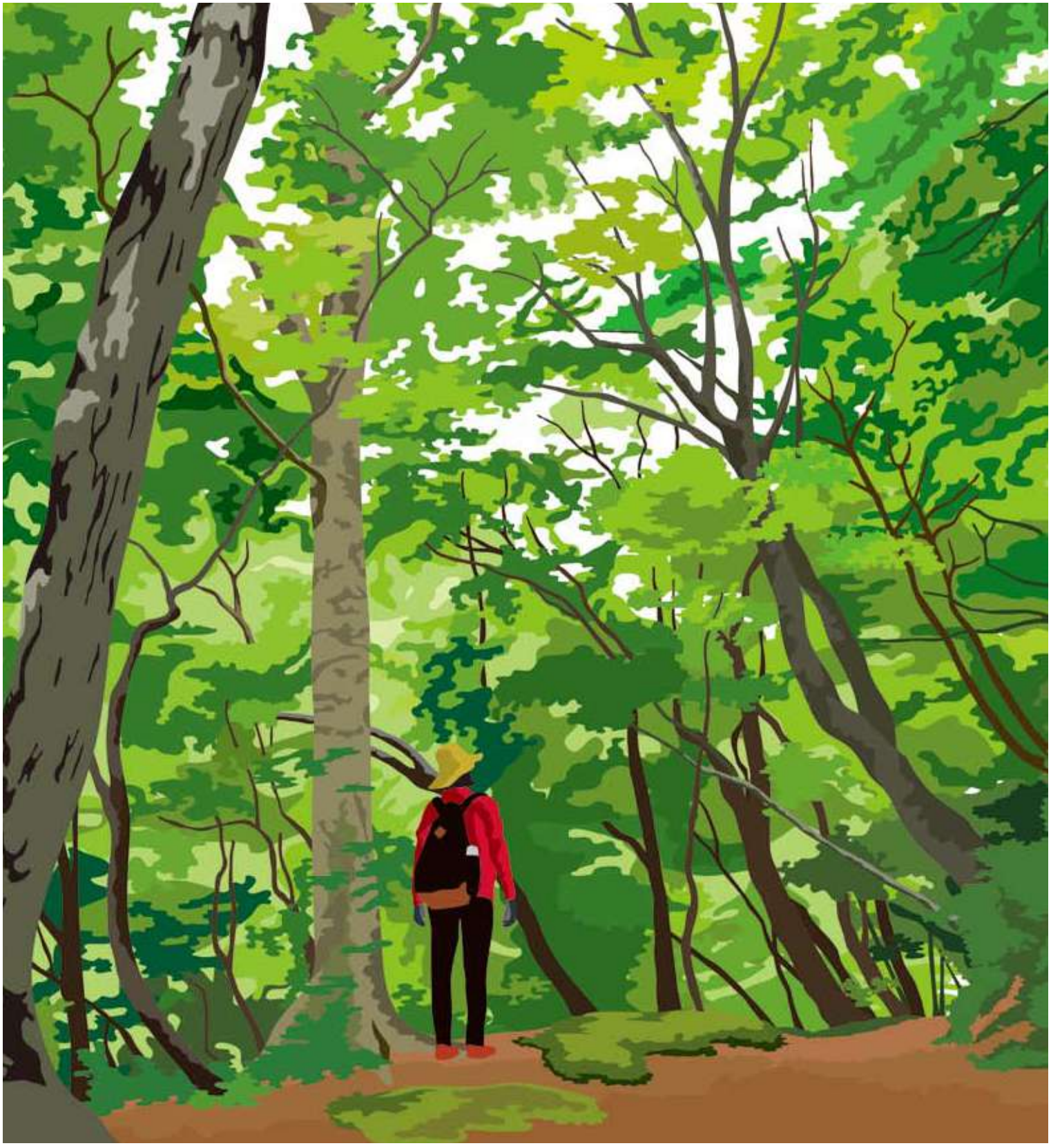


Mountain Science Center

University of Tsukuba

Mountains cover the majority of land in Japan, and forests spread across 70% of the country’ s land. Much of Japan’ s society, culture, and traditions are rooted in the mountains and forest.

Indeed in 2016, the national holiday, “Mountain Day” was established for these reasons. On the other hand, Japan is also a marine nation surrounded by the ocean. These natural features are reflected in the widespread research and education conducted throughout Japan in Forest Science and Marine Science.

Although the mountain areas are often the subject of research and education in individual research labs at universities and research organizations, an adequate system of research and education for the comprehensive exploration of mountains does not currently exist. For this reason, at the University of Tsukuba our aim is to establish a study of Mountain Science that spans science, agriculture, and engineering.

Mountain Science Center
University of Tsukuba

What is a Mountain?

What are mountains exactly?
Somewhere significantly higher than its surroundings, somewhere with a high elevation, somewhere with a substantial slope.
There are many definitions. According to these definitions, 20 – 30% of the world' s land surface is mountains, and it is said that 10 – 20% of the world' s population lives in the mountains.
There is an even larger population downstream from mountains, and the people who live here are affected by both the gifts and the disasters that the mountain brings.
Hearing the word "mountain" may only evoke thoughts of lofty and steep mountans, but at the Mountain Science Center at the University of Tsukuba, we think of the mountains intimately intertwined with our lifestyles in a broad sense, and cover what people familiarly consider mountains as well as everything from the mountain's summit to its foothtills, satoyama, which is the area between the foothills and arable flatland, and forests.

What is Mountain Science

Mountains are formed in the earth' s foundation (geosphere), and there are a wealth of creatures living there (biosphere) that are intricately involved in people's lives (anthroposphere).
It is said that half the world' s people are reliant on mountain resources. In the mountainous country of Japan, the proportion of people who depend on the mountains is even higher.

Looking across the mountain from its summit to its foothills, we can find water and other resources flowing here, and there are dramatic changes in its environment, including the temperature.
Thinking of mountains as this kind of system and exploring its connection to the geosphere, biosphere, and anthroposphere, will give us a proper understanding of mountains and how to maintain them appropriately. This will also lead to utilizing the mountains' gifts and avoiding its disasters.
We are aiming to establish Mountain Science as the academic field exploring mountains in this comprehensive manner.

In mountainous areas, a number of issues arise: a decrease in biodiversity, disasters (from heavy rain- and snowfalls, and sediment movement), forestry stagnation, aging populations and depopulation of mountain villages, decline of upland communities, and damage from animals. These issues are all complicatedly intertwined. Resolving them is also a task for Mountain Science.
In the mountain-rich country of Japan, these issues stand out acutely.
Finding the remedy for these urgent issues will lead to resolving the world's mountain issues as well.

