time (bottom)

Phenology is the study of seasonal events in plants and animals. Disturbances in plant phenology due to global warming have been reported in many locations around the world. As with external phenomena, such as flowering and leaf fall, gene function is also thought to be seasonally controlled in plant cells. It is necessary, therefore, to improve the prediction methods of plant phenology by incorporating gene expression analyses. The most prominent data set from my project is a two-year seasonal transcriptome of Arabidopsis covering 20,000 genes. The data it provides allows us to model many genes against meteorological data. The method we have developed can be applied to various technologies, enabling early reports of plant phenology, predictions of plant responses to global warming, designed breeding of crops, and other functions.

Hiroshi Kudoh, PhD
Professor, Center for Ecological Research 21
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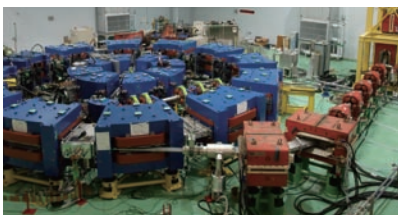
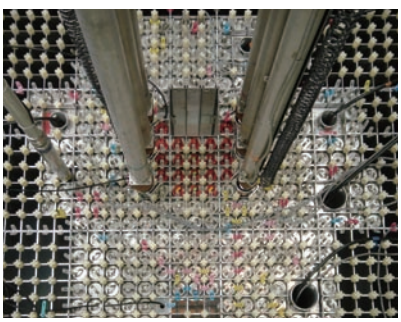
REACT-PHYS The Challenge of Nuclear Transmutation

Promising method of removing radioactive waste from power plants.

The accelerator-driven system (ADS) is a promising potential method to achieve the nuclear transmutation of radioactive waste (minor actinides and long-lived fission products) from nuclear power plants. When applying ADS to nuclear transmutation, spallation neutrons (high-energy neutrons) obtained by an injection of high-energy protons onto a heavy metal target are employed. Among the basic research projects into ADS, at the Kyoto University Critical Assembly (KUCA), a series of reactor physics experiments coupled with the fixed-field alternating gradient (FFAG) accelerator is being carried out, and the neutron characteristics of ADS are investigated through static and kinetic analyses by means of experiments and calculations.





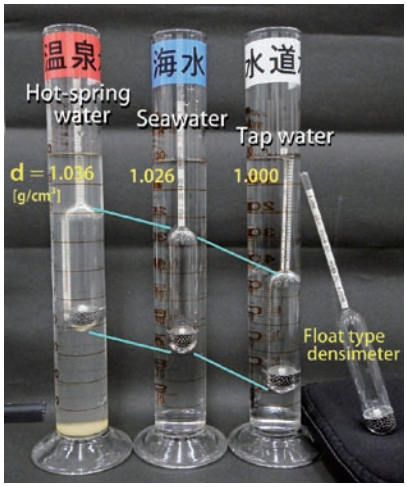
From the Editor For the work, He was listed in The Top 25 Most Downloaded Articles for 2011 *(Ann. Nucl. Energy)* from the Elsevier's Sciverse Sciencedirect and was awarded the JNST Most Cited Article Award for 2014 *(J. Nucl. Sci. Technol.)* from the Atomic Energy Society of Japan.

Cheol Ho Pyeon, PhD *Associate Professor, Kyoto University Research Reactor Institute* 33
www.rri.kyoto-u.ac.jp/shiroya-lb/

GEOFLUID-CHEM

Does Water Come from the Deep Earth?

Geochemical investigation of hot-springs originating from deep fluid.



The existence of hot-spring waters of high salinity was well known in non-volcanic regions, but their origin has been unknown for a long time. We began our geochemical investigation of hot-spring waters discharged in the non-volcanic regions of the southwestern part of Japan in 2003. Through our studies we expect to find hot-spring waters derived from deep fluid characterized by CO_2-bearing saltwater, such as Arima-type thermal water, which originates from dehydrated metamorphic fluid released from the Philippine-Sea plate subducting into the interior of the earth.

◂ Density measurements for saline hot-spring water sampled from Arima, seawater, and tap water using a float type densimeter

From the Editor An oral presentation on this research was chosen as a highlight paper of the Japan Geoscience Union Meeting in 2014 (SIT40-13).

Shinji Ohsawa, PhD

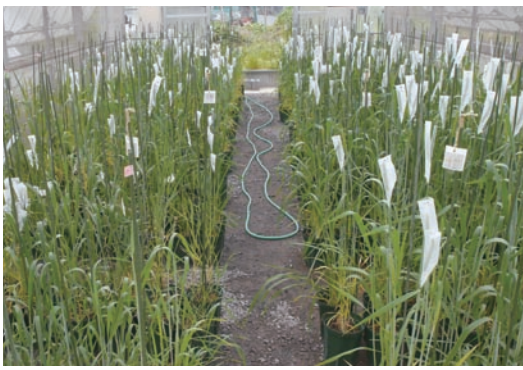
Professor, Beppu Geothermal Research Laboratory, Graduate School of Science 37

www.vgs.kyoto-u.ac.jp/japanese/personal%20page/j-ohsawa.html

BIO-SCI

Improving Wheat

Examining the genetic diversity of wheat relatives.



Wheat is one of the most important crops in the world. Its production requires less water than rice or corn, and wheat improvement is urgently needed to respond to the increase of the world's population. This will be achieved through the introduction of novel genes into wheat. It is very important, therefore, to understand the genetic diversity of relatives of wheat. I examined the genetic diversity of wheat relatives and found that, at present, quite a limited range of diversity is employed in wheat. I also discovered that the distribution of a wild relative of wheat has been greatly affected by post glacial climate changes.

Taihachi Kawahara, PhD

Associate Professor, Laboratory of Crop Evolution, Graduate School of Agriculture 17

www43.tok2.com/home/pgpinst/

POINTS OF INTEREST 5

The Laboratory of Crop Evolution 17

The Laboratory of Crop Evolution in the Plant Germ-Plasm Institute of Graduate School of Agriculture is a historic facility located in Mozume, Kyoto. The Laboratory originated as the Kihara Institute for Biological Research, founded in 1942 by Dr. Hitoshi Kihara, an internationally recognized wheat expert (See *Res. Act.* **4**, no.3 [2014]: 6-9). Dr. Kihara was engaged in research on various plants, including wheat and seedless watermelons. In 1959, Kyoto University purchased the land and premises. Since then, the university has utilized the facility as an agricultural experiment laboratory affiliated with the Graduate School of Agriculture.

WEB www2.ocn.ne.jp/~pgpinst/index_e.htm

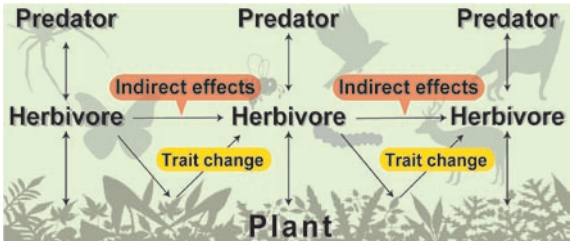
Dr. Hitoshi Kihara (1893–1986) was a geneticist who served as a professor in Kyoto University's Faculty of Agriculture from 1927 to 1956. He noticed that in wheat, seven chromosomes form the basic unit of inheritance and function, and named it a genome. The concept of the genome has been vital to the development of biology and genetic engineering.

