International Forum for Adaptability Science II: Technologies for a Sustainable Society

Nov. 30–Dec. 3, 2010, Sendai, Japan

Tohoku University Ecosystem Adaptability Global COE

Preface

Today, the Earth's environment is drastically changing due to global warming and human activities. These changes impact both organisms and ecosystems, altering landscapes, decreasing and shifting habitats, eliminating biodiversities, and so on. In this situation, the functions and services of organisms and ecosystems will be unable to maintain human society.

Is the impact of these changes broken down by current technologies? In order to continue to obtain natural resources, overcome natural disasters and diseases, and improve lifestyles, human beings have developed many kinds of technologies that enable point-by-point approaches to problems. For instance, civil engineering technology is useful to prevent decreases in coastal areas and is necessary for river management in urban development, including water utilization and disaster prevention. In agriculture, genetically monoclonal crops, which have resistance against single or multiple environmental factors, are grown on a large scale to increase the efficiency of crop yield. This kind of strategy is also applied for the obtainment of wood resources. Epidemic control uses chemical reagents, such as pesticides and antibiotics, to combat the spreading of infectious diseases, aiming at the eradication of pathogens.

Such nature-overcoming technology is, however, insufficient to deal with the currently severe environmental impact upon organisms and ecosystems, not only because of uncertainty in their response to environmental changes, but also because of environmental unpredictability. Ecosystem adaptability science* is a novel research domain regarding effective management schemes for the purpose of maintaining the functions and services of ecosystems by taking their adaptive environmental mechanisms into account. In the case of decreasing coastal areas, preservation technology for marine resources should be established based on the knowledge of nearshore ecosystems. Genetic diversity may conquer the reduction of yield in the midst of rapid environmental changes and spreading diseases. With the concept of ecological adaptability, epidemic control will also be more effective.

In this second International Forum, we focus on "eco-adaptability technologies" that can maintain ecological functions and services and protect sustainable societies against environmental changes by applying the natural mechanisms of ecological adaptability. Because this challenging measure has not been established yet, we should integrate the knowledge of ongoing technologies to achieve the goals of ecosystem adaptability science. Therefore, forum members in widespread fields of technology—including fissure science, agriculture, forestry, epidemiology, and engineering—are invited to participate by giving talks and taking part in discussions.

Ecosystem adaptability science

Ecosystems are subject to significant changes because of unavoidable global environmental changes, such as global warming. The most important measures to cope with these changes should include maintenance of multifold ecosystem functions and services. Industrial technology alone is insufficient to cope with such changes, not only because of the difficulties involved in timely innovation, but also because of limited and unpredictable resources and/or energy sources.

Organisms and ecosystems possess inherent properties to maintain and adjust themselves in response to environmental fluctuation. For instance, movement flexibility, adaptive plastic responses, and evolution of organisms may all help reduce loss of biodiversity. Adequate space and land also confer robustness. Furthermore, ecosystems have the innate ability to clean and decompose pollutants; thus, more effective management schemes for maintaining such natural abilities are essential. In support of current thinking (e.g. Levin, 1999) we propose a novel research domain, “ecosystem adaptability science,” that covers a wide range of disciplines and academic fields (biology, ecology, ecosystem technology, and socioeconomics) to maintain and better harness the multiple functions and services of ecosystems. Robustness and stability are required not only for ecosystems themselves, but also for the technologies and social systems that affect them. Thus, our new ecosystem adaptability science will include a wide range of natural, economic, and social scientific disciplines.

Basic science (ecology, evolutionary biology, environmental genetics, and environmental biology) aims to investigate the mechanisms by which organisms and ecosystems respond to environmental change. It also attempts to identify the properties that lend robustness and stability to organisms and ecosystems. Since response to environmental change varies according to biological entity and functional level (cell, organism, population, community, or ecosystem) it is important to establish robustness and stability at all of these levels. Technology (agriculture, ecosystem conservation, bio-regulation, and ecological engineering) investigates and develops technologies to maintain ecosystem services by applying methods identified by basic science. These include the adaptive management of ecosystems, technologies to assist sustainable use rather than to increase tentative efficiency, and/or the way incorporating the surprises. The social sciences (environmental economics and sociology) also study environmental unpredictability (risk) in relation to society. These include evaluation of ecosystem services, assessment of ecological risk, and measurement of human adaptation to global warming. We also need to develop social and economic systems that incentivize sustainable systems.

November 30, 2010

Day 1 - Tuesday

@SAKURA Hall

14:00 **Registration**

16:00-17:00 **Forum open**

Opening remarks

Tohru Nakashizuka

(Project leader of Tohoku University Ecosystem Adaptability GCOE program)

Concept of ecosystem adaptability science

Takehiro Sasaki

(Organizer from the first international GCOE forum)

17:00-18:00 **Welcome party, Exhibition**

December 1, 2010

Day 2 - Wednesday

@Sendai City Information & Industrial Plaza

12:00 **Registration**

14:00-17:00 **Session 1**

Technology for marine resource conservation

(Chairpersons: M. Ikeda & H. Endo)

14:00	Minoru Ikeda	Introduction of this session
14:05	Yoshiro Watanabe	Sustainable Use of Fluctuating Living Marine Resources
14:45	Frédéric Guichard	From dynamic metapopulations to the design of marine reserve networks
15:25	Coffee break	
15:40	Cameron Ainsworth	Tools for modelling marine food webs and fisheries
16:20	Susumu Chiba	Selective fishing causes unnatural changes in life history traits of exploited species

17:00-18:00 **Poster session (1)**

December 2, 2010

Day 3 - Thursday

@Sendai City Information & Industrial Plaza

9:00 **Registration**

9:30-12:30 **Session 2**

Sustainable agriculture under biotic and abiotic environmental changes

(Chairpersons: Y. Suyama & H. Tomimatsu)

9:30	Hiroshi Tomimatsu	Introduction of this session
9:35	Sergio Rasmann	Belowground plant volatile emissions to enhance biological control of crop pest

10:15	Dana Cordell	Peak phosphorus: Sustainable management of a critical resource for global food production
10:55	Coffee break	
11:10	Masanori Saito	Can manipulation of soil biological processes increase nutrient use efficiencies by crops? A case in arbuscular mycorrhizal fungi
11:50	Kazuaki Naito	Restoration of agricultural ecosystem under reintroduction of the oriental white stork
12:30-14:30	**Lunch**	
14:30-17:30	**Session 3**	
	Forest conservation resources to sustain society against environmental changes	
	(Chairpersons: M. Konoshima & H. Kurokawa)	
14:30	Masashi Konoshima	Introduction of this session
14:35	Mark Swanson	Matrix management in the 21st century: challenges, conservation strategies, and technical approaches
15:15	Michael Wimberly	Forest Management for Sustainability in a Changing Environment
15:55	Coffee break	
16:10	Nophea K. Sasaki	Managing forest resources for sustaining society under the REDD+ mechanism
16:50	Steven Strauss	Genetic modification of forest trees: A powerful tool gathering dust (hokori wo kabu-tteiru)?
	@Sendai City Information & Industrial Plaza	
18:00-20:00	**Forum reception/Poster session (2)**	

December 3, 2010

Day 4 - Friday

@Sendai City Information & Industrial Plaza

9:00	**Registration**	
9:30-12:30	**Session 4**	
	Control of epidemics and ecological adaptability concepts	
	(Chairpersons: S. Kurata & A. Goto)	
9:30	Shoichiro Kurata	Introduction of this session
9:35	Jean-Marc Reichhart	The antimicrobial defense in *Drosophila*, a paradigm for Innate Immunity
10:15	Monde Ntwasa	*E. intermedius* potential for antimicrobial peptide development and for biofuel production
10:55	Coffee break	
11:10	Kathy Han-Ching Wang	Alternative adaptive immunity in shrimp and its applications for the control of shrimp infectious diseases

11:50	Kaoru Azumi	New method for the risk assessment of marine chemical pollutants using ascidian DNA microarrays
12:30-14:30	**Lunch**	
14:30-17:50	**Session 5**	
	Ecological control of urban environments	
	(Chairperson: K. Nakano)	
14:30	Kazunori Nakano	Introduction of this session
14:35	Allen P. Davis	Ecological Treatment of Urban Storm Water Runoff
15:15	Abraham A. Mabelis	Ecological control of urban environments
15:55	Francisco J. Escobedo	Integrating ecosystem adaptability science, ecosystem services, and policies to mitigate urbanization and climate change effects
16:35	Coffee break	
16:50-17:20	**General discussion**	
17:20	**Closing remarks**	
	Masakado Kawata	

Invited Presentations

Sustainable Use of Fluctuating Living Marine Resources

Yoshiro Watanabe
Atmosphere and Ocean Research Institute, University of Tokyo

World capture production of living marine resources (LMR) increased in the second half of the 20th century, but stayed at a level of 85 million ton since the late 1980s. In contrast, world aquaculture production has increased to 33 million ton in 2006, occupying 28% of the total marine production. When we look into details of the aquaculture production, 46% is occupied by sea weeds and another 42% is by bivalves (oysters, mussels, etc). Sea weeds intake natural nutrients to grow, and bivalves wild phytoplankton and particulate organic matters. Some 11% is occupied by feeding culture of fishes and shrimps. In total, 97% of world marine production is by harvesting the seas.

The seas fluctuate naturally. In marine ecosystems, biogeochemical cycle varies and biological productivity changes. We experienced substantial changes in productivity of sardine and anchovy in the end of the 1980s in the western North Pacific. Sardine flourished up to 1987, but suddenly started failing in reproduction in 1988. Synchronously but contrastingly, anchovy started successful reproduction in this year. These changes in population trends seem to be associated with the Regime Shift of marine ecosystem in the western North Pacific.

In the 20th century, the Maximum Sustainable Yield (MSY) was the goal of fisheries managements as stated in Law of the Sea. We tried to stabilize LMR at a MSY level. Populations are relatively stable in the warm water areas. A subtropical round herring has been stable in catch at 45 kton in the last 50 years. The MSY theory may be applicable to this type of stable populations. In cold water fish Pacific herring, on the other hand, the catch fluctuated greatly owing to outbreaks of young fish once in several years. Maximum annual catch of Pacific herring was as large as 1 million ton. Nearly 50% of sum of the annual catches during 1910-1950 was occupied by huge 6 year classes. Outbreaks and inevitable large fluctuations are essential traits of populations of great biomass. The MSY theory is not applicable to the Pacific herring type of populations. We need a new theory for sustainable use of fluctuating LMR.