What is the Mountain Science Center (MSC) ?

The MSC was founded in April 2017, by combining Sugadaira Montane Research Center (since 1934) and the forest section of Agricultural and Forestry Research Center, consisting of Ikawa forest (since 1962), Yatsugatake forest (since 1949), and Tsukuba Experimental Forest (since 1973). Thirty-seven faculty members (as of March 2018) spanning the fields of biology, agriculture, earth science, and environmental science teach here. Many faculty members from Tsukuba Campus of the University of Tsukuba also concurrently teach here.

The purposes of MSC

Development of an academic field

Establish the academic field of Mountain Science to comprehensively explore the relationship between mountain environments and human activity from the perspective of the geosphere, biosphere, and anthroposphere and lead Japan and the world in Mountain Science research.

Creating a community

Achieve environmental conservation, disaster prevention/reduction, and economic revitalization of mountainous regions and communities and contribute to the creation of safe and secure communities through the cooperation of industry, government, and academia.

Fostering talent

In addition to a Master' s Program specializing in Mountain Science promoted through the cooperation of four universities (University of Tsukuba, Shinshu University, University of Yamanashi, and Shizuoka University), foster talented well-versed in Mountain Science who can solve the numerous issues involving mountainous regions and communities.

Aspects of MSC

1 Three solution-driven research divisions

We have established new research divisions (Division for Understanding Mountains, Managing Mountains, and Utilizing Mountains) and we are promoting Mountain Science research through the fusion of existing research fields.

2 Mountain Science Research Initiative

Establishing the Mountain Science Research Initiative to strategically build a cooperative relationship between research divisions, and within and outside the university, will lead to the smooth development of regional collaborations, industry-government-academia collaborations, and international and domestic joint research endeavors.

3 Establishing Mountain Science as a comprehensive science

Mountain Science, the study of mountainous areas and forests that account for 70% of the land in Japan, is still in the process of being formed. We are establishing Mountain Science as a comprehensive science and will lead the world with outstanding research.

4 Creating mountain jobs and contributing to regional revitalization

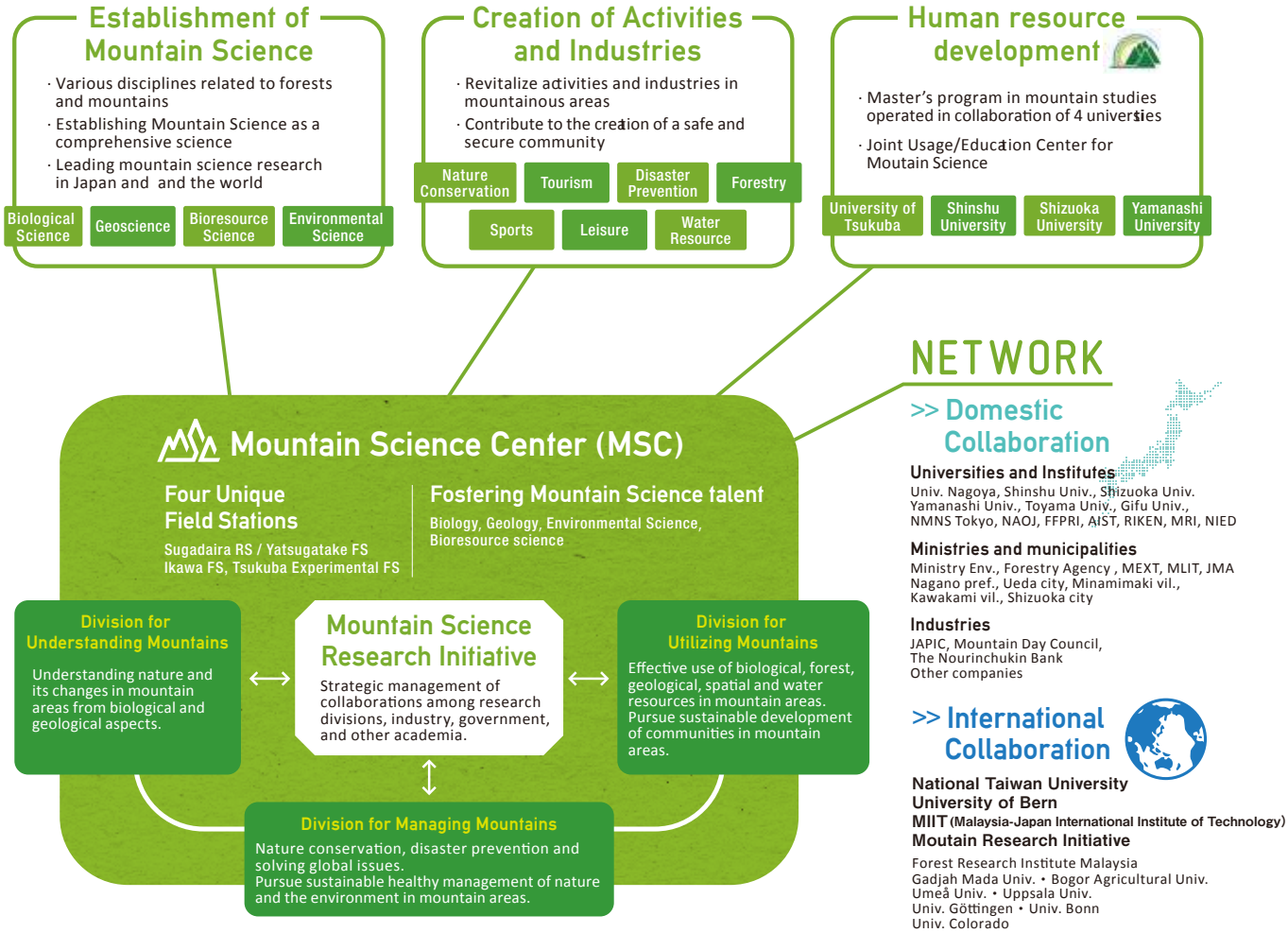
We are contributing to the creation of safe, secure, and healthy communities through the revitalization of a variety of work in mountainous areas and communities, such as forestry, tourism, disaster prevention and reduction, water resources, and sports, as well as the creation of mountain jobs.