ECOL

How is Biodiversity Created in Nature?

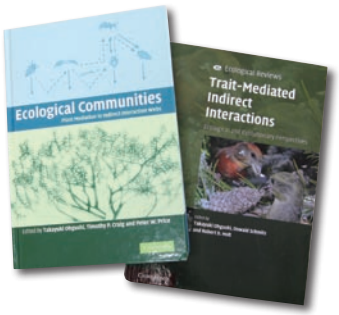
Conceptualization of the interaction networks in ecosystems.

Why are there so many species and interactions in nature? This has been the fundamental question in the field of Biology since the Darwin era. In this context, understanding how biodiversity is created and maintained is one of the most challenging issues in modern ecology. Food webs, based on "who eats whom," embedded in an ecological community, have long been a basic tool to explore how biodiversity is organized in a wide range of ecosystems. However, growing evidence is that nontrophic, indirect, and mutualistic interactions, which have not been involved in the traditional food webs, are essential in forming novel interaction networks, thereby enriching biodiversity. It is critical to consider these key interactions because they are ubiquitous and widespread in nature, and they play an important role in determining species and interaction diversity.



Indirect interaction web: It has been conventionally considered that food chains, or vertical species interactions, are independent of each other. However, it has recently been found that plant-mediated indirect effects, or horizontal species interactions, are closely linked to food chains. In this way, plants form the foundation of a complex ecological network, structured like a rich tapestry with interwoven horizontal and vertical threads.

My work has focused on the way in which nontrophic, indirect, and mutualistic interactions organize plant-based arthropod communities and alter their biodiversity. In 2005, I proposed a conceptual framework for an "indirect interaction web," which is an interaction network that enables us to understand the components of species and interaction diversity by focusing on nontrophic, indirect, and mutualistic interactions, as well as trophic interactions. Interaction linkages caused by plant-mediated indirect effects have the potential to greatly enrich biodiversity by increasing the diversity and complexity of the network structure of interacting species. Although feeding relationships are a crucial part of the network structure, food webs provide an incomplete picture of the forces structuring ecological communities and biodiversity because they have ignored the plant-mediated indirect effects induced by herbivores. The indirect interaction web can be utilized to improve our understanding of the complexity of a plant-based ecological community, and this knowledge will aid efforts to conserve interaction biodiversity in nature. Thus, the indirect interaction web has established a novel approach that explicitly incorporates such key interactions into the components of the traditional food webs. This approach can also provide fundamental insights into the big question of how evolution drives the organization of the ecological processes of communities and ecosystems.



Text books on "indirect interaction webs." Left: Ohgushi, Craig, & Price (2007). Right: Ohgushi, Schmitz, & Holt (2012).

Takayuki Ohgushi, PhD

Professor, Center for Ecological Research 21

www.ecology.kyoto-u.ac.jp/~ohgushi/en/index.html

MAR-ECOL

Dynamics of Zooplankton

Investigating links between phytoplankton and fish production.

Defined as animals that drift with the surrounding water, zooplankton encompass all sorts of taxonomic groups and play a wide variety of ecological functions in aquatic environments. My research focuses on small crustacean groups, specifically copepods and mysids, which are essential links between phytoplankton and fish production. My interests include how copepods and mysids respond to their changing environment, how they interact with one another, and how they contribute to fish production. Using simple traditional techniques, I conduct physical and biological sampling in rivers, estuaries, and coastal waters regularly throughout the year. For me, microscopic analyses of zooplankton samples are always full of wonder, and often lead to new research questions.

Microscopic image of estuarine copepods

▲ Dr. Suzuki, sampling in an estuary

Keita Suzuki, PhD *Assistant professor, Maizuru Fisheries Research Station, FSERC* 13

www.maizuru.marine.kais.kyoto-u.ac.jp/en/member-en/kyouin-en.html

PHYS-ECO

Ogasawara Islands: A Natural World Heritage Site

Research into drought tolerance of woody plants and ecosystem conservation.

The Ogasawara Islands are oceanic islands located 1000 km south of Tokyo. Approximately 70% of tree species in the islands are endemic. The soil is thin and of volcanic origin. The precipitation is relatively low, especially in summer, and the islands have exhibited a trend towards increased dryness over the past 100 years. As a result, extremely unique forests called "dry dwarf forests" have developed. I have examined the drought tolerance mechanisms of woody plants in such forests. The most drought-tolerant woody plants grow in the island's extremely thin soils. Ironically, such plants have the highest risk of death because of extreme soil dryness due to prolonged drought. With the predicted future shift in global precipitation patterns, the unique forests of the Ogasawara Islands could suffer irreversible damage. I hope to conserve this rare ecosystem for our next generation.

Atsushi Ishida, PhD

Professor, Center for Ecological Research 21

www.ecology.kyoto-u.ac.jp/~atto/Index.html

Hahajima

Anijima

SILVICULT

Learning from Old Japanese Ways

Towards the future, with the blessings of the forest.

Japan is a forest country. 67% of the land is covered with forests, of which 40% is plantations. Although, in the past, the Japanese developed customary practices for the sustainable use of forest resources, their traditional knowledge of "site-adapted forestry" is being lost due to social and economic changes in recent decades. I am developing a new sustainable forest utilization system suitable for modern and future societies which combines traditional methods and forefront technologies, such as Global Navigation Satellite Systems (GNSS), remote sensing, and forestry machines. This approach is called "precision forestry," and it involves not only forestry, but also the fields of ecology, engineering, economics, and sociology. While engaged in this challenging multidisciplinary work, I am living in a community near the Wakayama Forest Research Station, where I work in collaboration with the local community.

Hisashi Hasegawa, PhD *Chief and Associate Professor, Wakayama Forest Research Station, FSERC* 32

fserc.kyoto-u.ac.jp/wp/blog/topics/in_english

POINTS OF INTEREST 6

New Observatory Building at Shirahama

The new building of Shirahama Oceanographic Observatory 30, DPRI was completed in the end of 2014. The facilities and the features of the observatory are renewed, and the seminar room of the observatory is used as a temporary shelter space for local residents under tsunami warning. The fundamental observed data is released on the web site (http://rcfcd.dpri.kyoto-u.ac.jp/frs/shirahama/data.php).

WEB rcfcd.dpri.kyoto-u.ac.jp/frs/SOO_E.htm

(The Observatory web site)

VOLCANOL

Mitigation of Volcanic Hazards

Sakurajima—the most active volcano in the world.