Yoshiro WATANABE (ywatanab@aori.u-tokyo.ac.jp)
Professor, Living Marine Resources: Small pelagic migratory fishes, such as herring, sardine, anchovy, etc, are essential component of marine ecosystems in the world oceans. They connect plankton productions to top predator (tunas, sea birds, marine mammals) in terms of food web. They are essential food resources for human, occupying 25% of world production of LMR. Characteristic nature common to these species is a large variability. Japanese sardine fluctuated in biomass from 0.1 – 20 million ton in the last 30 years. Growth and survival in larval and juvenile stages are key processes in understanding dynamics of these fluctuating populations.

From dynamic metapopulations to the design of marine reserve networks

Frederic Guichard[1] and Tarik Gouhier[2]

[1]McGill University, Departement of BIology
[2]Oregon State University, Department of Zoology

In marine systems, classical theory holds that the influence of demographic processes and dispersal is confined to local populations whereas the environment controls regional patterns of abundance. Here, we reveal synchronized fluctuations in the abundance of mussel populations across a whole continent despite limited larval dispersal and strong environmental forcing. Dispersal among neighboring populations interacts with local demographic processes to generate characteristic spatial synchrony patterns that govern the dynamic distribution of mussel abundance over 1,800 km of coastline. We further show how our results can drive the optimal size and spacing of reserve networks for both fisheries and conservation. Properly configured networks of marine reserves can serve both conservation and fishery management goals. However, current spatial configuration guidelines are based on the assumption that reserve networks control the spatial distribution of species by altering natural patterns of abundance and connectivity in marine metapopulations. We show that reserve networks that accommodate instead of dictate the spatial distributions of abundance and connectivity create a positive feedback between spatial patterns of abundance, connectivity and larval supply that maximizes total abundance and persistence in both protected and unprotected areas.

Frederic Guichard (E-mail: frederic.guichard@mcgill.ca) is interested in the study ecosystems as complex systems and in problems of scale in ecology. He is more specifically interested in understanding how large scale patterns of biological diversity and abundance develop and are maintained from local interactions among individuals.

Related publications:

Gouhier, T.C., Guichard, F. And Menge, B.A. (2010). Ecological processes can synchronize marine population dynamics over continental scales. Proceedings of the National Academy of Sciences USA. 107:8281-8286

Guichard, F. (2005). Interaction strength and extinction risk in a metacommunity. Proceedings of the Royal Society of London B. 272:1571-1576.

Guichard, F., Levin, S.A., Hastings, A., and Siegel, D. (2004). Toward a dynamic metacommunity approach to marine reserve theory. BioScience. 54(11):1003-101

Tools for modelling marine food webs and fisheries

Cameron Ainsworth[1], Isaac Kaplan[1], Phil Levin[1], Beth Fulton[2]

[1] National Oceanic and Atmospheric Administration (NWFSC-NOAA), Seattle, USA
[2] Commonwealth Scientific and Industrial Research Organisation (CSIRO), Hobart, Aus

The last 30 years have seen fast progress in our ability to model marine ecosystem dynamics and predict the impacts of fisheries and climate on food webs. Advances in computing power and improvements in our understanding of how populations grow and interact have allowed the field of ecosystem modelling to progress from the simple predator-prey dynamics equations of Lotka and Volterra to complex multi-species and ecosystem-level population models. Although many national ocean policies and international agreements mandate the use of 'ecosystem-based management' (EBM), scientific tools have lagged behind the technical requirements of EBM, but ecosystem models are beginning to close the gap. I will provide a summary of the many ongoing ecosystem science initiatives and tool development programs underway in Canada, the US and Australia. In particular, I will highlight two successful modelling approaches, Atlantis (a biogeochemical simulator) and Ecopath with Ecosim (a mass-balance trophodynamic simulator). Current developments in these modelling systems highlight model coupling with oceanographic and global climate models, improved user interfaces, semi-automated model creation and parallelization of code to enable distributed computing. I will show case studies from the Eastern Pacific, including examples of where ecosystem models have been used in fisheries management.

Cameron Ainsworth (E-mail: cameron.ainsworth@noaa.gov)
Post-doctoral Fellow. My research is focused on understanding how human activities influence the structure and functioning of marine communities. Human activities such as fishing, coastal development and agriculture have had a broad and sustained impact on marine ecosystems worldwide; the result has been biodiversity loss, local extinctions and impairment of ecosystem services. However, where ecosystems are degraded, restoration of ecosystem health can be a cost-effective investment. For example, there is an established link between preserving biodiversity and maintaining harvested populations, which can be demonstrated numerically. We can therefore make a salient argument in support of marine conservation from an economic viewpoint by quantifying the value of ecosystem services.

Selective fishing causes unnatural changes in life history traits of exploited species

Susumu Chiba

Department of Aquatic Bioscience, Tokyo University of Agriculture,
Hokkaido 099-2493, Japan

Since mortality is a fundamental component that influences life history trade-offs in nature, commercially exploited marine organisms may change their life history parameters to accommodate fishing mortality. Generally, however, fishing selection counteracts natural selection because of its selectiveness. In recent years, reports of genetic shift in the growth and reproductive schedule of exploited species by size-selective fishing have been increasing dramatically. In addition, intentionally or unintentionally, fishing often selects only male or female. Since sex ratios are in equilibrium in accordance with the evolutionary stable strategy under natural selection, unnatural sex-selective mortality alters the fitness balance between male and female. However, there is less information on how sexual selection shapes the life history of exploited animals. After reviewing the effect of fishing as an evolutionary driving force, I describe a concrete example of plastic sex-ratio adjustment by a male-first sex-change shrimp exposed to unintentional female-selective fishing. I expect, however, that a genetic downsizing in their size at sex-change is due both to large-size-selective fishing and to female-selective fishing that exceeds the shrimp's ability to adjust its sex-ratio. At the end, I discuss the importance of an evolutionary perspective in efforts to sustain fishery yields.

Susumu Chiba (E-mail: s2chiba@bioindustry.nodai.ac.jp)
Associate Professor. My general research interests are in the evolutionary ecology of benthos and the application of this knowledge to sustainable fishery management. My main project currently is to demonstrate the effect of fishing on local populations of a pandalid shrimp, and then to design a shrimp fishery that combines demography, ecology and conservation genetics.

Belowground plant volatile emissions to enhance biological control of crop pest

Sergio Rasmann

Ecology and Evolutionary Biology, Cornell University, Ithaca, NY, 14853, USA

When attacked by herbivorous insects, plants emit volatile compounds that attract natural enemies of the insects. Despite the strong support for such interactions aboveground, only recently, there is mounting evidence that damaged roots can also emit signals in the soil responsible for attracting soil-dwelling entomopathogenic preadators or parasitoids near the site of damage. For example, the larvae of the western corn rootworm (*Diabrotica virgivera virgifera*), a maize pest that is currently invading Europe, induce the roots of many maize varieties to emit (*E*)-β-caryophyllene, which attracts entomopathogenic nematodes that infect and kill the voracious root pest. Most North American maize lines do not release (*E*)-β-caryophyllene, whereas European lines and the wild maize ancestor, teosinte, readily do so in response to *D. v. virgifera* attack. Recent research has however shown that the signal can be restored. To restore the signal, a non-emitting maize line was transformed with a (*E*)-β-caryophyllene synthase gene from oregano, resulting in constitutive emissions of this sesquiterpene, and transformed plants suffered significant lower root damage than the untransformed control. This demonstration that plant volatile emissions can be manipulated to enhance the effectiveness of biological control agents opens the way for novel and ecologically sound strategies to fight a variety of insect pests.

Sergio Rasmann (srasmann@gmail.com)

My main center of interest lies in the ecology and evolution of plant defenses against insect herbivores above- and belowground. Recently, I could uncover a new chemically-mediated belowground interaction, showing that corn roots, when attacked, emit a volatile organic compound in the soil (an odor), that increase the attraction of entomopathogenic nematodes toward their host, the insect larva feeding on the roots [1]. This research has strong implications for sustainable control of important root pests [2], as well as improving our knowledge on chemically-mediated interactions in natural systems [3].

1. Rasmann, S. et al. Recruitment of entomopathogenic nematodes by insect-damaged maize roots. Nature 434, 732-737 (2005).
2. Rasmann, S. & Agrawal, A. A. In defense of roots: A research agenda for studying plant resistance to belowground herbivory. Plant Physiology 146, 875-880 (2008).
3. Rasmann, S., Erwin, A. C., Halitschke, R. & Agrawal, A. A. Direct and indirect root defences of milkweed (Asclepias syriaca): trophic cascades, trade-offs and novel methods for studying subterranean herbivory. Journal of Ecology, doi: 10.1111/j.1365-2745.2010.01713.x (2010).

Peak phosphorus: Sustainable management of a critical resource for global food production

Dana Cordell

Institute for Sustainable Futures, University of Technology, Sydney,
PO Box 123 Broadway, NSW 2007, Australia

Global phosphorus scarcity is likely to threaten the world's ability to produce food in the future if concerted efforts are not soon taken by policy makers, scientists, industry and the community. Phosphorus is almost entirely used for food production in the form of fertilizers, yet the world's main source of phosphorus – phosphate rock – is a non-renewable resource that is becoming increasingly scarce. Phosphorus has no substitute in crop growth. Whilst global phosphorus scarcity is at least as serious as energy and water scarcity and many other global sustainability challenges, it has received very little attention. There are many dimensions and implications of phosphorus scarcity, from peak phosphorus, which is anticipated in the coming decades (after which demand will outstrip supply) to a lack of accessibility of phosphorus due to current inefficient use, ineffective governance and geopolitical tensions. If no action is taken now, a 'hard-landing' situation is likely to lead to further phosphate price spikes, increased phosphorus pollution and waste (including eutrophication), increased energy use, increase costs and hence reduced farmer fertilizer access, reduced global harvests and an increase in food insecurity. Averting a crisis is possible, however will require substantial changes to our physical and institutional infrastructure. Achieving a sustainable phosphorus future will require an integrated approach to substantially reduce global phosphorus demand through changing diets, increasing efficient use in agriculture and food commodity chain, coupled with a high recovery and reuse rate of all sources of phosphorus (from excreta and manure, to food waste, crop residues and other sources).

Dana Cordell (E-mail: Dana.Cordell@uts.edu.au)
Dana Cordell co-founded the Global Phosphorus Research Initiative (www.phosphorusfutures.net) in 2008 with colleagues in Sweden and Australia, as an outcome of her doctoral research on the 'sustainability implications of global phosphorus scarcity for food security', which she undertook jointly at the Institute for Sustainable Futures at the University of Technology Sydney, in Australia, and, Linköping University's Department for Water and Environmental Studies in Sweden. Dana is currently a core member of an international consortium of researchers working on the Sustainable Use of Phosphorus project for the European Commission. She also has 10 years of research and consultancy experience leading and undertaking interdisciplinary sustainable water, sanitation and waste management projects many of which involved high-level stakeholder engagement. Dana undertook an international masters degree in Sweden in 2004-5 on Water Resources and Livelihood Security, with a special focus on the challenges and opportunities of urine diversion and reuse.