5 Fostering new talent well-versed in Mountain Science

As the core organization of the Mountain Studies Master Degree Program, we are fostering new talent engaged in mountainous regions and communities

6 Alluring fields

We are developing research and education that make full use of the Alluring field locations of the Sugadaira Research Station, Yatsugatake Forest Station, Ikawa Forest Station, and Tsukuba Experimental Forest, which comprise the Mountain Science Center.



Various Mountain Fields

Sugadaira Research Station
Sugadaira,Nagano

Yatsugatake Forest Station
Nobeyama,Nagano

Ikawa Forest Station
Ikawa(Southern Alps), Shizuoka

Tsukuba Experimental Forest
Tsukuba, Ibaraki

We also connect to fulfilling network of cooperative universities and other world-wide universities and institutes.

University of Tsukuba, Tsukuba Campus
Tsukuba, Ibaraki

- Many teachers of biology, agriculture, geoscience, and environmental science.
- The administrative office of Mountain Science Center.

Sugadaira Research Station

Yatsugatake Forest Station

Ikawa Forest Station

Tsukuba Experimental Forest

The Establishment of Mountain Science

We will establish the field of Mountain Science to comprehensively explore mountains from the perspective of the geosphere, biosphere, and anthroposphere across the fields of basic science, agriculture, and engineering.

Basic Sciences

Ecology, Genetics, Topography, Hydrology, Systematic Taxonomy, Meteorology, Geology, Geography

Engineering Sciences

River Engineering, Environmental Engineering, Forest Engineering, Civil Engineering, Social Technology, Risk Engineering

Mountain Science

Agricultural Sciences

Natural Aspects

Silviculture, Forest Soil Science, Mountain Afforestation, Erosion Control Engineering, Forest Protection Science, Forestry

Social Aspects

Forest Policy, Forestry Business Administration, Environmental Economics, Forest Aesthetics, Mountain Village Sociology

INTO THE FIELD

COE for Education of Mountain and Natural History Science

(FY 2018-2022, MEXT Joint Usage Education Centers)

The diverse subject of Mountain Science, which covers biology, agriculture, earth science, and environmental science is set on the fields of various mountain areas and is open to university and graduate students nationwide. It is divided into the fields of mountains, forests, grasslands, and satoyama (foothills). We hope you' ll join in engaging directly with living organisms, and discovering the nature of the mountains, and the efforts of people. Mountain Science education is offered in the form of open exercises, commissioned exercises, and research instruction. This education takes place at field stations. Please see the overview of field stations below for details regarding the location of each field station and its facilities.

Location of each field station and its facilities

http://www.msc.tsukuba.ac.jp/en/en-kyoiku/

What are the Joint Usage Education Centers?

It is a system that was established in September 2009 by the Minister of Education, Culture, Sports, Science and Technology to support initiatives at universities for developing diverse and advanced education at national, public, and private universities by promoting the shared use of the human and physical resources each university possesses to provide high quality education that meets the needs of students and our diversifying society.

http://www.mext.go.jp/a_menu/koutou/daigakukan/1292089.htm

Master Degree Program of Mountain Studies

Master Degree Program of Mountain Studies

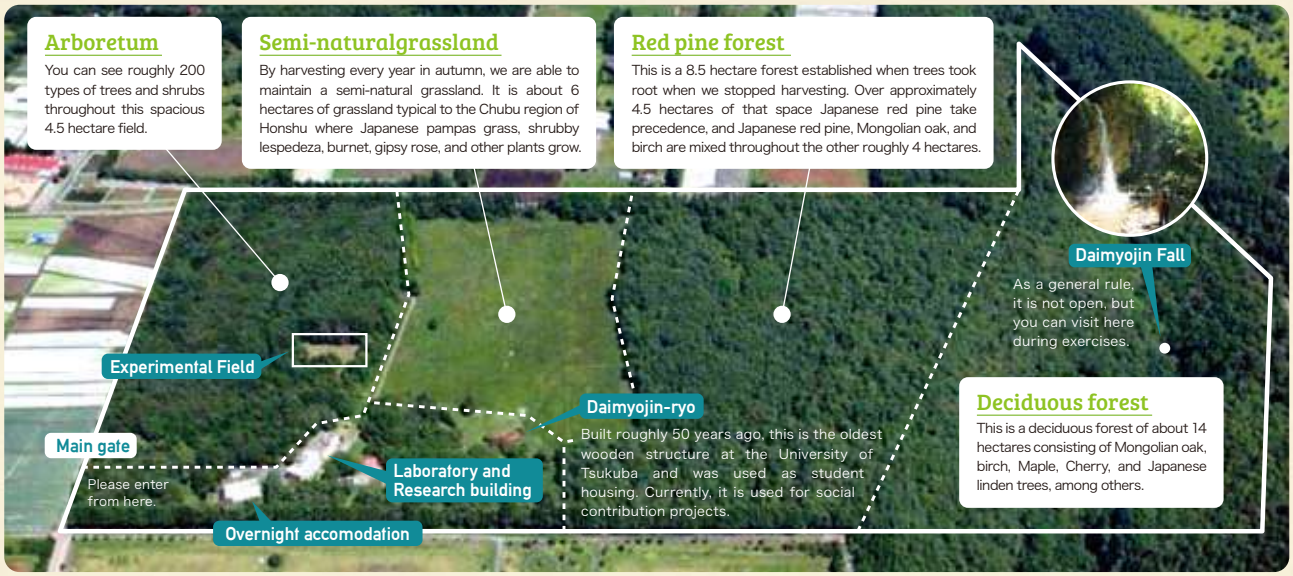
The Master Degree Program of Mountain Studies is a new postgraduate course created and offered through the collaboration of four universities: the University of Tsukuba, Shinshu University, Shizuoka University and the University of Yamanashi. The aim of this program is to cultivate people capable of addressing the specific needs of mountainous areas, including environmental issues and sustainable ecosystem management. The degree of “Master of Science in Mountain Studies” will be conferred upon completion of this program.

http://www.life.tsukuba.ac.jp/~sangaku/en/

Introduction to Field Stations

Sugadaira
Research Station

We opened these on and off campus facilities in the Chubu region of Honshu at an elevation of 1300 m promoting research, education, and contributions to the community across the fields of biological science, earth science, and agricultural, and other fields. The arboretum is open to the public on weekdays from 9 a.m. to 4 p.m. Please inquire at any time regarding research and educational uses or nature observation open to the general public.