Sakurajima Volcano

I have been conducting studies on forecasting the volcanic eruptions of Sakurajima at the Sakurajima Volcano Research Center since 1981. Sakurajima is the most frequently erupting volcano in the world. This year alone, over 600 vulcanian eruptions occurred at the Showa crater of the volcano. The most effective method to detect precursory signals of eruptions is ground deformation observation using tiltmeters and strainmeters in underground tunnels. A very large eruption occurred in 1914, ejecting over 2 km^3 of volcanic ash and lava. After the eruption, the magma was recharged in the reservoir north of the volcano and is now back to 90% of what it was before the 1914 eruption. It is vital that we establish methods to counter such a large eruption. The first step towards mitigating volcanic hazards is obtaining an early warning of eruption by detecting precursors and evaluating the time and scale of the forthcoming eruption.

Masato Iguchi, PhD *Professor, Sakurajima Volcano Research Center, DPRI* 42

kyouindb.iimc.kyoto-u.ac.jp/e/rF9qW

ECOL

How Does Winter Climate Change Affect Forests?

In-situ snow cover manipulation experiment in the university's forest station.

Climate change alters winter temperature and snowfall regime, changes which are expected to affect the structure and functioning of forest ecosystems. The Hokkaido Forest Research Station of Kyoto University's Field Science Research and Education Center is located in eastern Hokkaido, where the soil is frozen due to severely cold temperature and thin snow cover in winter. In the station's natural forests, the staff members are working in cooperation with a research group led by Prof. Hideaki Shibata of Hokkaido University to undertake a large scale in-situ snow cover manipulation experiment exploring the way in which winter climate change affects soil nutrient and microbial dynamics, plant productivity and phenology, and other factors. An interdisciplinary joint research project, the experiment involves ecologists, biogeochemists, hydrologists, physiologists, microbiologists, and pedologists.

Ryunosuke Tateno, PhD

Chief and Associate Professor, Hokkaido Forest Research Station, FSERC 1 2

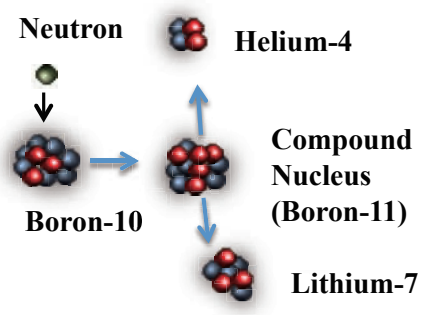
kyouindb.iimc.kyoto-u.ac.jp/e/cJ2sO (Dr. Tateno)

MED-SCI

Attacking Cancer with Neutrons

A study of radiation biology to enhance Boron Neutron Capture Therapy.

Cancer cells are surrounded by normal cells. A targeted therapy using neutrons, which kills only cancer cells, has been carried out at Kyoto University's Research Reactor Institute (KUR). Boron Neutron Capture Therapy (BNCT) uses the effect of the $^{10}B(n,\alpha)^{7}Li$ reaction to selectively destroy cancer cells injected with boron-10 compound. I have performed a study that aims to improve the effect of BNCT, and investigated DNA damage in the human body caused by neutron radiation. I found that Vitamin C is effective in protecting the human body from the effects of neutron radiation, which is has a greater effect on the human body than x-ray radiation. I aim to develop a neutron treatment for cancer with few side effects.



The low-energy neutrons combine with ^{10}B to form ^{11}B, releasing lethal radiation (alpha particles and lithium ions) that can kill cancer cells

From the Editor Dr. Kinashi was awarded the Tamiko Iwasaki Award by the Japanese Radiation Research Society in October 2014.

Yuko Kinashi, MD, PhD *Associate Professor, Kyoto University Research Reactor Institute* 33

www.rri.kyoto-u.ac.jp/en (KURRI web site)

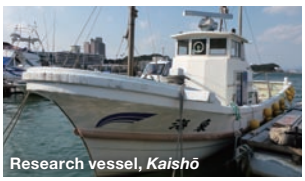
HYDRAUL

Capture the Wind, Waves, and Currents

Field observation of meteorological and oceanographic phenomena.

Shirahama, one of the most famous hot spring resorts in Japan, is often affected by typhoons and is subject to severe wind and wave conditions. The observation tower of the Shirahama Oceanographic Observatory (SOO), Disaster Prevention Research Institute (DPRI), Kyoto University takes field measurements of meteorological and oceanographic phenomena. Such field data is crucial to understanding various phenomena in coastal regions. Field data of severe wind and wave conditions is particularly scarce because of the difficulty in obtaining it. The data gathered by the observation tower therefore has an important role to play in investigating coastal processes such as air-sea interaction. The long-term continuous measurement provided by the observatory contributes to a multidimensional understanding of coastal processes caused by numerous factors, including the Black Current.

Yasuyuki Baba, PhD
Associate Professor, Shirahama Oceanographic Observatory, DPRI 30
rcfcd.dpri.kyoto-u.ac.jp/frs/SOO_E.htm



Research vessel, *Kaishō*

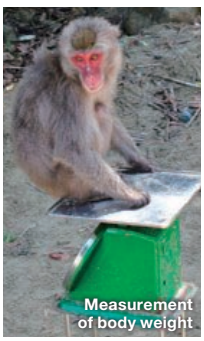
The observation tower of the SOO

ANIM-ECOL

Do Infants Grown Slowly Catch Up Ones Grown Fast?

Body weight data throughout life in Japanese Macaques in field.

An adult female and its baby



Measurement of body weight

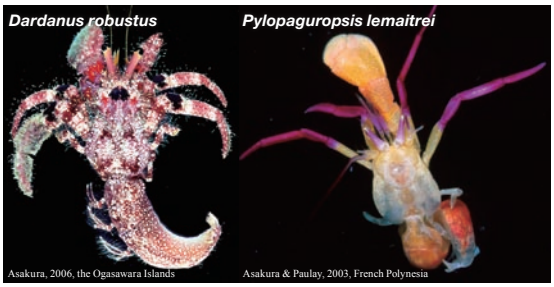
Koshima islet, where all the Japanese macaques have been identified for over sixty years, is well-known as birthplace of primatology in Japan. Unique data such as maternal lineage and monthly body weight data has been accumulated for long term. While body weight is one of important indexes which affect animals' survival and reproductive performance, it's almost impossible to measure it in field. In my analysis female infants grown slowly give birth to less offspring than ones grown fast due to shorter life span and longer interbirth interval. Males grown slowly also suffer disadvantage in survival and related index, lifespan and maximum body weight in whole life time. So infants which are behind in growth may be going to pay in their adulthood.

Akiko Takahashi, PhD *Researcher, Koshima Field-Station, Wildlife Research Center* 40
www.wrc.kyoto-u.ac.jp/koshima_st/index_e.htm

MARINEBIOL

Biodiversity in Marine and Freshwater Crustaceans

New developments in marine biology studies.