Can manipulation of soil biological processes increase nutrient use efficiencies by crops? A case in arbuscular mycorrhizal fungi.

Masanori SAITO

Field Science Center, Graduate School of Agricultural Science, Tohoku University, Naruko-Onsen, Osaki, Miyagi, 989-6711, Japan

Increase in crop productivity is required to meet food demands of growing human population. To attain high yields of crops, a large amount of nutrient as fertilizers is applied to soil. As a result, it is often that excess N and P cause environmental pollution such as eutrophication. Therefore, nutrient use efficiency by crops should be increased for sustainable agriculture. Especially, the use efficiency of P is low in Japan because a large part of arable lands is covered by volcanic ash soils with strong P fixing capacities. Therefore, high rates of P fertilizers have been applied to these soils, and much of them accumulate in these soils.

To use the accumulated soil P efficiently, arbuscular mycorrhizal (AM) fungi is focused. AM fungi belonging to Glomeromycota are obligate symbiotic organisms in association with plant roots. AM fungi absorb P from soil and supply it to host plants and in turn obtain photosynthates from those plants. Regulation mechanisms of nutrient exchange between AM fungi and plant is still poorly understood. We have so far clarified that (1) glucose is the main form of photosynthate transferred from plants to AM fungi; (2) the intake of sugars by AM fungi appears to be linked to their supply of P to the host plant; (3) a fungal alkaline phosphatase plays a role in this P supply process; (4) the vacuoles responsible for transporting P within AM fungal hyphae are tubular in shape and arranged in extensive bundles that also move as one.

In soils poor in available P, AM fungi have remarkable effect of growth promotion of host plants. Therefore, the AM fungi have been expected to increase P use efficiency. Commercial inoculum of AM fungi is now available. We examined if AM fungal inoculation improved yield of Welsh Onion which requires high dose of P fertilizer. However, in the soils where P already accumulated, the symbiosis between AM fungi and plant is inhibited. It is now under examination if AM fungi can contribute to increase in P use efficiency of crops in the soils which previously received high dose of P fertilizer.

Masanori Saito (E-mail: msaito@bios.tohoku.ac.jp)
Dr. Saito, Professor of Environmental Crop Science, was appointed at the present position in 2008. Until 2008 he worked as a researcher in soil microbiology and soil science in Tohoku National Agricultural Experiment Station, National Institute of Livestock and Grassland Science, and as a director of department in National Institute for Agro-Environmental Sciences. He has been main working on physiology and ecology of arbuscular mycorrhizal fungi for more than 20 years. He is now interested in various agro-environmental issues; e.g. life cycle assessment of agricultural activities, and carbon sequestration in arable soils.

Restoration of agricultural ecosystem under reintroduction of the oriental white stork

Kazuaki Naito

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Shounji, Toyooka, 668-0814, Japan

The loss and deterioration of biodiversity affect daily life of humans through decrease of ecosystem service as the biodiversity is linked to stability of biotic community. An umbrella species such as the oriental white stork can be an indicator for restoration process of biotic community, because of its broad range in habitat and high position in food web. In Toyooka Basin, Hyogo, Japan, the reintroduction project of oriental white storks that once became extinct in the wild, started in 2005 and more than 40 storks were flying in 2010. In this project, restoration of agricultural ecosystem is a key in terms of habitat improvement, because the storks forage small animals such as fish, frogs, insects, and snakes in rural landscape. Therefore, the White Stork Friendly Farming Method was developed as a new method to produce safe and tasty rice, and simultaneously to conserve diverse animals living in paddy field. This farming method is composed of 1) consideration for environments through reduction of agricultural chemicals, 2) usage of compost and local organic materials, and 3) management of irrigation and drainage in the paddy fields. In 2010, this farming method was performed in about 220 ha of paddy fields and as a result storks often visited such area.

Kazuaki Naito (kaznait@stork.u-hyogo.ac.jp)

My research…

I joined in the reintroduction project of oriental white storks in Toyooka Basin, Japan in 1999. My interest is habitat analysis of storks and ecological restoration in rural area. The reintroduction is carried out in rural area where local people inhabit, and therefore habitat restoration should be performed in cooperation with local community 1. In addition, restoration of ecosystem in the paddies is an important issue in the project not only for the storks themselves but also for enhancement of biodiversity in rural area 2, 3. Analysis of foraging habitat of the released storks reveals that rural landscape with high biodiversity provides a good foraging site for them.

1. Naito, K. Ohsako, Y., Kikuchi, N. and Ikeda, H.. 2002. Landscape assessment for the restoration of a favourable habitat for the oriental white stork in Japan: the reintroduction project. Landscape Planning & Horticulture, 3: 2(2): 196-201 (2002).
2. Naito, K., Ohsako, Y. & Ikeda, H. Rural area --. In: Kameyama, A., Kuramoto, N. & Hioki, Y. (Eds.) Nature Restoration and Rehabilitation : Using Ecotechnological Approach,, 112-123 (2005) (in Japanese).
3. Naito, K. & Ikeda, H. Restoration of agricultural ecosystem symbolized by reintroduction of oriental white stork. In: Ohgushi, T., Kondoh, M. & Tsubaki, Y. (Eds.) Community Ecology, Vol. 6, 129-158. Kyoto University Press, Kyoto. (2009) (in Japanese).

Matrix management in the 21st century: challenges, conservation strategies, and technical approaches

Mark E. Swanson

Assistant Professor, Landscape Ecology and Silviculture
Department of Natural Resource Sciences, Washington State University
Pullman, Washington, United States of America

In land use planning, the matrix is defined as the unreserved (managed or developed) portion of a landscape or planning region. Since human activities have become a globally dominant influence, and reserve areas cannot provide all possible environmental services, the question of how to maintain biological diversity and function in matrix areas is not merely academic in nature. Besides commodity production and possibly development, matrix areas are being called on to conserve water quality, connectivity for organism movement between reserves, aesthetics, in situ habitat, and many other values. Conservation strategies for matrix lands include networks of riparian buffers, variable retention of biologically important structures, reserves at micro- and mesoscales, maintenance of a range of stand compositions and age classes, and maintenance of elements of natural disturbance regimes. Technology can play a key role in matrix research and management. Excellent examples include remote sensing , geospatial technologies, and remote tracking of mobile organisms (e.g., large carnivores) to understand spatial response to management. Conservation strategies of the 21st century must recognize the importance of the matrix for many values, and provide sound strategies for enhancing ecological functionality in these areas.

Mark E. Swanson (markswanson@wsu.edu)
Assistant Professor, Landscape Ecology and Silviculture. Dr. Swanson studies early-successional forest ecosystems, stand development, wildlife spatial ecology, forest biomass production, and forest carbon. He is a member of the Ecological Society of America, the American Society for Photogrammetry and Remote Sensing, and the Society of American Foresters (including faculty advisor status for the Society of American Foresters at WSU). He received the departmental teaching award in Natural Resource Sciences in 2009, an “Outstanding Mentor” award from the WSU 2009 Mentor of the Year Awards program, and several awards jointly with his Society of American Foresters student organization. He is a member of the Pinchot Partners collaborative working group in western Washington and the Northwest Environmental Forum. Degrees: B.S. Forest Management (1999), PhD, Forest Ecosystem Analysis (2007) from Dr. Jerry F. Franklin’s lab at the University of Washington, Seattle, WA.

Forest Management for Sustainability in a Changing Environment

Michael C. Wimberly and Mark A. Cochrane

Geographic Information Science Center of Excellence, South Dakota State University, Brookings, SD 57007-3510, USA.

Future changes in climate and land use will impact forest landscapes in myriad ways, and will necessitate adaptation to sustain commodity production and ecosystem services. A key ecological process driving many of these changes will be disturbance. For example, weather patterns and human activities influence the frequencies and locations of wildfire ignitions, as well as the sizes and severity patterns of the resulting fires. Furthermore, forest management practices frequently modify disturbance regimes through the suppression of natural disturbances such as fire, the use of prescribed burning, or the introduction of novel disturbances such as forest harvesting. Thus, understanding disturbance ecology, particularly the interactions between climate, disturbance regimes, and forest management, is critical for developing strategies to adapt to environmental change. Simulation modeling research has demonstrated that forest landscapes exhibit complex, non-linear and transient responses to changes in fire frequency. Empirical studies based on satellite remote sensing and field data have shown that forest management activities can either increase or decrease fire severity. These findings highlight some important limitations of current approaches to forecasting climate change impacts on forest ecosystems, and provide insights into the management strategies that will be necessary for adaptation to changing environments.

Michael C. Wimberly (Email: michael.wimberly@sdstate.edu)
Mike Wimberly is an associate professor in the GISc Center of Excellence at South Dakota State University. He received a BA from the University of Virginia, an MS from the University of Washington, and a Ph.D. from Oregon State University. His work integrates ecological concepts with satellite imagery, GIS datasets, and spatial statistics to assess environmental and health hazards at broad spatial scales. Current research includes studying how landscape patterns of fuels, vegetation, and physiography affect the risk of high-severity wildfire; ecological forecasting of disease outbreaks in the United States and Africa; examining the influences of physical and social environments on human health; and exploring the environmental implications of expanded biofuels feedstock cultivation.

Managing forest resources for sustaining society under the REDD+ mechanism

Nophea Sasaki

Graduate School of Applied Informatics, University of Hyogo

Sustaining forest resources for multiple benefits has gained momentum, especially since the adoption of Bali Action Plan in 2007. The Copenhagen Accord recognizes the increasingly important roles of reducing emissions from deforestation and forest degradation, forest conservation, sustainable forest management, and enhancement of carbon sinks (REDD+) in achieving global climate change mitigation target while providing co-benefits to forest resource owners. Although REDD+ has huge potentials, many recently studies failed to discuss the potential carbon emissions and benefits from all REDD+ activities. In this presentation, potential carbon emission reductions under REDD, forest conservation, forest management, and forest restoration are discussed along with particular focus on forests in Cambodia. Depending on assumptions, our results suggest that REDD+ mechanism could reduce up to 50.3 TgCO2 year^{-1} under REDD and avoid 5.7 TgCO2 year^{-1} of carbon emissions under sustainable forest management while maintaining wood supply from the forest. More carbon sinks are also expected under the forest conservation and carbon sinks enhancement options (the latter through forest restoration). With a price of $5 per MgCO2, Cambodia potentially generate up to $280 million annually from REDD and forest management alone. These huge measurable potentials could only be achieved if Cambodia is committed to firmly managing its forests under the REDD+ terms and agreements. Capacity building will also be required in order to achieve multiple benefits from the REDD+ agreement.