Plant Succession Example

Before the facilities here were established, the space was an expansive grassland, but after planned management, it is now somewhere good examples of vegetation in a variety of successive stages can be observed up close. In the foreground there is a grassland maintained with annual harvesting.
Beyond that lies a red pine forest established through natural renewal when harvesting was stopped around 1970. In the same way, a mixed forest of red pine and deciduous broad-leaved trees began here around 1945. Even further beyond that is a coppice regenerated deciduous broad-leaved tree forest born from the tree stumps left after a firewood forest was felled.
The trees here are more than 80 years old. This broad range of transition stages supports a large amount of biodiversity. The further back you progress, the longer the amount of time has passed for each transition stage as if you are slipping back in time.

Mountain Biodiversity Studies

Since its establishment in 1934, we have been promoting mountain biodiversity studies, which includes natural history, classification, generation, ecology, genealogy, and reciprocal actions based on the three main pillars of plants, which create the framework of the ecosystem, insects and arthropods, which have the largest known diversity, and fungi and microorganisms, which have the largest unknown diversity. There are approximately 400 kinds of herbaceous plants and trees, 29 of the 32 orders of insects living on earth, and 86 of the 136 orders of fungi that can be observed and collected on the premises resulting from amassed know-how over many long years.

Glacial Relict

Species that were once widespread during the ice age had their growing seasons shortened as the climate warmed, and those that survived distributed throughout the limited remaining habitats are called glacial relicts. Many such creatures can be seen in Japan' s steep alpine belt. Meanwhile, Sugadaira has a cold climate similar to Wakkanai (the northernmost city in Japan) with gentle topography preferred by glacial relicts that include plants growing here such as the Rosa davurica, Miyabe maple, Shibata maple, Crataegus chlorosarca, Triosteum sinuatum Maxim., Lonicera vidalii, Lonicera maackii, and Lonicera morrowii, and the habitation of animals such as Grylloblattodea, and Scopura longa.


Crataegus chlorosarca


Rosa dauvurica Pallas


Acer miyabei


onicera maackii


Triosteum sinuatum


Grylloblattodea yuasai


Scopura montana

Precious Semi-Natural Grassland

This area is a semi-natural grassland of 6 hectares maintained with harvesting via human interference. The more than 60 cm deep black Andosol here is estimated to be grassland environment deposits that have continued for approximately 5500 years starting in the Jomon period. Grasslands have been cultivated and maintained with natural disturbances and human-led fires and grazing and are thought to account for 10% or more of Japan' s land from hundreds of thousands of years ago to beyond the ice age. However, the grasslands have declined rapidly in recent years due to the suppression of natural disturbances by humans and abandonment of artificial grasslands and now account for a mere 1% of land in Japan, which means that the numerous organisms that have inhabited the grasslands since ancient times are now in danger of extinction. It is extremely rare for an academic institution to be in possession of a grassland dominated by diverse native plants and utilize in research and education that includes operational experiments.

Low Temperature Environment in Winter

The cold of winter here is harsh with temperatures below freezing even during the day in the middle of winter for days on end. The average temperature in February is minus 5.5 degrees Celsius. December through April produces a roughly one-meter accumulation of snow, but as it is located in the Japan Sea weather sphere, there are many sunny days and you can observe winter birds and find footprints in the snow left behind by Japanese serow, squirrels, and other wild animals in the winter ecosystem that can be witnessed here. Exercises and research on snowy and ice climates that make use of the high-elevation and low-temperature environment are also conducted here.

Field Course in Biology durin snow season

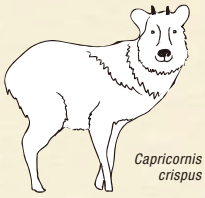
Japanese squirrel

Field course in Meteorology and Glaciology

ow air temperature environment in winter

Ikawa
Forest Station

The Ikawa Forest Station occupies the upper middle basin of Higashigouchi stream, a tributary of The Ooi River. As the slope is steep and the ground is brittle, collapsed areas can be found throughout. Across the vast secondary forest of more than 1300 hectares, you can observe the vegetation changing in accordance with the altitude. The Ikawa Forest Station Administrative Office, which is the operation base for the forest station, is located 25 kilometers down the Ikawa River from the forest station. It is equipped with accommodations for a maximum of 28 people, a kitchen, bath, toilet, and internet (Wi-Fi).



Capricornis crispus

Two of Major Fault Lines and Sediment Movement

The Ooi River upper river basin is sandwiched between two of Japan' s major fault lines, the Median Tectonic Line and the Itoigawa-Shizuoka Tectonic Line making the area subject to intense crustal deformation and the foundation in the area here collapses easily. Sandstone and shale formed on the ocean floor end of the Cretaceous period (approx. 60 million year ago) rose at an accelerated rate over the last several million years and at the same time severely corroded. As a result the Ikawa Forest Station boasts one of the country's highest sediment yields and the sediment movement here is more active than any other university-owned field in Japan. A debris avalanche occurs virtually every year, and research is conducted on erosion control and topography that make use of this phenomenon. The movement of the forest' s soil and water is surveyed in exercises for acquiring knowledge and skills regarding the forest' s function and usage. We measure the effects climate change, changes in forest vegetation, and deforestation have on micro weather systems and soil movement, as well as carbon and nitrogen circulation. Topography and erosion control engineering research is also often conducted here.

Earth flow sediment

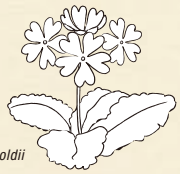
Bears Stripping

In the Ikawa Forest Station, which is a treasure chest of wildlife, damage from bears stripping the bark from trees leaves them worthless for construction use and is seriously hurting the forestry industry.

Yatsugatake Forest Station

Yatsugatake Forest Station

There are three fields within the organization of the Yatsugatake Forest Station. Megumi Forest (literally meaning forest of blessings, administrative office on site, 14 hectares) is in the southern portion of the Nobeyama highland. Two kilometers to the northwest of the Megumi Forest lies the Yatsugatake Forest (80 hectares, hereinafter this is what the term "Yatsugatake Forest" refers to) and the Kawakami Forest (189 hectares) sits four kilometers to the southeast. These places are inhabited by rare organisms such as Japanese primrose, Japanese dormice, and the Luehdorfia puziloi butterfly, and education and research on forests, parasitic fungi, soil, and hydrology are conducted here.