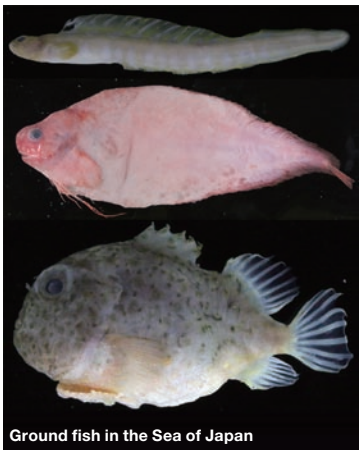
My research interests focus on marine and freshwater crustaceans and other benthic macro-invertebrates, and range broadly across animal behavior, population dynamics, community ecology, taxonomy, systematics, biogeography, phylogeogaphy, and environmental sciences. I have been intensively studying the taxonomy of hermit crabs in the Indo-West Pacific area and found global patterns of diversity. The greatest diversity is seen in the Philippines, Malay Peninsula, and Australia, known as the Indo-Malayan center of maximum marine biodiversity, or the coral triangle, due to its large number of marine organisms. A distribution boundary of many species is found at the eastern edge of West Pacific (i.e. the East Pacific Barrier). Hotspots of speciation are found in peripheral areas of the Indo-West Pacific, including Japan, Hawaii, and the Red Sea.

Akira Asakura, PhD *Professor, Seto Marine Biological Laboratory, FSERC* 31 kyouindb.iimc.kyoto-u.ac.jp/e/qR7vD

SYST FISH

Fish in the Sea of Japan

When and where did they come from?


Ground fish in the Sea of Japan

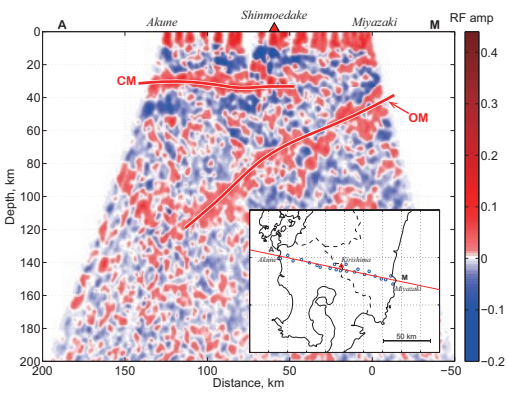
The Sea of Japan, a semi-enclosed sea in the North Pacific, is joined to neighboring waters via relatively narrow shallow straits. Accordingly, sea level regressions during the glacial periods likely resulted in the isolation of the Sea of Japan and the fragmentation of many populations of marine organisms. Based on molecular genetic analyses, I have revealed the impact of historical events for grand fish in the Sea of Japan. For example, clear genetic divergences between the Sea of Japan and other geographic regions of the North Pacific were found in the *Sake-bikunin* species of snailfish. The genetic divergence suggested that colder climates from the late Pliocene epoch and the isolation of the Sea of Japan during the Pleistocene epoch may have driven its divergence. Interestingly, similar patterns of genetic divergence have been detected in some other ground fish, which suggests that they have been isolated through a common historical event.

Yoshiaki Kai, PhD *Assistant Professor, Maizuru Fisherise Research Station, FSERC* 13
www.maizuru.marine.kais.kyoto-u.ac.jp/en/

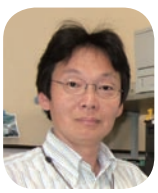
GEO-PHYS

Seeing Underground with Seismic Waves

Imaging the Philippine Sea plate subducting beneath southern Kyushu.



What is occurring under the ground beneath southern Kyushu, where a Nankai Trough megaquake could occur and magma is generated beneath the Sakurajima and Kirishima volcanoes? Using seismic waves, we try to see the earth's interior, through which light cannot propagate. Since 2010, we have deployed seismometers with an average spacing of 5 km from Miyazaki to Akune via the Kirishima volcano. We have analyzed P waves from large earthquakes in distant regions, such as Indonesia, extracted S waves which were converted from the P waves at seismic velocity discontinuities, such as the top surface of the Philippine Sea plate, and obtained an image of the geometry of the discontinuities. We have successfully imaged the oceanic Moho (OM) in the subducting plate and the continental Moho (CM) in the western part of southern Kyushu, both of which are boundaries between the crust and the mantle.



Takuo Shibutani, PhD
Chief and Professor, Tottori and Miyazaki Observatories, Research Center for Earthquake Prediction, DPRI 19 39
www1.rcep.dpri.kyoto-u.ac.jp/~shibutan/index.html

POINTS OF INTEREST 7

Japanese Cedar Wood House

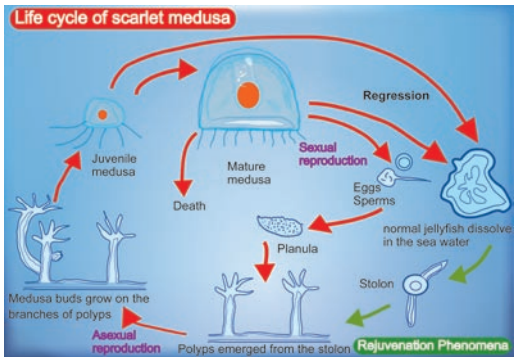
Unique building using a method developed by the university.

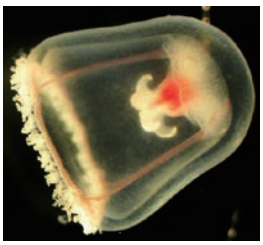
International Seminar House in Yoshida Campus, is constructed of thinned timber from Japanese cedar trees grown at the university's Wakayama Forest Research Station. The construction method used, called "j.Pod," was developed by an industry-academia collaboration group including Prof. Masami Kobayashi and Assoc. Prof. Hirohide Kobayashi from Graduate School of Global Environmental Studies. The method was also used to construct other university buildings, including parts of the Wakayama Forest Research Station and some buildings on Yoshida North Campus. Through promoting the use of the j.Pod construction method, the university seeks to contribute to local forestry and industry.

ANIM SYST BIOL

Will Human Dreams of Immortality Come True Through Jellyfish Research?

Biological and life science studies of immortal and ephemeral jellyfishes.





After the publication of a paper announcing the first ever achievement of ten consecutive rejuvenations of the Jellyfish species *Turritopsis* spp. in laboratory conditions, various subsequent biological studies were carried out. These included further successful records of rejuvenation, as well as a public exhibition of the jellyfish at Kyoto University's Shirahama Aquarium. It is anticipated that the jellyfish's ability to rejuvenate will be further explored, mainly through genetic and molecular approaches, and that in the future, the results of those studies could be applied to make the long-held human dream of rejuvenation a possibility.

In contrast, a special research project is being undertaken for genetic and molecular studies on the parallel evolution of a very short-lived species of jellyfish, the bivalve-inhabiting hydrozoan *Eugymnanthea japonica* Kubota, found in the Pacific and Atlantic Oceans.

If life science studies comparing these two tiny jellyfish could provide the key to human immortality, it would be the greatest revolution in the evolutionary history of the Earth, heralding a complete, and highly beneficial, change in our way of life and social communities.

From the Editor Dr. Kubota received the Award of the Biogeographical Society of Japan in 2012 for his numerous works of immortal jellyfish. His studies were reported by the *New York Times* in December 2012, resulting in his participation in Google Zeitgeist 2013 (London), Ideacity 2013 (Tronto), and other significant scientific events.