Nophea Sasaki (nopsasaki@gmail.com)

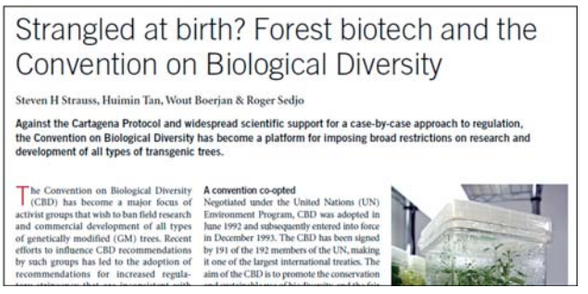
Dr. Nophea Sasaki (Kim Phat) is an Associate Professor in Forest Carbon Management at the University of Hyogo. He is originally from Cambodia. He was a forester before becoming a scientist. He worked as postdoc at Max Planck Institute for Biogeochemistry and Bullard Fellow at Harvard University. Since 2002, his research has been expanded to include forest carbon management and international climate policy with particular emphasis on sustainable forest management in Southeast Asia. His work on forest definitional problems and forest degradation was covered by Nature in 2009. He is currently a member of REDD Management Board of Forestry and Forest Product Research Institute, Japan and editorial board of Forestry: an International Journal of Forest Research.

Genetic modification of forest trees: A powerful tool gathering dust (hokori wo kabu-tteiru)?

Steven H. Strauss, Distinguished Professor of Forest Biotechnology

Department of Forest Ecosystems and Society / Molecular and Cellular Biology Program Oregon State University, Corvallis, Oregon USA, 97331-5752

The last two decades have seen great progress in transgenic approaches to genetic modification of forest trees. A number of studies and/or commercial experiences have shown the delivery of important traits in the field, including accelerated flowering, herbicide tolerance, pest resistance, frost tolerance, modified wood properties, enhanced nitrogen metabolism, and male-sterility. These studies have also shown that, after initial screening for stability, tree performance is highly reliable. The development of extensive genomic sequence information for many species provides numerous options for advanced trait modification. Thus, the biological potential for new advances to help accelerate the inherently slow rate of tree breeding is great. However, a number of serious problems are severely constraining, and in many cases have stopped, further development. These include: 1) Gene transfer systems that are inadequate in efficiency to address the diversity of tree species and genotypes, with little investment to improve them. 2) National and international regulatory constraints on research and development that make it extremely costly and risky to conduct essential field trials, or to include transgenic trees in breeding programs (Figure, Nature Biotechnology 2009). 3) Marketplace obstacles, especially FSC "green" certification, that make it very difficult for industries to sponsor field research and have greatly limited commercial and government investment in research and development.



Strangled at birth? Forest biotech and the Convention on Biological Diversity

Steven H Strauss, Huimin Tan, Wout Boerjan & Roger Sedjo

Against the Cartagena Protocol and widespread scientific support for a case-by-case approach to regulation, the Convention on Biological Diversity has become a platform for imposing broad restrictions on research and development of all types of transgenic trees.

The Convention on Biological Diversity (CBD) has become a major focus of activist groups that wish to ban field research and commercial development of all types of genetically modified (GM) trees. Recent efforts to influence CBD recommendations by such groups has led to the adoption of recommendations for increased regula-

A convention co-opted

Negotiated under the United Nations (UN) Environment Program, CBD was adopted in June 1992 and subsequently entered into force in December 1993. The CBD has been signed by 191 of the 192 members of the UN, making it one of the largest international treaties. The aim of the CBD is to promote the conservation

Steve Strauss (Steve.Strauss@OregonState.Edu)
Strauss works on genomics and transgenic biotechnology of trees, with a focus on Populus. He has published more than 180 scientific papers and given more than 180 invited lectures His laboratory has trained 21 graduate students, 20 postdoctoral scientists, and more than 40 professional and technical staff. Some emphases of his work has been on mitigation and modeling of gene flow, and interacting with the public and government agencies to improve regulations. More information is available (http://www.cof.orst.edu/coops/tbgrc/Staff/strauss/index.htm).

The antimicrobial defense in *Drosophila*, a paradigm for Innate Immunity.

Jean-Marc Reichhart, Laure El Chamy, Akira Goto

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The adaptative immune system with its antibodies, B and T cells arose only once during evolution, around 500 million years ago in the first vertebrates. In invertebrates, the defence mechanisms are purely innate.

In *Drosophila*, an infection provokes the rapid synthesis of powerful antibiotic peptides by the fat body. The control of this expression involves the TOLL and the IMD pathways. The role of these pathways is illustrated by experiments in which mutant flies are challenged with fungi or bacteria. In TOLL-deficient mutants, survival to fungal infections is severely compromised. By contrast, IMD mutants are markedly affected by bacterial infections.

In Vertebrates, recognition of microbes by the innate immune system takes place at the cellular level by a family of transmembrane receptors homolog to *Drosophila* Toll, namely the Toll like receptors. In *Drosophila* however, these recognition events take place in the open circulatory system via soluble excreted recognition proteins and the signals must be conveyed onto Toll by extracellular proteolytic signalling pathways.

Upstream of the IMD pathway, other PGRPs are recognizing Gram-negative microbial determinants. We are now interested in how these two pathways are activated and regulated in light of recent discoveries on host-pathogen interactions.

Jean-Marc Reichhart (E-mail: JM.Reichhart@ibmc-cnrs.unistra.fr).
Professor at Strasbourg University and Institut Universitaire de France.

Overuse of antibiotics leads to emergence of new pathogens or re-emergence of multi-resistant forms of old pathogens, a growing threat for human health. We study the innate immune system and host-pathogen interactions using the fruit fly (*Drosophila melanogaster*) as a model organism in order to find alternative solutions to combat the infectious diseases of the future.

E. intermedius potential for antimicrobial peptide development and for biofuel production

Rodney Hull, Moyo Phanankosi, Karl Rumbold and Monde Ntwasa

School of Molecular & Cell Biology, Gatehouse 512. University of the Witwatersrand, Jan Smuts Avenue. Wits. 2050. South Africa.

Abstract

Euoniticellus intermedius, a tunneling beetle, lives beneath dung pats where it feeds and reproduces. Adults obtain nutrients from the microbe - rich liquid portion of manure without consuming the dung. The larvae consume dung in the brood balls.

Dung beetles have important agricultural benefits and are often introduced in the environment for control of ecological damage. Some of the benefits include nutrient recycling, improvements to soil tilth and pest control. Tunneling beetles are the most beneficial to pasture health as they enhance soil conditions by increasing percolation. They reduce the number of parasites acquired by cattle and the population of pestiferous flies such as the African buffalo fly, the Australian buffalo fly, the bush fly, the face fly and the horn fly.

We explored benefits in exploiting *E. intermedius* biology for development of antimicrobial peptides to combat infections and for use in the food industry. This is based on the comfortable survival of *E. intermedius* in microbe-rich environments. We also investigated the possible exploiting *E. intermedius* for biofuels. In its midgut and hindgut we find distinct communities with definite capabilities in cellulose degradation and in methane production.

Monde Ntwasa (monde.ntwasa@wits.ac.za)

Broadly, we are interested in strategies employed by eukaryotes in responding to stress, particularly infection and DNA damage. We found the African Dung beetle and Drosophila to be important models to study Infection (dung beetle) and DNA damage (Drosophila). We use core molecules biology techniques, genomics and proteomics to accomplish our research objectives[1, 2].

Relevant papers

1. R Hull, M Ntwasa. Glycolytic flux occurs in Drosophila melanogaster recovering from camptothecin treatment. Anti-Cancer Drugs 2010; In press.
2. LM Khanyile, R Hull, M Ntwasa. Dung beetle database:comparison with other invertebrate transcriptomes. Bioinformation 2008; 3 159-161.

Alternative adaptive immunity in shrimp and its applications for the control of shrimp infectious diseases

KC Han-Ching Wang, Pin-Hsiang Chou, Hao-Shuo Chang, I-Tung Chen

Institute of Biotechnology, National Cheng Kung University, Tainan 701, Taiwan

Adaptive immunity was once thought to be a hallmark of vertebrate immunity, but recently this has been challenged by evidence which shows that in at least some invertebrate animals, the innate immune responses are supplemented by a novel immunity that exhibits specificity and memory. There is also evidence for alternative adaptive immunity in shrimp: vaccination studies have shown that inactivated pathogens or subunit protein vaccines were efficacious in protecting shrimps from mortality induced by those pathogens. The underlying mechanisms of this alternative adaptive immunity are distinct from those found in vertebrates, and the putative key molecule is the Down syndrome cell adhesion molecule (Dscam). Our current research began by characterizing the first shrimp Dscams from three shrimp species. We found that the alternative regions of shrimp Dscam were located at 3 extracellular Ig domains, and even the cytoplasmic tail region. We also found a unique tail-less form of Dscam, which has not been reported in other invertebrates. After challenge with virus or saline, all of the shrimp hemocytes initially presented populations of highly varied Dscam isoforms, however, in WSSV-persistent shrimp, the Dscam populations tended to have increased numbers of particular isoforms. To date, we continue to investigate the immuno-mechanism of Dscam and how it related to invertebrate alternative adaptive immunity.

KC Han-Ching Wang (E-mail: wanghc@mail.ncku.edu.tw)
Assistant Professor. Recent studies have suggested that the invertebrate innate immune responses appear to be supplemented by a novel immunity that exhibits specificity and memory. Although the underlying mechanism of this “alternative adaptive immunity” is not yet well understood, the molecule Dscam seems likely to play a key role. Our main research work has focused on the involvement of Dscam in alternative adaptive immunity. Moreover, we are also interested in the pathogenesis of shrimp viral pathogen WSSV. From our research, we hope to provide a scientific basis for optimizing the strategies of shrimp vaccine. We believe it is very important to both science and aquaculture industry.