Primula sieboldii

Yatsugatake Forest

Located on the gentle slope stretching from the foothills on the east side of Yatsugatake' s main peak, Akatake, at an elevation of 1400 – 1450 meters. It is a natural forest occupied predominantly by Mongolian oak and birch trees (90%) mixed with lower shrubs such as hazel. The forest floor is mainly covered in Sasa nipponica. It is our policy to preserve these broadleaf forests. The soil is composed of Mesozoic sedimentary and Neogene period rocks and covered in Yatsugatake eruption residue and a layer of sandy foothill gravel. Black forest soil is distributed across the surface, which has poor drainage and breathability. As there are no large mountain streams among such soil and forest, recessed areas and small grooves are easily wet and transitional moors with mostly Moliniopsis japonica are scattered throughout. The surrounding area is mostly agricultural land pioneered after the war.

Megumi Forest

At an elevation of 1350 meters, there is a nature trail maintained among the surrounding facilities, which include an administration building and accommodation building, and it is open to the public for activities such as wild vegetable harvesting and mushroom picking. While growing the young forest of broad-leaved deciduous trees used by people, we are aiming to be an experiential outdoor facility where people can enjoy the gifts of the local grasses and flowers, forests, and trees.

Megumi Forest

Kawakami Forest

The Kawakami Forest is located in the elevation range of 1360 – 1790 meters on the westernmost end of the Kanto mountain range. It is an artificial forest composed mainly of larch (70%) and the remaining portion is a secondary forest composed of Mongolian oaks and birch trees. The forest station is on the border of Nagano and Yamanashi Prefectures and at the same time forms a watershed for both the Pacific Ocean and Japan Sea sides. Within the forest there are five incised valleys that feed into Misawa a branch of the Yadegawa River, which is a tributary of the upper Chikuma River. As such migrating sediment soil is distributed throughout the mountainside. The geology is made up of slate and other sedimentary rocks from the Mesozoic era, but on top of that there is a deposit layer of andesite from Mt. Iimori's volcano and the surface is covered in a base layer of weathered andesite and volcanic ash and covered in brown and black forest soil. The soil structure is mature making it better suited to an artificial forest than the Yatsugatake Forest Station. Small area dispersion clear-cutting (regeneration cutting) to induce a mosaic forest is implemented under a forest management plan.

Glirulus japonicus

Tsukuba

Experimental Forest Station

Botanical garden

The topography of the experimental forest station is made up of a layer of Kanto loam. When building the University of Tsukuba, rice paddies and wetlands were filled with soil dressing, and the soil features have now become complex. At Hyotaro Pond adjacent to the botanical garden, we conduct water quality surveys and catch and survey aquatic organisms with the aim of improving the environment. In the botanical garden, approximately 300 species of mostly native Japanese trees have accumulated. The orchard is mainly managed to provide replenishing plants to the botanical garden. The bamboo forest is used as a resting place for raw wood injected with mushroom fungi in exercises. The amounts of sunlight and water are adjusted to control the amount that develop. Over 0.21 hectares on the northern side, konara oak, sawtooth oak, and other trees are cultivated from seedlings as raw wood for mushroom growing and used in exercises and research. There is a botanical garden management building that acts as the base of operations for these activities.

Botanical garden, insects and fungi

The botanical garden is used as a place for plant-related education and research and relaxing on campus, but its value is not limited to plants alone. As a variety of trees are planted, a variety of insects and fungi come to inhabit them, so it is also used as a site for researching insects and fungi. A new variety of wasp has also been discovered in the botanical garden.

Insect trap

Shiitake cultivation

The Hyotaro Pond and aquatic organisms

At the Hyotaro Pond, surveys of the water quality and aquatic organisms continue to be regularly conducted. As a result, we were able to learn that a large number of non-native species, including bullfrogs, bluegills, and crayfish inhabit the pond. Although, this is certainly not a desirable ecosystem, we have used the situation to our advantage in exercises experimenting with the expulsion of non-native species and as a place to test effective non-native species expulsion methods.

the Hyotaro Pond

The experimental forest for growing cedars

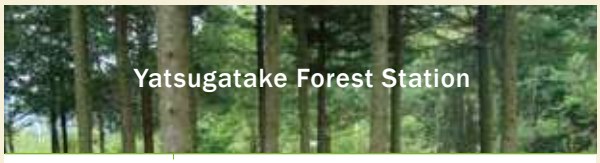
There is an experimental forest specifically for growing cedars in the orchard. It is made up of cedars collected from 14 populations of natural cedar forests in Japan consisting of seven cedar populations from the Japan Sea side and seven populations from the Pacific Ocean side. As the seedlings are still small, we look forward to using them in future research.

The experimental forest for growing cedars

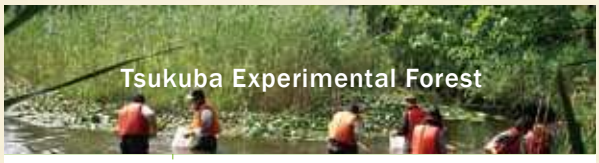
Field station comparative data

latitude	36.52473°N
longitude	138.34855°E
elevation	1315 m
annual average temperature※	6.6 °C
monthly average temperature※	-5.5～19.4 °C
Annual precipitation※	1343 mm
Maximum snow depth※	106.7 cm
Site area	35 ha (6ha of grassland, 4ha of red pine forest, 4.5 ha of mixed forest, 14 ha of deciduous broad-leaf forest, 4.5 ha of Arboretum)
Facilities and equipments	Overnight accommodation (44 people, Meals provided) Laboratory (40 people) Lecture room (30 people) Canopy tower (21m high) DNA sequencer Electron microscope (transmission type/scanning type) Microscope (stereoscopic microscope (40), optical microscope (40) Various incubators Various Refrigerators/ freezers minibus (26 people) Various vehicles
Staff members (as of 2018)	Faculty member (7), Researcher (1), Technical staff (7), Clerical staff (2)

latitude	35.21752°N (office premises)
longitude	138.22300°E (office premises)
elevation	755 m (office premises)
annual average temperature※	9.0 °C
Annual precipitation※	2800 mm
Site area	1760 ha of experimental forest, 0.47 ha of office premises
Facilities and equipments	Overnight accommodation (24 people) and AdministrationBuilding Dining room and Lecture room Microscope (stereoscopic microscope,optical microscope 7 units) Incubator Muffle furnace Reflection stereoscope Power shovel Various vehicles
Staff members (as of 2018)	Faculty member (2), Technical staff (2), Part-time staff (1)