Shin Kubota, PhD

Associate Professor, Seto Marine Biological Laboratory, FSERC 31

www.benikurageman.com/en/index.htm?

www.seto.kais.kyoto-u.ac.jp/shinkubo/shinkubo_home/index_en.html

HUM ECOSYST

The *Kozagawa* Project

A First Step for Global Restoration.


Ichimaiiwa (monolithic rock formation) in Koza River

The earth is composed of three ecosystems: wild, cultural, and pseudo-cultural. The wild ecosystem originated at the time of the big bang, the cultural ecosystem evolved from the wild ecosystem with human intervention, and the pseudo-cultural ecosystem rapidly appeared in an unsustainable manner collisions and fusions of cultures between polytopic civilizations.

In modern and early modern Japan, some regions have been blessed with, or suffered chaotically from, various elements of man-made ecosystems. As a result, wild and cultural ecosystems have dwindled and become vulnerable, while pseudo-cultural ecosystems have been expanding and causing harm.

I have launched a voluntary project, the *Kozagawa* Project, comprising members from the townsmen, government, industrial, and academic sectors. The project adopts as its symbol a monolithic rock formation in the Koza River, a natural national treasure. The *Kozagawa* Project is a 50-year field program which regards the southern Kii Peninsula as a model region for applied anthropology, and aims to restore all aspects of the region's wild, cultural and pseudo-cultural ecosystems to well-balanced dynamic phases using the wisdom of cosmology regarding the interactions of the four fundamental forces (gravitational, electromagnetic, strong nuclear, and weak nuclear). The project began in 2004, and its first stage will last until the middle of the 2050s.

The data and folklore knowledge collected in this project have been documented in *The Report of the Kozagawa Project's Combined Forces: FSERC/ KOPCOM,* **1-10**.

Shinya Umemoto, PhD *Director and Associate Professor, Kii-Oshima Research Station, FSERC* 28

fserc.kyoto-u.ac.jp/oshima/

MID-BEGINNERS

How Do We Calculate the Value of π?

Opening new horizons with the Monte Carlo method.

Cherenkov radiation glowing in the core of the Kyoto University Research Reactor (KURR)

How do we calculate the value of π, the ratio of a circle's circumference to its diameter? It is well known that this value can be calculated by using random numbers instead of arithmetic methods. This stochastic approach is known as "the Monte Carlo method," and it is now being applied to many areas of science, including neutron and light transport calculations in nuclear reactors. However, the method is not always a sufficiently versatile tool to replace other conventionally used deterministic methods. I am currently devoted to research that could expand the area of application of the Monte Carlo method. Recently, I succeeded in using the method to establish an algorithm to solve a complex-valued transport equation. I hope that this accomplishment enlarges the areas in which the Monte Carlo method can be applied, and opens the way for further developments.

Toshihiro Yamamoto, PhD

Associate Professor, Kyoto University Research Reactor Institute 33

www.ne.t.kyoto-u.ac.jp/en/information/laboratory/person/YamamotoToshihiro-fold?set_language=en

ENG

Magic Toilet: The Future of Global Sanitation

Alleviating water pollution and food shortage.

A third of the seven billion people on Earth are without sanitation, which puts their water supplies at risk. Sanitary sewer systems in the developed world are effective but not sustainable. To achieve a high level of efficiency, it is generally not advisable to mix or dilute different types of waste, and yet the current toilet and sewer systems mix and dilute urine and feces—with each other and with other liquids, including water. A solution to this problem could be "diversion." Our body naturally separates urine (high in essential nutrients for plants) from feces (low in nutrients, but high in pathogens). Sewer systems which employ urine diversion have the benefit of producing waste which can be used as a fertilizer in developing countries, and in developed countries they reduce the load on nutrient removal processes. This technique is compatible with public sewer and centralized treatment systems in developed countries.

Yoshihisa Shimizu, PhD

Professor, Graduate School of Engineering /
Research Center for Environmental Quality Management 22

www.eqc.kyoto-u.ac.jp (RCEQM web site)

Specially designed toilet can divert (separate) urine from feces

POINTS OF INTEREST 8

Abuyama Observatory

WEB abuyama.com/top.html

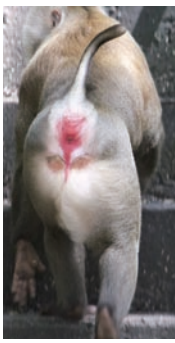
Established in 1930, the Abuyama Observatory 18 is located 218 m above sea level at the top of the *Bijin Yama* ridge, which stretches south from the summit of Mt. Abuyama in northeast Osaka prefecture. Built on the slope of the mountain, the observatory consists of a main building and an adjoining annex on its west side. The observatory was described as a remarkable modern heritage site in the report on modern heritage produced by Osaka prefecture in 2007. The report compared the entrance hall connecting the main building and the west annex to "the interior of a modernized Greek temple." Many people visit the observatory to see

EVOL MORPH PRI

The Evolutionary Morphology of Macaques

History and mechanisms producing new species of macaques.

Macaques, such as Japanese monkeys, are common monkeys living widely in Asia. They have diversified greatly into twenty-one living species. I am investigating their diversity, mechanisms, and the history of how their traits have evolved. By means of ecological segregation, they share common habitats, forest type, geographical conditions and life styles of terrestriality vs. arboreality. Macaques have survived climate changes in glacial periods, which likely had a great influence on their phylogeny and morphology. Macaque morphology has been shaped not only by their fundamental life activities, such as feeding or positional behavior, but also by the communication in their societies which varies greatly among species.

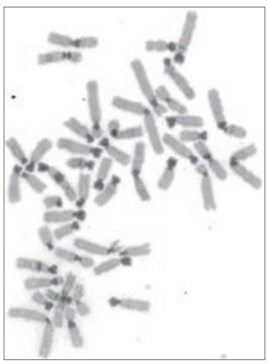


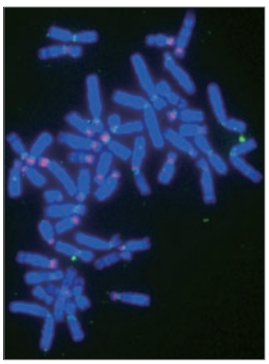
Yuzuru Hamada, PhD *Professor, Primate Research Institute* [20]
www.pri.kyoto-u.ac.jp/shinka/keitai/index.htm

EVOL MORPH PRI

Why are Genomic "Garbage Cans" Important?

Seeking the pathway that Chromosome evolve from constitutive heterochromatin.





Constitutive heterochromatin regions (black regions in fig. left) are colloquially called genomic garbage cans because they are filled with junk DNA (inert genetic material). However, these so-called 'wastelands' are actually quite important for the creation of chromosome changes and/or karyotype evolution. In monocentric chromosomes with a single centromere, that centromere and its vicinity provide an important apparatus for morphological differentiation among chromosomes and constituting markers for karyotype evolution. The apparatus is generally composed of multiple repetitive DNA sequences, and can be analyzed via fluorescent *in situ* hybridization (FISH) techniques using specific DNA probes (fig. right). My work investigates the evolutionary pathways of chromosomes from the perspectives of such structural and component alterations.