New method for the risk assessment of marine chemical pollutants using ascidian DNA microarrays

Kaoru Azumi

Center for Environmental and Health Sciences, Hokkaido University, Japan

Ascidians (sea-squirts) are marine invertebrate chordates, sessile filter feeding animals that are affected by human-mediated ocean-borne chemical pollutants. We have developed a large-scale oligo DNA microarray of the ascidian *Ciona intestinalis*. We initially obtained the expression profiles of *Ciona* genes throughout the life cycle (from fertilized egg to aged adult), and categorized 10,415 genes into 49 clusters and into the following five super-clusters: embryonic gene cluster, embryonic and adult gene cluster, adult gene cluster, stably-expressed gene cluster, and maternal gene cluster. Based on the above classification criteria, we have now constructed a novel risk assessment system for marine chemical pollutants using the ascidian DNA microarray. First, we use the microarray to identify genes that are up- or down-regulated after exposure of ascidians to pollutants. Second, we categorize up- or down-regulated genes using our classification criteria and estimate effects of the pollutants. Third, to verify the estimation, we investigate the inhibitory effects of pollutants on ascidian embryogenesis and metamorphosis. For example, from microarray data, we estimated that organotin compounds might affect ascidian embryogenesis and metamorphosis. We then performed bioassays using ascidian embryos and larvae and found that low concentrations of organotins strongly inhibited both embryogenesis and metamorphosis of the ascidians. Our new risk assessment system will be a valuable tool for monitoring chemical pollutants in the marine environment.

Kaoru Azumi (E-mail: kaoru@pharm.hokudai.ac.jp)
Lecturer. Ascidians belong to the phylum Chordata, as do vertebrates, and they are useful experimental animals for the analysis of developmental genomic networks. Ascidians are also good indicators of marine pollution because they are sessile filter feeders that are ubiquitous in the oceans, including the coastal zones of industrialized countries. Our research goal is to establish an experimental system using ascidians to reveal the biological effects of marine pollutants and to determine their modes of action. We also aim to establish a monitoring system using wild ascidians that can detect pollution in the marine environment throughout the world's oceans.

Ecological Treatment of Urban Storm Water Runoff

Allen P. Davis

Department of Civil and Environmental Engineering, University of Maryland,
College Park, MD, 20723, USA

As point sources become better managed and as (sub)urban growth continues to consume undeveloped land, stormwater runoff from impervious surfaces grows in importance as a contributor to water resources degradation. Bioretention (a soil/vegetation management practice) and related technologies have been promoted as "low impact" natural stormwater management practices to mitigate impacts of growth. Fundamental, applied, and monitoring research has been completed demonstrating the performance of these technologies. Quantifying performance is problematic, however, due to the highly dynamic flow and water quality conditions experienced by these facilities.

Low impact technologies will moderate flow rates and reduce surface discharge volumes, dependent on specific design characteristics. Suspended solids are effectively treated via filtration mechanisms. Heavy metals and hydrocarbons are adsorbed strongly onto the media. Accumulations of these pollutants will occur at the surface of these facilities, creating ownership challenges, but facilitating maintenance.

Neither phosphorus nor nitrogen species are very effectively removed via traditional bioretention. Novel modifications to bioretention are investigated to enhance the efficacy of bioretention facilities in P and N removal. For P, this entails amending the media with amorphous aluminum and iron. N removal may be enhanced via the use of submerged anoxic zones to promote denitrification.

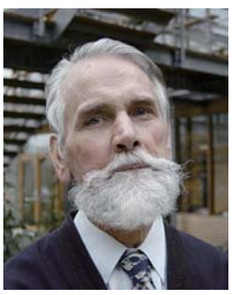
Allen P. Davis (E-mail: apdavis@umd.edu)
Professor. For over 15 years, I haves been investigating sources and treatment of pollutants in urban storm water runoff with a focus on bioretention and related technologies. My research group has developed specifications for bioretention media and sizing criteria. We have demonstrated pollutant treatment mechanisms of adsorption, filtration, and biological transformations. Recent work has evaluated enhanced treatment for the removal of phosphorus and nitrogen.

Ecological control of urban environments

Abraham Mabelis

Alterra, Wageningen –UR (Centre for Ecosystem Studies)
postbox 47, 6700 AA Wageningen, The Netherlands

Urban green can offer cultural, regulating, supporting and production services. The importance of these services depends on the amount and configuration of urban green, as well as its quality. The maintenance of urban green is important for the well-being of citizens: their physical and mental health. A robust green infrastructure can be maintained by connecting green areas by means of green corridors along waterways, roads and railways. Such a stable framework can function as an ecological network. Green areas in one's living environment may ameliorate pollution and contribute to a better microclimate, but environmental quality of the whole city should be controlled by proper management of polluting sources.
For judging the quality of green urban areas the use of it by citizens has to be taken into account. Possibilities for exercising are important for maintaining health, but there should be also places for emotional release and restoration. In order to counteract alienation of citizens from their natural environment native species could be promoted. From people which have lack of experience with nature we cannot expect that they will care for it. We don't value what we don't know and we don't protect what we don't value.



Abraham Mabelis (bram.mabelis@wur.nl)
As Senior guest employee of the Centre for Ecosystem Studies (Alterra, Wageningen-UR) I am involved in the use of ecological information in the planning and management of urban green areas. A few years ago I worked on effects of habitat fragmentation on the survival probability of species (Department of Landscape Ecology). Before that time I worked 20 years at the State Institute for Nature Management (RIN). As member of different working groups of volunteers I am involved in nature conservation, environmental protection, nature management and nature education
Publications

Mabelis, A.A., 2000. Nature quality of urban green. On: CD ROM (J. Němec, prod.), Praga 2000, Natura Megapolis, Envi Typo Praha.
Mabelis, A.A., 2005. Opinions of children about loss of nature. Southern African Journal of Environmental Education, 22: 123-136.
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Mabelis, A.A. & G. Maksymiuk, 2009. Public participation in green urban policy: two strategies compared. Int. J. of Biodiversity Science & Management 5 (2): 63-75

Integrating ecosystem adaptability science, ecosystem services, and policies to mitigate urbanization and climate change effects

Francisco J Escobedo
School of Forest Resources and Conservation, University of Florida,
Gainesville, FL, USA

Urban societies have implemented different policies and technologies to mitigate the environmental, social, and economic impacts of urbanization and climate change. Unfortunately, these rarely consider the benefits of ecosystem structures and functions. However, recent ecologically based studies have shown that ecosystem services can mitigate many of these problems effectively in urban and peri-urban areas. Even though urban ecosystems possess many unique patterns and processes relative to natural ones; urban ecosystems can be studied using the basic principles of ecology and other socio-ecological approaches. This presents an opportunity to integrate principles of ecology, sustainability, and policy analyses to the science of ecosystem adaptability to solve many problems common to urban areas. Although urban areas are characterized by altered structures and functions, multi-scale issues, complex property rights, differing interests and policies, several urban problems can be addressed by managing for: specific ecosystem structures, focusing on specific ecosystem service outcomes, and accounting for co-benefits and associated costs. Selected case studies from North America, South America, and China will present a framework for adapting ecosystem services and to analyze how ecosystem science can be used to develop policies and incentives to efficiently address issues associated with urban sustainability and climate change.

Francisco J Escobedo Ph.D. (E-mail: fescobed@ufl.edu)
Assistant Professor. I conduct applied research that quantifies the ecosystem services and value of urban and peri-urban forests. I also study the effects of hurricanes, pollution, and invasive woody plants on urban forests and human settlements. Selected publications:
Escobedo et al. 2010. Analyzing the efficacy of subtropical urban forests in offsetting carbon emissions from cities. Env. Sci. Pol. 13:362-372.
Zhao et al. 2010. Impacts of urban forests on offsetting carbon emissions from industrial energy consumption for Hangzhou, China. J. Env. Man. 91(4): 807-813.
Escobedo and Nowak, 2009. Spatial heterogeneity and air pollution removal by an urban forest. Land. Urban Plan. 90:102-110.
Escobedo et al. 2008. Analyzing the cost-effectiveness of Santiago, Chile's policy of using urban forests to improve air quality. J. Env. Man., 86: 148-157.
Escobedo, F., Chacalo, A., 2008. A preliminary estimate of air pollution removal by Mexico City's urban forest [Translation from Spanish]. Interciencia, 33: 29-33.

Poster Presentation

List of Poster Presentations

P1.	**Abe, Hirokazu**	Identification and Seasonal Occurrence of the Planktonic Polychaete Larvae in the Onagawa Bay, Northeastern Japan
P2.	**Etoh, Hiroko**	Appropriate policies for promotion wood bioenergy production in Japan
P3.	**Fujibayashi, Megumu**	A symbiotic relationship between pond snail, *Bellamya chinensis* and attached algae on their shell
P4.	**Hirase, Shotaro**	Lack of gene flow between two geographical groups of intertidal goby, *Chaenogobius annularis* revealed by nuclear DNA markers
P5.	**Ishida, Satoshi**	Title to be confirmed
P6.	**Ishida, Seiji**	Application of an inexpensive and high-throughput genomic DNA extraction method for the molecular ecology of zooplanktonic remains
P7.	**Kamiyama, Chiho**	Seasonal change of light competition among species with various functional groups in moorland plant communities
P8.	**Kanou, Hirotaka**	Signaling mechanisms of receptor-type Guanylate Cyclase Gyc76c, mediating innate immune responses in *Drosophila melanogaster*
P9.	**Kato, Fumie**	Adaptation of crop to cultivation in semi-arid regions: Mechanism of deep-sowing tolerance in wheat
P10.	**Kawamura, Kana**	Isolation of Arabidopsis mutants that alter the photosynthetic rate depending on CO_2 concentration
P11.	**Kimura, Akane**	Genetic interaction of global transcriptional regulators, Fur and OxyR, in *Burkholderia multivorans*
P12.	**Kojima, Tomomi**	Plastic and evolutionary responses of leaf traits to light gradients

P13. Makino, Wataru Development of retrospective monitoring techniques for lake ecosystems

P14. Nagahama, Yumi Importance of seagrass (*Zostera japonica*) as a food source for benthic invertebrate in intertidal zone

P15. Nagano, Soichiro UV damage and protection in high- and lowland ecotypes of *Arabidopsis halleri* ssp. *gemmifera*

P16. Okajima, Ryoko Cause of Bimodal Distribution in the Shape of a Terrestrial Gastropod

P17. Okuma, Atsushi Critical roles of non-hematopoietic cells in prevention of autoimmune reactions revealed by the studies on IkB-ζ-deficient mice

P18. Ozaki, Hiroshi Variation in growth and its response to elevated CO_2 among *Arabidopsis thaliana* ecotypes

P19. Pu, Zhengning A Multi Region CGE Model for China under the Consideration of Energy Tax

P20. Shin, Woo-Seok The study on contribution of microbial organic matter in sediment formation

P21. Takeda, Fumihiko Allelopathically Inhibiting Potential shown by *Potamogeton pusillus* Community Against *Microcystis aeruginosa*

Identification and Seasonal Occurrence of the Planktonic Polychaete Larvae in the Onagawa Bay, Northeastern Japan

Hirokazu Abe, Yoshinari Endo, Waka Sato-Okoshi

Graduate School of Agricultural Science, Tohoku University, Sendai 981-8555, Japan

Polychaete is the marine worm which falls under the phylum of Annelida. They play a major role in the functioning of benthic communities, in terms of recycling and reworking of benthic sediments, bioturbating sediments and in the burial of organic matter. Many polychaetes pass through a planktonic larval phase during their early life history. In sessile and benthic polychaetes having little mobility, the planktonic larval phase represents the only opportunity to acquire new habitats and to cross with other populations. Variability in recruitment is potentially important for the function, dynamics, and structure of populations and communities. Despite the great importance of the group in the functioning of marine benthic ecosystem, however, little is known about the dispersal and return mechanisms of planktonic larval phase of polychaetes due to the difficulties of identification of these larvae. Human activities such as coastal development and breakwater construction may have potentially huge impact to the dispersal of planktonic larvae by changing velocity and direction of the coastal currents. Understanding of planktonic larval phase of polychaete is required for sustainability of marine ecosystems. In this presentation, we will show the identification technique for planktonic polychaete larvae and their seasonal occurrence in the innermost part of Onagawa Bay, northeastern Japan.