latitude	35.94413°N
longitude	138.46972°E
elevation	1350 m (Megumi Forest)
annual average temperature※	7.0 °C
monthly average temperature※	-6.1～20.0 °C
Annual precipitation※	1465 mm
Maximum snow depth※	96.9 cm
Site area	80 ha of Yatsugatake Forest, 14 ha of Megumi Forest and office premises, 188 ha of Kawakami Forest
Facilities and equipments	Overnight accommodation (38 people) Seminar room (30 people) Laboratory (30 seats) Microscope (stereoscopic microscope, optical microscope 24 units) Incubator Various vehicles
Staff members (as of 2018)	Faculty member (1), Technical staff (2), Part-time staff (2)



latitude	36.11641°N
longitude	140.10133°E
elevation	28 m
annual average temperature※	14.5 °C
monthly average temperature※	2.4～27.1 °C
Annual precipitation※	1253 mm
Site area	3.4 ha of field, 2.2 ha of Botanical garden
Facilities and equipments	Training room (36 people) Laboratory Microscope (stereoscopic microscope, optical microscope) Incubator (2) Compact excavator Various vehicles
Staff members (as of 2018)	Faculty member (1), Technical staff (2), Part-time staff (2)

※ annual average for several years

【Open Facility and sharing facilities】 Transmission electron microscope (Hitachi HT7700, Sugadaira Research Station)

【Open Data】 Sugadaira Research Station: Meteorology, biota, and every tree census. See http://www.sugadaira.tsukuba.ac.jp/activity/database.html
Forest Stations: Meteorology, biota, and timber stock. See http://www.msc.tsukuba.ac.jp/ens/base_data.html

Initiative and Divisions

Mountain Science Research Initiative

This initiative promotes collaboration among the three divisions (Mountain Comprehension Division, Mountain Utilization Division, and Mountain Management Division) within the Mountain Science Research Center. It also actively promotes cooperation among industry, government, and academia and aims to develop the field of mountain science by strategically building collaborative research in Japan and overseas.


Participation in an event


Conclusion of a cooperative agreement with the Forestry Agency

For example, we are building cooperative relationships in order to promote distinguished research by holding international symposiums, inviting both domestic and overseas experts in the field of mountain science, and proactively registering and participating in international networks related to mountain science. To promote collaboration among industry, government, and academia, we have entered into a cooperative agreement with the Forestry Agency' s Kanto and Chubu Regional Forest Offices, and we are working with the Forestry Agency on educational research regarding mountains. We are also collaborating with The Japan Project Industry Council (JAPIC) and the National Mountain Day Council to actively propose means of revitalizing forests and working to popularize mountain science among the general population.

In addition, we are expanding our cooperative and collaborative relationships with mountain-oriented publishers and companies. We have invited people involved with these agencies, companies, and organizations to serve as instructors and conduct lectures in our Mountain Studies Master Degree Program, and in this way, we are promoting education and research based on the cooperation among industry, government, and academia.

Division for Understanding Mountains

In the Mountain Comprehension Division, our activities work to deepen our understanding of the natural environment in mountainous regions and its transition from the past to present and into the future based on the fields of biology and earth science. Currently, the natural environment in mountainous regions is facing numerous environment issues, including climate change and loss of biodiversity. In this division, we are engaged in education and research aimed at resolving these issues and the sustainable coexistence of nature and mankind.

Climate Change

We are working on a broad range of issues related to climate change, including the fixed amount and circulation of carbon dioxide in forests, the melting of permafrost and soil erosion in Japan and around the world, and the water environment and resources at the headwaters in mountains. We hope to provide knowledge that will be beneficial to understanding the relationship between the climate and mountain environments and methods for its management.


Investigation scenery in the beech (*Fagus crenata*) forest

Biodiversity

In terms of biodiversity, we are contributing to the understanding and development of this basic science through: the elucidation of the genetic diversity of trees in the Asian region, the investigation of the complex symbiotic pollination system between plants, pollinator, and microorganisms, the determination of the systematic taxonomy of fungi living in a various environments, the study of the biology of lichens, and by providing new knowledge regarding the systematic evolution and diversity of insects.

Division for Managing Mountains

In the Mountain Management Division we are engaged in education and research regarding forest management and its utilization, including forest disaster prevention and wood resources mainly in the Chubu area mountains. Our focus is on the practical application of the basic science investigated in the Mountain Comprehension Division.

Natural Disaster Prevention and Reduction

Japan's central mountainous region and its surroundings are home to some of the highest elevations in Japan. The mountains that make up this area near Japan' s central fault line are characterized by their extreme steepness and brittleness and the mixture of mountains formed from volcanic activity. Scientific efforts in mountain disaster prevention are very important in an area such as this. Our efforts to elucidate the mechanisms of landslides, which frequently occur in steep mountainous areas, incorporate on-site observation and experimentation. In addition, in a country like Japan with a large number of volcanoes, responsive measures to landslides are a necessity, as are conservation activities that harmonize with the surrounding environment. We are addressing this issue by investigating the factors influencing vegetation succession and the factors that define it. In addition to thorough field observation, we are broadening the range of education and research by conducting simulations based on those observations.


The forest at the Mountain Science Center's Ikawa Forest Station where landslides frequently occur on the steep mountain surface.


Vegetation on Mt. Asama's surface beginning to recover after a volcanic eruption.

Forest Management and Usage

While there are abundant forests in Japan's central mountain region, many of those forests are not well managed. In addition, they suffer serious damage from wildlife. We are working on proposals to manage the forests aimed at an optimal solution for timber production and countermeasures against wildlife damage, taking into consideration what is most suitable for the land and the trees.

In terms of our forest usage activities, in addition to aspects such as forest resources, we also delve further into research regarding tourism in mountainous regions, and we have also been working on issues regarding the relationship between climate change and tourism in mountainous regions. We are studying ways to manage mountainous regions using tourism within forest ecosystem services.


Forest management and usage


The Chichibu mountains and Yatsugatake from the peak of Mt. Kobushi.

Division for Utilizing Mountains

In the Mountain Utilization Division, we work to understand the value of mountainous regions' various resources (living organisms, forests, topography and geography, space, water, etc.), and through effective and sustainable activities involving these resources, we conduct educational research with the aim of contributing to the development of local societies and mountain communities. This division is characterized by its dual approach from both a natural science and social science perspective.

Regarding issues in the realm of natural science, we are conducting research on the utilization of wood and the development of processing techniques and new uses for biological resources in mountainous regions along with the effects of agricultural pests. For example, this would include research on the characteristics and applications of wooden materials treated with different processing methods, such as compressed wood or heat-treated wood. In the realm of social science issues, we analyze the development process of sightseeing and tourism in mountainous regions and compare and analyze cases overseas, measure the economic effects forest therapy businesses bring to local communities, research forestry management and measures to train forestry laborers and their effects, consider the structure of the continuous bamboo forest development project, and other research with the aim of developing mountain communities and resolving issues.