Hirohisa Hirai, PhD *Director and Professor, Primate Research Institute* [20]
www.pri.kyoto-u.ac.jp/sections/molecular_biology/english/hirai.html

the building itself, rather than the historic seismometer it houses. The upper floors, in particular, provide tremendous panoramic views of the Osaka Plain. The night view is also spectacular, with the countless lights of Osaka City seeming to spread out to the far corners of the earth. There is also an ancient tomb (*kofun* in Japanese) on the top of the *Bijin Yama* ridge. Dr. Toshi Shida, the first director of the observatory, discovered the *kofun* in 1934 while excavating a tunnel to conduct seismographs. A lacquered coffin containing a mummy was found in a stone chamber. X-ray photographs of the mummy taken by Dr. Shida using advanced radiographic technology indicated that the mummy was a person of noble rank. It is speculated that it could be the remains of Fujiwara no Kamatari, a famous figure in Japanese history. Visitors welcome. Take a taxi from either Settsu-Tonda Station or Takatsuki Station on JR line.

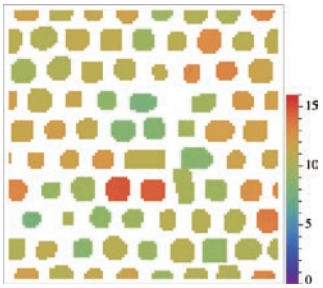
Dr. Toshi Shida (1875-1936) is famous for discovering a quadrant-type push-pull distribution of initial seismic motion (push-pull of P wave initial motion, distributed in quadrants,) predicting the existence of deep earthquakes, and the discovery of the "Shida Number" in earth tidal force (the elastic deformation of the earth due to solar and lunar attraction). Dr. Shida also established the Beppu Meteorological Research Laboratory (which later became the Research Center for Geophysics), of Department of geophysics, Kyoto University.

MARINE BIOL

Mathematics Reveals the Origin of Cooperation

Studying the evolution of cooperation through equation and computation.

Cooperation is an important characteristic in some organisms, including humans, although such a behavior can be difficult to evolve and maintain. Typically, when all members of a population behave cooperatively, a defecting individual can enjoy a greater advantage by avoiding cooperative efforts. Such individuals are so-called "free rider" or "cheaters." We are theoretically investigating the evolutionary process of cooperative interaction using mathematical modeling and computer simulation. We are currently studying three aspects of the evolution of cooperation: (1) relationships between structures of cooperation and variation of cooperation levels in a population, (2) the effects of negotiation between players on the evolution of cooperation, and (3) the joint evolution of resource exploitation and cooperation in two-dimensional space. In the latter research project, we revealed that, in the spatial structure, the evolution of cooperation can be facilitated by the evolution of resource exploitation that is accompanied by a competition among individuals (Fig.1). This indicates a paradoxical feature in the evolution of social interaction, i.e. a positive interaction (cooperation) can be evolutionarily promoted by the simultaneous development of a negative interaction (exploitation) in a spatially structured population.



Spatial distribution of individuals. Blue indicates a lower level of altruism and red represents a higher level. The white region represents empty sites.

Textbook of theoretical evolutionary ecology (A. Yamauchi, *Shinka-seitaigaku-nyumon* [Tokyo: Kyoritsu Shuppan Co., Ltd., 2012])

Atsushi Yamauchi, PhD

Professor, Center for Ecological Research 21

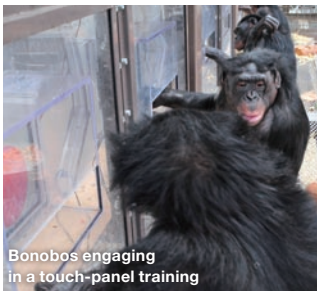
www.ecology.kyoto-u.ac.jp/~a-yama/main-e.html

PRIMATOL

Our Evolutionary Neighbors

Comparative study of chimpanzees and bonobos.

At Kumamoto Sanctuary, we have received bonobos from US zoos and initiated a new scientific project to study them. Currently Kumamoto Sanctuary is the only place in Japan housing bonobos, and it is also home to the largest number of chimpanzees in the country. Chimpanzees and bonobos are the closest living relatives of humans, and can thus be called our evolutionary neighbors. By conducting a comparative study of chimpanzees and bonobos, we seek to uncover the evolutionary origins of the human mind. We are also engaged in fieldwork studies of their wild counterparts in Africa. Through these "two-by-two comparisons," that is, chimpanzees vs. bonobos and wild vs. captivity, we aim to gain true knowledge about human nature.


Bonobos engaging in a touch-panel training

Satoshi Hirata, PhD (right) **and Naruki Morimura, PhD**

Professor and Program-Specific Associate Professor, Kumamoto Sanctuary, WRC 41

www.wrc.kyoto-u.ac.jp/kumasan/indexE.html

The Hakubi Project

Opportunity for Outstanding Young Talent

The project was established in 2009 to foster outstanding young researchers and recruits twenty international researchers per year as associate and assistant professors. The project is open to any researcher in any academic field.

WEB www.hakubi.kyoto-u.ac.jp/eng

ETHOL

Controlling an Invasive Animal: the Cane Toad

Using the behavior and ecology of cane toads to control their populations.

Takashi Haramura, PhD

Assistant Professor, The Hakubi Centre for Advanced Research / Seto Marine Biological Laboratory, FSERC 31

www.hakubi.kyoto-u.ac.jp/eng/02_mem/h25_haramura.shtml

ATMOS RADER

Radar Atmospheric Physics for Accurate Weather Forecasts

Development of 1.3-GHz Wind Profiler Radars.


LTR


LQ-7

Observations of wind velocity profiles are crucial for studying meteorological phenomena, weather forecasting, etc. The wind profiler radar (WPR) is one of the most suitable remote sensing instruments for determining the height profiles of wind velocity vectors with high time and height resolutions. We developed the first active phased-array WPR known as the lower troposphere radar (LTR). It has a frequency of 1.3 GHz and a peak output power of 2 kW with a 4×4 m active phased-array antenna. The same radar system is adopted in the JMA[1] wind profiler network, WINDAS.[2] Next, using seven Luneberg lens antennas, we developed another 1.3-GHz WPR known as LQ-7, which has a peak output power of 2.8 kW. Recently, the JMA replaced the WPRs of WINDAS with LQ-11, which is similar to LQ-7 but uses eleven lens antennas.

1) Japan Meteorological Agency, 2) Wind Profiler Network and Data Acquisition System.

From the Editor For his achievements, Dr. Hashiguchi was awarded the Minister's Prize for Science and Technology of the Ministry of Education, Culture, Sports, Science and Technology of Japan and the Horiuchi Prize of the Meteorological Society of Japan.