Hirokazu Abe (E-mail: abehiro@bios.tohoku.ac.jp)
I am a PhD student in Laboratory of Aquatic Ecology at Tohoku University. I am interested in biology and ecology of marine invertebrates especially polychaete. To understand how the dynamics of planktonic larvae of marine invertebrates establish the benthic populations and communities, I am studying biology and ecology of the planktonic polychaete larvae.

Appropriate policies for promotion wood bioenergy production in Japan

Hiroko Etoh, Nophea Sasaki

Graduate School of Applied Informatics, University of Hyogo,
Higashikawasaki-cho 1-3-3-22F, Chuo-ku, Kobe 650-0044, Japan

Substituting the use of fossil fuel with woody biomass for generating energy has become an increasingly important option for reducing greenhouse gas（GHG）emissions in Europe. As GHG emissions continue to increase, Japan must additionally reduce about 7.6% of its emissions in order to fulfill its commitment to the Kyoto treaty. Although various domestic reduction measures have been taken, it is still difficult for Japan to meet its Kyoto reduction commitment. The only option with potential huge reduction left for Japan is the utilization of woody biomass to replace the heavy-GHG emitting fossil fuel for energy generation. Unfortunately, this option has not been considered due generally to the perception that it is very costly option in Japan. By comparing and analyzing successful bioenergy policies in Europe and policies in Japan, this research is aimed at proposing appropriate policies for promoting woody biomass utilization in Japan. Our study suggests that competitive electricity market, favorable renewable energy taxes and setting up fixed electrical price for renewable bioenergy policies were not available in Japan, and therefore should be introduced in order to the promote the utilization of woody biomass for bioenergy generation.

Hiroko Etoh (E-mail: ab08x102@ai.u-hyogo.ac.jp)
I am a doctoral student at the Graduate School of Applied Informatics, the University of Hyogo in Kobe, Japan. My main research theme is wood bioenergy policies in Japan. Etoh ＆ Sasaki have published papers in Japanese Journal of Forest Research, Applied Energy, and FORMATH journal.

A symbiotic relationship between pond snail, Bellamya chinensisand attached algae on their shell

Megumu Fujibayashi, Kazunori Nakano, Osamu Nishimura

Graduate School of Engineering, Tohoku University, Sendai 980-8578, Japan

The shell of pond snail *Bellamya cipangopaludina* is generally covered with attached algae. In this study, the interaction between *B. chinensis* and these attached algae was investigated. Mixing model with stable carbon isotope ratio revealed that the main carbon source of *B. chinensis* was attached algae on their shell not sediment and suspended matter. Another experiment showed that the *B. chinensis* which were allowed to graze attached algae on their shell showed higher growth rate than other individuals which were prohibited to graze attached algae. This results indicated attached algae was good food source for *B. chinensis*.

B. chinensis had not only negative effects but also good effects for attached algae. The dominant species of attached algae was not found in sediment and water column. *B. chinensis* seemed to provide attached alage with shell as hard substrate. Moreover, the pedal mucus by *B. chinensis* could stimulate the growth of attached algae on the shell from our laboratory experiment. This study showed there is a symbiotic relationship between *B. chinensis* and attached algae on their shell.

Megumu Fujibayashi (fujibayashi@eco.civil.tohoku.ac.jp)

Pond snail *Bellamya chinensis* was one of the dominant species in wetland ecosystems, such as paddy field and shallow lake in Japan. However, their population has declined and red data list have designated *B. chinensis* as a near threatened species. Generally dominant species have significant effect on the ecosystem, moreover considering the general role of snails as benthic herbivores, their reduction might cause to disrupt the balance of wetland ecosystems. Preservation of *B. chinensis* seems to contribute for maintaining balance of wetland ecosystems. In my study, nutrient requirement of *B. chinensis* is focused to determine important food sources for their conservation.

Lack of gene flow between two geographical groups of intertidal goby, *Chaenogobius annularis* revealed by nuclear DNA markers

Shotaro Hirase, Minoru Ikeda, Manami Kanno & Akihiro Kijima

Graduate School of Agricultural Sciences, Tohoku University,
Onagawa 986-2242, Japan

Phylogeographic and population genetic studies are important for predicting the impact of future environmental change on species distribution. Our previous study based on mitochondrial (mt) DNA marker revealed the existence of two lineages (Pacific Ocean and Japan Sea) in *Chaenogobius annularis*, and that they diverged approximately 1.7 million years ago. These results suggest that this species dispersed into Japan Sea in association with the formation of its southern straits in the early Pleistocene period, and that the following isolations of Japan Sea in the Pleistocene glacial periods had interdicted the gene flow between Pacific Ocean and Japan Sea groups. However, the hybridization between them was possible to occur in the Pleisto-Holocene interglacial periods due to the opening of Japan Sea. If the directional hybridization has occurred, mtDNA marker can't detect it absolutely due to its maternal inheritance. Therefore, we estimated the gene flow between two groups since they diverged, based on bi-parentally inherited nuclear markers. We analyzed eight microsatellite (ms) DNA loci for 465 specimens from 15 localities on Japanese and Korean coasts. The Bayesian clustering analysis showed that all individuals are clearly assigned into two clusters consistent with the two mtDNA lineages. Moreover, there are no common alleles between the two groups at one microsatellite locus. Allozyme analysis also showed the two groups shared no alleles at one locus out of 13 loci examined. These results indicate that the lack of gene flow between Pacific Ocean and Japan Sea groups has been continued since they diverged in the early Pleistocene period.

Shotaro Hirase (E-mail: tonpeigoby@bios.tohoku.ac.jp)
I am doctoral student. I have researched at Field Science Center in Onagawa, Miyagi prefecture. My interest is in the evolutionary history of Japanese coastal species under the past environmental changes.

The estimation of local extinction rate in landscape scale: combining two matrices, land-use matrix and canopy species composition replacement matrix.

Satoshi Ishida & Tohru Nakashizuka

Gratduate School of Life Science, Tohoku University, Sendai 980-8578, Japan

In a few decades, deciduous forest biodiversity was degraded by human land-use, (e.g. firewood logging, conifer planting and pasturing) in Japan. To conserve biodiversity, we should estimate effects of land-use on rare species. However, analyzing land-use effects in landscape scale require enormous data, and it is difficult to clarify the dynamics of all tree species. Therefore, we combined two matrices, the land-use change matrix and the canopy species composition replacement matrix, to predict species composition and local extinction rate of each species.

The land-use change matrix represents the land-use transition probability in one generation. We defined four land-use types; natural forest, secondary forest, conifer forest and pasture. The canopy species composition replacement matrix represents the transition probability of canopy composition in one generation. Using these matrices, we predicted dominant species abundance and local extinction rates in one hundred generations. Furthermore, we established two management strategies, the Satoyama management and the natural forest conservation, which control the land-use change matrix depending on the human purpose.

The results from our model indicate that the Satoyama management increased dominant species abundance, while the natural forest conservation decreased local extinction rate in some species, *Fagus crenata*, *Fagus japonica* and *Acer mono*, not having disturbance dependency.

Application of an inexpensive and high-throughput genomic DNA extraction method for the molecular ecology of zooplanktonic remains

Seiji Ishida[1], Hajime Ohtsuki[2], Yoshihisa Suyama[3], Jotaro Urabe[2]

[1] International Advanced Research and Education Organization, Tohoku University, Sendai 980-8578, Japan
[2] Graduate School of Life Sciences, Tohoku University, Sendai 980-8578, Japan
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Long-term monitoring data of biotic community and water quality is necessary to detect environmental changes, but is unavailable in most lakes. Even in the lakes without monitoring data, paleolimnological approaches provide indirect means to reconstruct past changes. Previous studies revealed that changes in genetic structure of *Daphnia* resting eggs in the sediment well corresponded with changes in biotic community and water quality. However, we should note that hatching rate from the resting eggs is variable between populations and between years even in the same population. If hatching rate is high, we have a problem to reconstruct the past changes in the *Daphnia* egg bank. Here we focus on ephippia in sediment instead of the resting eggs. Ephippia derive from modified and thicken carapace of sexual female, and cover and protect resting eggs. Whether the eggs hatch or not, ephippia of the eggs are almost permanently left in the sediment. We firstly developed the technique to extract genomic DNA from the *Daphnia* ephippia, applying methods of hot sodium (Hot Shot), thermal shock, and ultra homogenization, and adapting PCR conditions, with high success rate (>70%) of DNA extraction, amplification, and sequencing. We foresee a broad use of this technique for various remains.

Seiji Ishida (E-mail: ishidaseiji@m.tohoku.ac.jp)
Assistant Professor. My research interest is how quaternary glaciations and recent anthropogenic impact have altered biodiversity of freshwater species in the northern hemisphere. I conduct phylogeographic and taxonomic studies on freshwater zooplankton to reveal population history and invasion. I also conduct interdisciplinary research relating to paleolimnology and molecular ecology of freshwater zooplankton.

Seasonal change of light competition among species with various functional groups in moorland plant communities

Chiho Kamiyama[1], Shimpei Oikawa [2], Takuya Kubo[3] and Kouki Hikosaka[1]

[1] Graduate School of Life Sciences, Tohoku University, Aoba, Sendai 980-8578, Japan;
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[3] Graduate School of Environmental Earth Science, Hokkaido University, Sapporo, Hokkaido 060-0810, Japan.