We approach our educational research activities with a multi-faceted perspective so that they can lead to environmental improvement and economic development in mountainous regions.


The soundboard on grand harps are reinforced with carbon fiber.

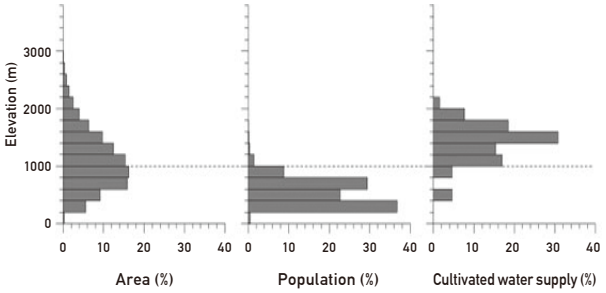

Forest therapy

Research Topics

Geosphere

Water is a gift from the mountains

Tsutomu YAMANAKA



There is a saying that “the forest cultivates water,” but in fact if we are referring to water supply, then the mountains are more important than the forest. Mountains, with their high altitudes and low temperatures, have high rainfalls and low evaporation rates. They also store the winter snowfall from spring to summer. As a result, mountains are often described as natural water towers. We used hydrogen and oxygen isotopes, which make up the water molecule, to examine at what altitude water sources are built up by rainfall and found that in both Nagano and Yamanashi prefectures, approximately 90% of the water supply source is cultivated at an altitude higher than 1000 meters. In other words, a natural water tower’s height is higher than 1000 meters.

Figure : Altitude distribution by area, population, and cultivated water supply in Yamanashi Prefecture (from Yamanaka & Yamada 2017)

Monitoring geomorphic changes in the Southern Japanese Alps

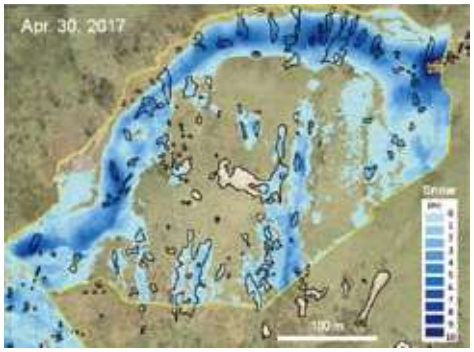
Norikazu MATSUOKA

The Southern Japanese Alps is the most dynamic mountain range in Japan. Rockfalls, landslides, and debris flows often occur on its steep slopes, and the rivers transport the sediment into the surrounding plains and basins. Over the last 40 years, we have monitored temporal changes in geomorphic processes with various field equipment. For example, in order to decipher the timing and trigger of rockfalls, we record opening of rock joints with crackmeters, air and rock temperature, precipitation, windspeed, and rock moisture content every 1-3 hours. We also monitor the daily conditions of the rockwall with a time-lapse camera to identify when and where rock blocks have detached

Photo : Monitoring geomorphic changes in the Aresawa landslide that calves the Southern Japanese Alps.

Photogrammetry to explore snow depth on a steep mountain

Atsushi IKEDA



On mountain slopes above the forest line, snow is blown from the windward direction and accumulates in the leeward direction. The accumulated thick snow layer often glides down and occasionally erodes the ground below. As part of our research in erosion processes, we measured snow depth on Mt. Tairappyo. The snow on the studied slope was too deep to use a snow measuring rod, and it was dangerous for researchers to visit the site in the avalanche season. Therefore, we used photographs taken from a drone to make 3-D models of the snow surface. We found the snow depth from the difference in altitude between the snow and ground surfaces (figure). We were also able to learn the details of the surface erosion through the same photogrammetry using a number of photographs taken in different seasons. Finally, we discussed the events contributing to both winter and summer erosions.

Figure : Snow depth at the end of April on the western ridge of Mt. Tairappyo. The black lines are used to encircle eroded surfaces.

Exploring weather fluctuation in mountainous areas

Kenichi UENO

Mountain environments are strongly affected by global climate change by means of land-atmosphere interactions. I have been engaged in precipitation system studies over the Tibetan Plateau and Himalayas, which are affected by Asian monsoon variabilities, including several international projects, such as JICA, as my lifework. In Japan, mountain weather data archive and satellite precipitation comparison studies have been conducted in central Japan under JAXA cooperation research. At the same time, effects of forest phenology variabilities on micro-meteorology and rain-on-snow in high-elevations by extra-tropical cyclones have been investigated using Sugadaira and Yatsugatake Research Stations.

Photo : Meteorological observations against the backdrop of Yatsugatake

Research Topics

Geosphere

Characteristic sediment disasters in volcanic areas

Yosuke YAMAKAWA

How sediment disasters triggered by rainfall, such as landslides, are formed and the amount of dangerous volumes of rain may vary greatly depending on geology, which is the ground conditions of the area. The landslide that occurred on the western slope of Mt. Mihara on Oshima Island in the Izu Peninsula (surface failure in photo) due to the heavy rains brought by typhoon #26 in October 2013 (800 mm of rainfall over 24 hours) was of the sediment loess layer during the volcano' s dormant phase. Compared to the sediment of the tephra layer during an active phase of the volcano, it has a finer grain and therefore served as a low-permeable layer. We can then infer that the rainwater that infiltrated vertically formed a saturated zone directly on top of the loess layer, and the upper surface of the loess layer served as the slip surface destabilizing shallower soil clods, which caused the landslide.

Photo : Surface failure on the western slope of Mt. Mihara

The carbon cycle of a mountain as seen through dead trees

Mitsuru HIROTA

In my field of specialty, ecosystem ecology, great importance is placed on describing the state and functions of nature in a true and faithful manner. For example, when you think of a forest, you probably imagine lush, green trees, but the corpses of dead trees are also an important element. These dull looking dead trees not only serve as habitats for insects and fungi, they also have the function of changing the flow of water and matter in the forest and can perform long-term carbon sequestration. However, the difficult part is how we examine them. Dead trees vary in form and degree, such as trees that are still standing though dead, trees that have fallen over in the forest, and dead trees buried in the soil. The most accurate way of examining them is a very primitive method consisting of walking through the forest and noting the characteristics of all of the dead trees, such as size, weight, type, and degree of decay (photo).