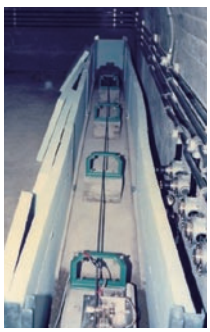
Hiroyuki Hashiguchi, PhD
Associate Professor, Research Institute for Sustainable Humanosphere 23
www.rish.kyoto-u.ac.jp/

GEO-PHYS

Seeking the Forerunners of Earthquakes

The differences between normal and anomalous phenomena.

Do you believe that major earthquakes are preceded by *anomalous* phenomena, such as increases in electromagnetic noise and ground deformation? There are many reports of such phenomena, but it is a great challenge to distinguish between *normal* and *anomalous* phenomena. Moreover, we have few chances to observe earthquake-related phenomena, because major earthquakes (fortunately) do not occur frequently. I am trying to define the objective differences between *normal* and *anomalous* phenomena, through precise geophysical observations, mainly around the Miyazaki Observatory near *Hyuga-Nada* in southwest Japan, where large earthquakes have repeatedly occurred, together with mathematical modeling of the obtained data.



Instruments housed in a tunnel to observe subtle strain of Earth's crust

Ken'ichi Yamazaki, PhD *Assistant Professor, Miyazaki Observatory, DPRI* 39
www1.rcep.dpri.kyoto-u.ac.jp/observatories/MYZ.html

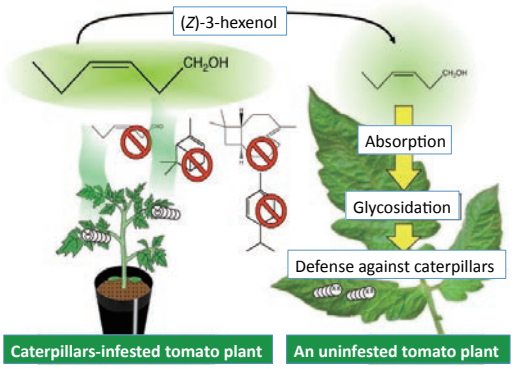
Invasive animals destroy native ecosystems, and the cane toad is one of the most harmful invasive animals in the world. Cane toads have spread to naturally beautiful Japanese islands, such as Ishigaki Island and the Ogasawara Islands. I am seeking methods to control cane toad populations on Ishigaki Island, which lies west of Okinawa, by using the toad's evolved behavior and ecology. I am currently conducting research on their mating call (males call females) and on the pheromones of tadpoles (inducing cannibalism or decreasing the survival of metamorphosis). Through this research I am seeking ways to gather many cane toads together on one site for easy collection, and to decrease the number of cane toads emerging from ponds. Cane toads have been introduced to many areas in the world. Therefore, to find methods to control invasive populations of cane toads world-wide, I am collaborating with scientists in the University of Sydney, Australia, where the cane toad is also an ecological problem.


Cane Toad on Ishigaki Island

CHEM ECOL

How Do Plants Smell Danger?

Deciphering the mechanisms involved in plant-to-plant communication.



When exposed to volatiles from conspecific plants infested with caterpillars, undamaged plants became more defensive against caterpillars that may come in the future. This is called plant-to-plant communication mediated by infested plant volatiles. An intriguing question is how uninfested plants smell volatiles. In communication between tomato plants, the amount of (*Z*)-3-hexenylvicianoside (HexVic) (glycoside of (*Z*)-3-hexenol) increases in the exposed plants, and this compound negatively affects the performance of caterpillars. The aglycon of HexVic, (*Z*)-3-hexenol, is transmitted in the air from the neighboring infested tomato plant. Glycosidation of airborne alcohol is commonly seen in many plant species. Thus, glycosidation is one of the mechanisms involved in the volatile reception (smell) in plant-to-plant communication.

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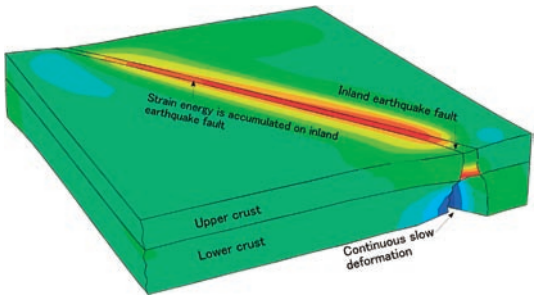
SEISMOL

The Mystery of Earthquake Generation

Why do inland earthquakes occur?



Surprisingly, it is not known why inland earthquakes occur. In the Japanese Islands, it is believed that inland earthquakes are generated as strain energy is accumulated by the subduction of oceanic plates. However, inland earthquakes do not occur by this process alone, since the accumulated strain energy is released through the occurrence of large subduction zone earthquakes. In my research, I propose a hypothesis that continuous slow deformations beneath inland earthquake faults accumulate strain energy on the faults and I am examining this hypothesis using observation data. I have developed a new seismic observation system that enables continuous seismic recording at many stations of an order of ten thousands, which has never been done before. I have named it the Manten System, and I have installed approximately 300 stations in Japan and New Zealand. The project is based at the Abuyama observatory.

From the Editor This work is funded by the Grant-in-Aid for Scientific Research on Innovative Areas (2014-2018).

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EVOL-BIOL

When Predators Promote Speciation

Theory of speciation processes promoted by biased predation.

Speciation, the formation of new species, has been the "mystery of mysteries" ever since Darwin, because the first mutant of a new species has difficulty in producing offspring. A snake eating land snails recently suggested a solution to this old conundrum: biased predation on resident individuals (in this case, right-handed snails) could increase the relative fitness (survival advantage) of mutants (left-handed snails), and eventually promote speciation. By analyzing population-genetic models, I found that genetically dominant alleles are favored with predation, whereas recessive alleles are more likely to spread without predation. The speciation theory will be further examined by molecular biological studies in the near future.

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FOREST

Why are Forests Important?

A long-term ecosystem research project based on water cycles and forest education.

In recent years, the demand for environmental education is increasing in Japan and throughout the world as human beings obtain overwhelming power and greedily pursue more profits, with little awareness that the basis of our existence is in danger. To address this problem, I am undertaking long-term ecological-hydrological research in the Yusen-Dani natural forest covered watershed of Kyoto University Forest in Ashiu, Kyoto. I also engage in forest education activities for citizens and students in Tokuyama Experimental Forest in Shunan City, Yamaguchi. I believe that through my work I can develop an integrated concept of education, natural science, and philosophy.

Tadashi Nakashima, PhD *Chief and Lecturer, Tokuyama Experimental Station, FSERC* 36

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PALEONTOL

Searching for Primate Fossils in Southeast Asia

Evolutionary history and differences of primate fauna in Southeast Asia.