Climate change may affect species composition through affecting interspecific interactions. Competition for light is one of the most important interactions in plant community. We hypothesized that light acquisition efficiency (absorbed photon per unit mass) differs among functional groups, which may affect species composition. We evaluated light acquisition, biomass allocation and leaf lifespan in species coexisting in moorland at different altitudes in northern Japan. The number per quadrat and total aboveground mass per unit area were lower in evergreen than in deciduous species, but the number and aboveground mass of evergreen species increased with increasing altitudes. We found that instantaneous light acquisition efficiency in August (absorbed photon flux per unit aboveground mass) was lower in evergreen than in deciduous species. However, yearly light acquisition efficiency (absorbed photon flux per year per unit aboveground mass) in evergreen species was comparable to that in deciduous species, because evergreen species received strong light in early spring when deciduous species have not started to expand their leaves. Furthermore, evergreen species had a higher light acquisition efficiency in leaf lifetime (absorbed photon flux in the lifespan per unit leaf mass) in higher altitude, which may explain why evergreen species are more successful at higher altitude.

Chiho Kamiyama (E-mail: chihokamiyama@gmail.com)
Ph. D. student.
Main interest: How interspecific interaction for light contributes to species coexistence and how the mechanism changes with climate change.
Key words: Canopy structure, Leaf angle, Life form, Light partitioning, Biomass allocation, photosynthesis, leaf lifespan

Signaling mechanisms of receptor-type Guanylate Cyclase Gyc76c, mediating innate immune responses in *Drosophila melanogaster*

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In recent years, new types of infectious diseases have occurred by a drastic change of the environment. It's not enough or sustainable only to develop new antibiotics, antiviral agents, and pesticides, for protecting human and other species from diseases. In order to adapt to these circumstances, a further investigation into the Host-Pathogen interaction is critically needed.

Innate immunity is a highly conserved host defence system in both vertebrates and invertebrates consisting of cellular and humoral response. In *Drosophila melanogaster*, circulating blood cells, known as "hemocytes", play important roles in cellular responses such as phagocytosis, melanotic mass formation, and wound healing. Infection induces an increased number of hemocytes, and this hemocyte proliferation is critical to survival of flies especially in the early phase of bacterial infection until production of anti-microbial peptides is initiated.

Gyc76c, originally identified from genome-wide gain-of-function screening using anti- microbial peptide reporters, is one of the family of receptor-type guanylate cyclases. The results of our versatile experiments suggested that Gyc76c is not only involved in humoral response but also in hemocyte proliferation. Interestingly, our further experiments proposed that these immune responses are mediated via cyclic-GMP. Here, I will discuss more detailed molecular mechanisms of this novel signaling pathway focusing on cGMP-dependent kinases and cGMP-gated channels in the innate immunity.

Hirotaka Kanou (Ph.D student, E-mail ; b0yd1016@s.tohoku.ac.jp)
My research interest is the molecular mechanisms of the innate immune system, which is conserved in both vertebrates and invertebrates as a front-line of host defense. Our experiments are carried out using *Drosophila melanogaster* (Fruit Fly), a sophisticated model of host organism.

Adaptation of crop to cultivation in semi-arid regions: Mechanism of deep-sowing tolerance in wheat

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Deep-sowing tolerance, the emergence of seedlings from deep seeded conditions, is involved in stand establishment in semi-arid regions, where the soil surface is too dry for seed germination. Hong Mang Mai (HMM), a native wheat variety in Loess plateau, elongates its first internode at an extreme rate and can emerge from much deeper soil than do others because of its super-response to a phytohormone, gibberellins (GA). As an approach to understand mechanisms underlying the deep-sowing tolerance of HMM, we compared kinetics of several factors related to growth of the first internode in HMM with those in deep-sowing sensitive cultivars. In all cultivar, number of cells longitudinally-piled inside the first internodes was well correlated to length of first internode. GA treatment increased cortical cell number and accelerated epidermal cell elongation, whereas hardly affected cortical cell length and epidermal cell number. Interestingly, GA-treated HMM exhibited that the rates of elongation in epidermal cells and proliferation of cortical cells were drastically enhanced, more than those of others. These results suggest that the both cell elongation and proliferation make an important contribution to elongation of first internode. The first internode of HMM may possess a pronounced GA effect on cell elongation and proliferation, which exert tolerance to deep-sowing conditions.

Fumie Kato (E-mail: katofumi@affrc.go.jp)
Ph.D. student. Global environmental changes cause reduction in crop yield. To mitigate the effects of the changes, usage of tolerant cultivars are simple yet effective ways. My interest is how the tolerant cultivars adopt and avoid to impacts of environmental change. Currently, I am involved in investigating the mechanisms of flower opening in the early morning helps avoid sterility induced by heat stress at anthesis in rice (*Oryza sativa* L.).
Present address: National Institute of Crop Science, Tsukuba, 305-8518, Japan

Isolation of Arabidopsis mutants that alter the photosynthetic rate depending on CO_2 concentration

Kana Kawamura, Nobuharu Fujii, Kouki Hikosaka, Hideyuki Takahashi

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Abstract (Less than 200 words, you can also put figures if you like)
Atmospheric CO_2 concentration has increased from 280 ppm before the industrial revolution to the present 390 ppm and predicted to reach 500-1000 ppm at the end of this century. The plant photosynthetic rate is limited by the ribulose-1,5-bisphosphate carboxylase (Rubisco) at the current CO_2 concentration but by other proteins at high CO_2, suggesting that Rubisco content will be excessive in the future . Because of allocating huge amount of N to Rubisco (20 - 30% of total leaf N), photosynthetic N use efficiency at the elevated CO_2 would be improved if N is reallocated from Rubisco to other proteins. However, current plants do not exhibit such acclimatory responses to elevated CO_2, suggesting that they are not adaptive to the future environment. So we hypothesize that if a mutation which reduces the amount of Rubisco happens in some individual, it may be advantageous in the future. To test this hypothesis, we attempt to isolate *Arabidopsis* mutants that change the ratio of photosynthetic activity under the elevated CO_2 condition to that under a normal CO_2 condition. We have screened 8,000 *Arabidopsis* M_2 plants by detecting chlorophyll fluorescence as a measure of photosynthetic activity, and isolated 2 mutants that increase the ratio. We will investigate phenotypic and genetic traits of the mutants.

Kana Kawamura (E-mail: kawamura@ige.tohoku.ac.jp)
Graduate student. Plant photosynthetic rate will be affected by elevated CO_2 concentration in the future. I'm interested to know whether plants photosynthetic system can achieve the acclimatic changes to elevated CO_2 condition. This research will provide a new insight that improves photosynthetic activity of plants under the elevated CO_2 condition.

Genetic interaction of global transcriptional regulators, Fur and OxyR, in *Burkholderia multivorans*

Akane Kimura, Satoshi Yuhara, Yoshiyuki Ohtsubo, Yuji Nagata, Masataka Tsuda

Department of Environmental Life Sciences, Graduate School of Life Sciences, Tohoku University, 2-1-1 Katahira, Sendai 980-8577, Japan

Iron is an essential element for the growth of almost all bacterial species. However, a high concentration of intracellular iron is very toxic to the cells under aerobic conditions, because the cells metabolically produce hydroxyl peroxide (H_2O_2), which reacts with iron to generate a highly toxic hydroxyl radical. An iron-responsive transcriptional regulator Fur (ferric uptake regulator) is one of the key regulator proteins for intracellular iron homeostasis. We previously identified fur gene in a soil-derived β-proteobacterial strain, *Burkholderia multivorans* ATCC 17616, and indicated that the Fur protein is pleiotropically involved in iron homeostasis, removal of reactive oxygen species (ROS), and carbon and nitrogen metabolism. The *fur* mutant of ATCC 17616 was also sensitive to a reactive nitrogen species, nitric oxide (NO). In this study, we isolated the spontaneous suppressor mutants tolerant to NO under the fur mutant background. Subsequent microarray-based comparative genomic analysis and direct sequencing analysis indicated that the sof (suppressor of *fur*) mutants had a two-base deletion in *oxy*R gene, whose orthologs encode H_2O_2 - responsive transcriptional regulators in other bacteria. The sof mutant and the artificially constructed *fur-oxy*R double-deletion mutant showed the indistinguishable phenotypes in that both mutants were (i) more resistant to ROS, NO, and streptonigrin (an iron-activated antibiotics) than the fur mutant, and (ii) able to grow by using the carbon sources that cannot support the growth of the fur mutant. These data indicated that there is genetic interaction between the fur and *oxy*R functions.

Akane Kimura (E-mail: merton03@ige.tohoku.ac.jp)
Graduated from the Faculty of Horticulture, Chiba University. Graduated from the Graduate School of Advanced Integration Science, Chiba University. (M.D.) Ph.D. course at the Graduate School of Life Sciences, Tohoku University.

Plastic and evolutionary responses of leaf traits to light gradients

Tomomi Kojima & Kouki Hikosaka

Graduate School of Life Sciences, Tohoku University, Sendai, Japan

Plant functional traits vary along environmental gradients. Such variations may include both plastic and evolutionary responses. Plastic response is an alteration in traits in an individual depending on growth environment, while evolutionary response is a differentiation of niche among species. The direction of trait change is often different between plastic and evolutionary responses. Leaf mass per area (LMA) is known to increase plastically with increasing growth irradiance. However, it has also been shown that high LMA species tend to be found shade environment. Here we ask why direction of LMA change is different between plastic and evolutionary response. We measured morphological, chemical and physiological traits of leaf along light environmental gradients in the understorey of a mixed deciduous-evergreen forest. Within species, LMA as well photosynthetic capacity increased plastically with increasing growth irradiance. Among species, however, LMA was higher in lower irradiance. Higher leaf toughness may contribute to longer leaf life span, and hence shade-tolerance. We suggest that high LMA as a plastic response contributes to high photosynthetic capacity, while high LMA as an evolutionary response contributes to long leaf life span.

Tomomi Kojima (E-mail: kojimatomomi33@gmail.com)
I am a PhD student at Tohoku University. I study how plant functional traits response to environmental gradients. I especially focus on the difference between plastic response and evolutionary response of leaf traits.

Development of retrospective monitoring techniques for lake ecosystems

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Climate change and human activities over the last several decades have been influencing ecological processes on various scales. For maintaining ecosystem functioning and services effectively along with the climate change and human impacts, new management protocols through adaptive environmental changes (i.e. Ecosystem Adaptability Science, EAS) are necessary, rather than nature-overcoming technologies. The concept of EAS is a powerful tool for lake ecosystem managements as well; however, sufficient amounts of information on a given lake prior to its visible changes by climate change and/or human activities are often unavailable due to the lack of long-term monitoring data. In such cases one cannot apply EAS to the lake since one cannot uncover “adaptive environmental mechanisms”. To overcome such situations, we are currently trying to develop a “retrospective” monitoring protocol for lake ecosystems with the aid of paleolimnological skills. Specifically, we are trying to identify useful indicators in the lake sediments for describing environmental and ecosystem changes for the last 100-200 years while modern anthropogenic activities have increased. These indicators are biological and chemical information including DNA of plankton remains, specific organic matters, and their stable isotope signatures. In the poster this project is explained in detail.