Photo : Dead tree investigation at the site of a volcanic eruption on Miyake Island.

Biosphere

The life of plants governed by mountain rules

Kenta TANAKA (also known as Tanaka KENTA)

The flower ***Arabidopsis kamchatica*** (photo) can be found distributed throughout the Japanese central mountainous area at elevations from zero to 3000m. At low elevations it is an annual plant and at higher elevations it changes its way of life and becomes a perennial adapting to the higher elevation. In the highlands there are also hairs on the leaves whilst the leaves often have no hair in the lowlands. Along the rivers that carry the seeds from the highlands, there are plants with hairy leaves even in the lowlands. However, as the hairy plants tend to produce fewer seeds and have a difficult time surviving in the lowlands, they are a burden on the lowland populations. As such, the life of ***A. kamchatica*** is governed by mountain rules: (1) dramatically different environment depending on elevation and (2) the flow of matter from the summit down to the foot.

Photo : *Arabidopsis kamchatica*, which prefers sand and gravel

The natural history of fungi living in the mountains

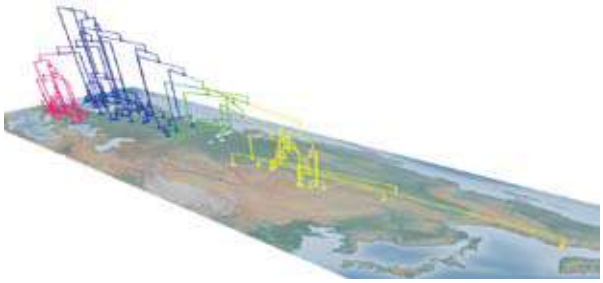
Yousuke DEGAWA

Our research focuses on the natural history of the kingdom Fungi which includes the phylogenetic classification and ecology of all groups of the fungi (Chytridiomycota, Zygomycota, Dikarya) as well as pseudofungi and slime molds in mountainous areas, such as Sugadaira. There are about 100,000 species of molds, yeasts, mushrooms and other fungi known around the world, but it is said that if we include the species that are yet unknown, the total number would reach 5 million species. Our aim is to use our fieldwork to elucidate the relationship between fungi and various animals and plants, which is where this enormous diversity was generated. In recent years especially, new groups of fungi have been discovered in the intestinal tracts of insects and other arthropods. Attention is now being drawn to the characteristics of their life histories and their applied value to industries such as fermentation and pharmaceuticals.

Photo : Right - *Anisolabis maritima* (common species of earwig)
Left - *Pinnaticoemansia coronantispora* zygomycetes discovered in its intestine

Using genetic information for the conservation and management of species and ecosystems

Yoshiaki TSUDA



Over the long histories of living species there have been numerous geohistorical events. These include crustal deformation and the formation of mountains and rivers. There have also been climate changes, such as the progression from the ice age to the interglacial period. These events and changes have caused shifts in the distribution of species and adaptions to their environments resulting in the formation of the current distribution. Assessing the histories of these organisms is not only important in an evolutionary biological sense, but also in predicting how organisms and ecosystems will change under the conditions of future climate change. In our research, the large mountain ecosystem stretches from the mountains to the ocean and we study the population genetics and genomics of various domestic and overseas organisms including trees, fish, mammals, insects, endangered species, and non-native species, applying our research to the conservation and management of ecosystems.

Figure : Genetic composition of the coniferous species distribution on the Eurasian continent (Tsuda et al. 2016 MolEcol re-analyzed data)

Looking at the movement of mountain forests

Tatsuyuki SEINO

The trees that make up a forest vary from place to place depending on species and the height of the forest. If we can understand what brings about these changes, we can understand the characteristics of mountain forests. We have set up a fixed testing site in the forest and measure information such as the height of trees and the girth of their trunks, as well as measuring how much they have grown and when they died every few years. The measuring itself is a relatively simple and straightforward process. However, movement of forests can only be seen from measurement data accumulated over a long-time span. It is also necessary to measure in many places to see the characteristics of each location.

Photo : Investigation site at Ikawa Forest Station

Anthroposphere

Regional study in mountainous areas

Satoshi TACHIBANA

We are using materials and data collected from conducting participatory observations, interviews, and questionnaires to understand and analyze changes over time and actual conditions of various aspects of mountain areas and communities, such as how communities are formed in mountainous areas and people' s lifestyles, how local resources are managed and used, and the structure of industry. We are carefully studying related previously written literature and survey reports and designing research in accordance with theories and research topics obtaining materials over the course of stays that consist of days, weeks, and months (photo). Some researchers stay on site for long periods of time utilizing their insight and intuition based on the use of their own five senses while they collect and analyze data and materials from the research trips. Utilizing such regional study methods, we are hoping to contribute to the development of mountainous areas and communities from a humanities and social science approach.

Photo : Investigating local bioresources

Studying mountainous area tourism

Masaaki KUREHA

Humans have had various relationships with mountainous areas over time. Traditionally, mountains have been important for collecting food (plants and animals) and fuel, and for religion. In the last 150 years, mountains have attracted attention as the target of tourism with the advent of various activities such as trekking and skiing. We are elucidating the characteristics of this tourism from a geographical standpoint. Our main research subject is the ski resorts in the Austrian Alps. Recently, we have been comparing Japan and the Austrian Alps with regard to the relationship between mountain resorts and trekking.

Photo : Lech (a mountain resort in the Austrian Alps)

Pamphlet of Mountain Science Center
Published in March, 2020

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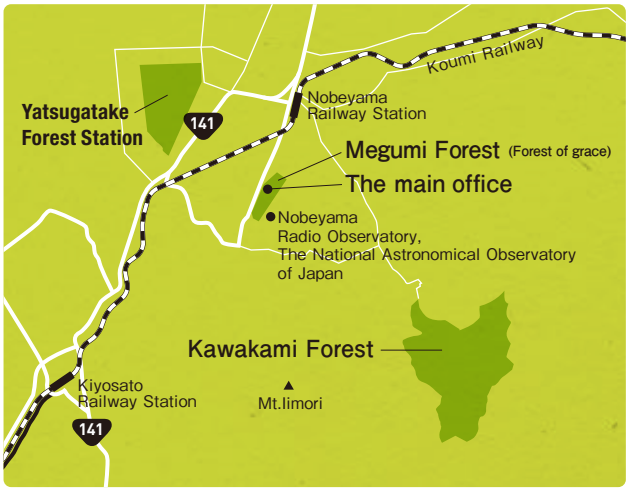

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