Since 1998, I have carried out paleontological investigations in central Myanmar with the main aim of discovering primate fossils. Myanmar is located in continental Asia, and since the 19th century it has been very well known for producing a diverse quantity of mammalian fossils, including those of primates from the Tertiary sediment (up until sixty five million years ago). In particular, fossil primates from the latest Middle Eocene Pondaung Formation are regarded as the oldest anthropoid primates in Southeast Asia (including New and Old World monkeys, apes, and humans). I am now searching for primate fossils from the Late Miocene to Pliocene Irrawaddy sediments in Myanmar to make comparisons with the Pleistocene primate fauna in Guangxi Province, southern China. The differences in primate fauna are likely influenced by the environmental change in Southeast Asia, such as the emergence of a monsoon climate.

▲ In a water jar locally used in a north east province of Thailand

From the Editor For his work on this this project, Dr. Takai received the Academic Award of the Palaeontological Society of Japan in 2008.

Masanaru Takai, PhD

Professor, Primate Research Institute 20

www.pri.kyoto-u.ac.jp/sections/keitou/index_e.html

Excavation and investigation of primate fossils in Myanmar

Myanmarpithecus, a fossil discovered by Dr. Takai and his colleagues

A right-handed snail

HAKUBI (白眉), means 'white eyebrows' in Japanese (白 : white, 眉 : eyebrows). The word originates from a Three Kingdoms era (220-280 AD) Chinese legend: "Three kingdoms saga." According to the legend, one of the kingdoms, called Shu, was home to five brothers with extraordinary talents. The fourth brother; *Baryō Kijō*, who was particularly outstanding, had white hairs in his eyebrows, and so the term *Hakubi* has come to refer to particularly talented individuals.

馬良季常 (Baryo Kijo) ©Yutaka Amataka

MAR-SCI

Exploring Underwater in Japan

Diving surveys reveal the effects of global warming and the impact of the March 2011 tsunami.

My hero is Jacques-Yves Cousteau, who co-invented Aqua-lung and pursued underwater exploration around the world. As I cannot afford to have a ship like Cousteau's famous *Calypso* to play with, I consistently dive in local waters. I have conducted twice-a-month underwater visual surveys at our research station for over thirteen years. Through those surveys, I have revealed seasonal and inter-annual changes in the fish community. I found that tropical fish are increasing, which suggests warming trends in the Sea of Japan. I also dive in northeast Japan once every two months. Although the entire fish community there was wiped out by the tsunami in March 2011, it has gradually recovered with increasing abundance, species richness, and larger fish.

Lionfish *Pterois lunulata*, a subtropical species, is becoming common in the temperate Sea of Japan

Schools of rockfish *Sebastes cheni* were totally devastated by the tsunami in 2011, but have recovered in three years

Reiji Masuda, PhD *Associate Professor, Maizuru Fisheries Research Station, FSERC* 13

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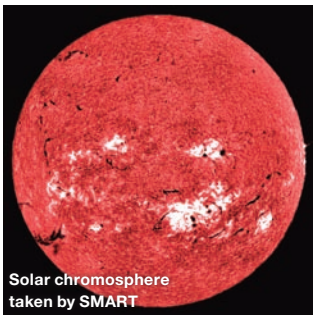
SOLAR PHYS

Space Weather Forecasts

Studying the solar activity and its effects on the earth.

It is not only light that streams towards Earth from the Sun. Firstly, there are the streams of charged particles that flow from the Sun (know as solar wind), filling the heliosphere and sometimes interacting with the Earth. When Solar flares, and other explosive phenomena, occur on the Sun, high energy photons and huge clouds of magnetised plasma (Coronal Mass Ejections; CMEs) are thrown outward. If these reach Earth, then man-made satellites and power stations that form part of society's infrastructure, and also the activities of Humankind in space are all vulnerable to damage from these phenomena. These changes to the space environment are called Space weather. As humankind extends its reach into space, the prediction of solar activity, and its impact on Earth, is becoming more and more important. At Hida Observatory, using the Solar Magnetic Activity Research Telescope (SMART) to observe the chromopshere and magnetic field across the whole solar disk, we are making great strides towards understanding the the mechanism behind flares and coronal mass ejections and working towards making accurate space weather forecasts. Note that our group uses a multi-faceted approach to study the Sun; not only with observations of solar activity using both space- and ground-based telescopes, but also with simulations and theoretical analysis,.

To make space weather forecasting a reality, continuous observations of the sun are necessary. Led by Kwasan and Hida Observatories, in collaboration with researchers throughout the world, the CHAIN project works to place low-cost telescopes around the world, guaranteeing that there is 24-hour coverage of solar activity. The first step of the CHAIN project was to move the Flare Monitor Telescope (FMT) from Hida Observatory to the Solar station of Ica University, Peru in 2010. The second station is at Saudi Arabia and the telescope will be in operation in 2015.



Solar chromosphere taken by SMART

SMART at the Hida Observatory

Kazunari Shibata, PhD[1], Kiyoshi Ichimoto, PhD[2], Satru Ueno, MS[3], Shin'ichi Nagata, PhD[4]

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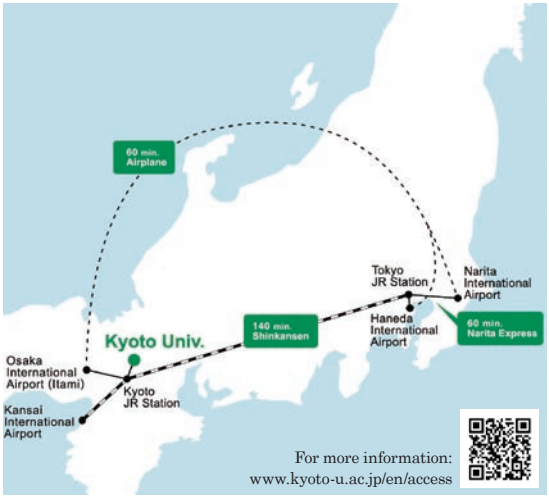
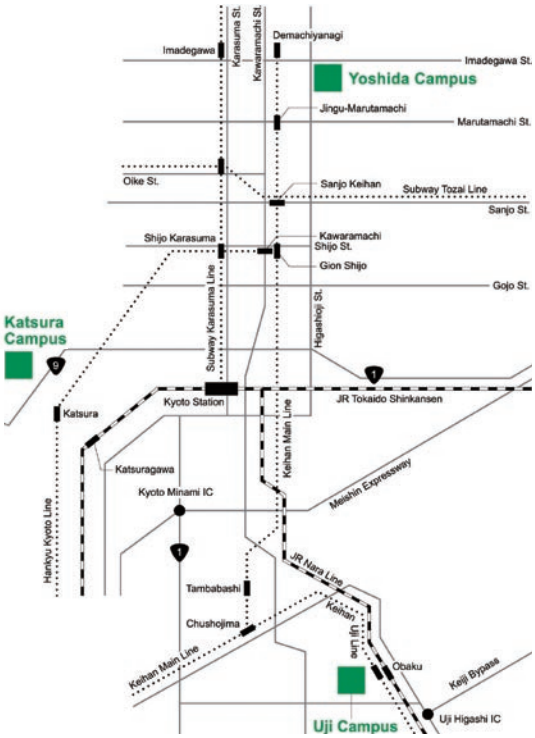
ACCESS





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