Wataru Makino (E-mail: makinowataru@m.tohoku.ac.jp)
We study lake ecosystem ecology from the standpoint of Ecological Stoichiometry, the balance of multiple chemical substances in ecological interactions and processes, as well as evolutionary biology.

Importance of seagrass (*Zostera japonica*) as a food source for benthic invertebrate in intertidal zone

Yumi NAGAHAMA, Munehiro NOMURA, Megumu FUJIBAYASHI,
Woo-seok SHIN, Osamu NISHIMURA

Graduate School of Engineering, Tohoku University, Sendai 980-8579, Japan

Zostera japonica, a kind of seagrass, forms patch-like meadows in intertidal zone. Some researches showed that fauna of benthic invertebrate in seagrass area was different from that of adjacent sand area, however, the mechanism of the difference between them was not clarified. The objective of this research is to clarify the role of *Z. japonica* as a food source for benthic invertebrate. We focused on *Phacosoma japonicum*, *Batillaria cumingii and Umbonium* sp.. *Phacosoma japonicum* is dominant bivalve species; *Batillaria cumingii* and *Umbonium* sp. are general snails in our researched intertidal zone. Those invertebrates inhabited both seagrass and sand area. The population of *B. cumingii* was higher than *Umbonium* sp. in seagrass area, though opposite result was obtained in sand area. The population of *P. japonicum* in seagrass area is as same as them in sand area. Using stable isotope and fatty acid analysis it was revealed that *B. cumingii* assimilated Zostera-derived organic matter more efficiently than *Umbonium* sp. which mainly assimilated diatoms. Moreover, *P. japonicum* assimilated hardly any Zostera-derived organic matter. The sediment of seagrass area contained higher amounts of Zostera-derived organic matter in comparison with the sediment of sand area. These results suggested patch-like meadow created variety of food sources availability and caused species richness in intertidal zone.

Yumi NAGAHAMA (E-mail: nagahama@eco.civil.tohoku.ac.jp)
JSPS Research Fellow.

- Analysis of Organic Matters Transportation by Stable isotope and Fatty acids in Benthic Ecosystems of *Zostera Japonica* Meadows, (2009) Proceedings of the third international conference on estuaries and coasts,1,329-335
- Characterization of seagrass bed habitat and its effect on benthic fauna, (2007) Journal of Environmental Systems and Engineering(VII), 63, 4, 233-240
- The Influence of Demersal Habitat Structure Formed with Coastal Erosion on Macrobenthos and Demersal Fishes, (2008) Environmental Engineering Research,45,89-95

UV damage and protection in high- and lowland ecotypes of *Arabidopsis halleri* ssp. *gemmifera*

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Ultraviolet (UV) radiation is hazardous to organisms, because it can cause damage in their DNA. Plants have evolved several mechanisms to tolerate UV stress. For example, accumulation of UV-absorbing compounds may act as UV filters. Plants can repair damage in DNA such as cyclobutane pyrimidine dimmer (CPD) with CPD photolyase. UV radiation increases with altitude. We hypothesized that plants that inhabit mountainous conditions are more tolerant to UV radiations. We studied lowland and highland ecotypes of *Arabidopsis halleri* ssp. *gemmifera*, which is closely related to *A. thaliana*, a well-known model plant of molecular biology. We studied the extent of damage in DNA and activity of CPD photolyase in plants growing in the field. We found that CPD contents increased with altitude. It was lower at highland type than at lowland type within same altitude, suggesting different tolerance between the ecotypes. CPD photolyase activity was slightly higher at highland than at lowland type. Highland type accumulated greater amount of UV-absorbing compounds, which might also contribute to increased tolerance to UV. These results suggest that highland type has higher UV tolerance than lowland type.

Soichiro Nagano (E-mail: naganosoichiro@gmail.com)
Ph.D student. High mountainous region is one of the most vulnerable ecosystems to global change. My interest is in physiological ecology and evolutionary biology of high mountainous plants. I hope my study make a contribution against global change.

Cause of Bimodal Distribution in the Shape of a Terrestrial Gastropod

Ryoko Okajima and Satoshi Chiba

Department of Ecology and Evolutionary Biology, Graduate School of Life Sciences, Tohoku University, Aobayama, Sendai 980-8578, Japan.

The distribution of a phenotypic state is often discontinuous and dispersed. An example of such a distribution can be found in the shell shapes of terrestrial gastropods, which exhibit a bimodal distribution whereby species possess either a tall shell or a flat shell. We propose a simple model to test the hypothesis that the bimodal distribution relates to the optimum shape for shell balance on different substrates. This model calculates the theoretical shell balance by moment. Empirical distribution of shell shape is obtained by compiling published data and performing a new analysis. The solution of the model supports one part of the hypothesis, showing that a low-spired shell is the best balanced on horizontal surface. Additionally, the model shows that both high- and low-spired shells are well balanced and suited on vertical surfaces. The shell with a spire index (shell height divided by diameter) of 1.4 is the least well balanced as a whole. Thus, spire index is expected to show a bimodal distribution with a valley at 1.4. This expectation was supported by empirical distribution of a spire index, suggesting that the bimodality of shell shape in terrestrial gastropods is related to shell balance.

Ryoko Okajima (E-mail:okajima@mail.tains.tohoku.ac.jp)

●Ryoko Okajima. 2008. The controlling factors limiting maximum body size of insects. Lethaia. 41: 423-430.
●Ryoko Okajima and Satoshi Chiba. 2009. Cause of bimodal distribution in the shape of a terrestrial gastropod. Evolution. 63: 2877–2887.

Critical roles of non-hematopoietic cells in prevention of autoimmune reactions revealed by the studies on IκB-ζ-deficient mice

Atsushi Okuma, Tomoyuki Ohba, and Tatsushi Muta

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The immune system is essential not only for host defense against pathogens but also for homeostasis. It is one of the most important systems for adaptation to changing environmental conditions that provides individual robustness. IκB-ζ (Nfkbiz) is a gene that plays crucial roles in transcriptional control of the innate and adaptive immune systems. We found that IκB-ζ gene-deficient mice develops chronic inflammation in facial skin. The inflammation spontaneously develops in the specific pathogen-free conditions due to autoimmune reactions. Transplantation experiments using the wild and the mutant hematopoietic cells revealed that IκB-ζ-deficiency in non-hematopoietic cells, but not in hematopoietic cells including lymphoid cells, plays critical roles in the initiation of the autoimmune disease. Thus, homeostasis maintained by the immune system requires not only lymphoid cells, but also sophisticated functions of non-hematopoietic cells, whose malfunctions may lead to autoimmune reactions.

Atsushi Okuma (E-mail: ohkuma@life.biology.tohoku.ac.jp)

Graduate Student
My work focuses on the pathology of IκB-ζ-deficient mice to reveal the physiological relation between innate immunity and adaptive immunity.

Variation in growth and its response to elevated CO_2 among *Arabidopsis thaliana* ecotypes

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It is known that effects of elevated CO_2 on growth vary among species. To study mechanisms underlying this variation, 44 ecotypes of *Arabidopsis thaliana* from various latitudes and altitudes were grown under ambient and elevated (800 ppm) CO_2 concentrations. Biomass determined at 38 days after sawing considerably varied among ecotypes: under both CO_2 concentrations, biomass varied by ca 2.7 fold. Enhancement of biomass by elevated CO_2 also varied from 1.43 to 3.16 fold, indicating a significant variation in the CO_2 response among ecotypes. The variation in relative growth rate was mainly ascribed to net assimilation rate rather than leaf area ratio. Enhancement ratio of biomass by elevated CO_2 was significantly correlated with photosynthetic nitrogen use efficiency.

Hiroshi Ozaki (E-mail: ozaki@m.tohoku.ac.jp)
My interest is plant response to environment, especially in photosynthesis. Plants are much more dynamic than we usually expect them to be. This dynamic behavior is important for their performance under natural conditions, when resources are distributed heterogeneously in space and time. Endogenous networks in plants buffer plant processes from external fluctuations. It is thus an important task for future research to identify how dynamic external conditions interact with plants and how plants optimize its behavior in real time.

A Multi Region CGE Model for China under the Consideration of Energy Tax

Pu Zhengning

Graduate School of Economics and Management, Tohoku University

China, a nation that had been known as the third largest economy in the world and also been known as one of the world's largest carbon emitters recently was always been criticized for its environmental policies were not strong enough or the nation was lack on its environment protect responsibility. Recently, a new report from IEA (International Energy Agency) had point out that "China has now overtaken the United States to become the world's largest energy user." It had also said in that news report that "China's demand today would be even higher still if the government had not made such progress in reducing the energy intensity of its economy." But it should be notice that, there were rarely researches to neither prove whether the above criticism was right or wrong nor to show what would happened to the country and the world, when any serious environmental protection policy was execution in China. In this study, a Multi Regional Computable General Equilibrium model (CGE model) was attend to be used to evaluate the effects of strict environmental protection policy to different region of China. Furthermore, the future study is also trying to make a linkage between the multi-regional CGE model of China and the GTAP, in order to discuss how the effect of environmental protection policies in China feedback to the whole world.

Pu Zhengning (E-mail: zennipu@gmail.com)
Research Assistant. Doctor student of Graduate School of Economics and Management, Tohoku University. Current research field is environmental economic, mainly focus on the construction of the Environmental Computable General Equilibrium (CGE) Model which could use for adjusting the local environmental policy. Until now, I had constructed a CGE model that could adjust energy tax policy under a "one country, multi regional condition" which could help to analyze the problems between economy development and global warming.

The study on contribution of microbial organic matter in sediment formation

Woo-Seok SHIN, Megumu FUJIBAYASHI, Yumi NAGAHAMA,
Munehiro NOMURA, Kazunori NAKANO and Osamu NISHIMURA

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The tidal flats are the transition zone from land to ocean system and receive organic matters and nutrients transported from rivers or oceans. The dynamics of organic matter in tidal flats have been intensively studied, questions still remain regarding the origin of sources, fate and role of organic mater in the benthic ecology of estuaries. Previous studies have shown that particulate organic matter transported through rivers and oceans is significant component of sediment formation in estuarine tidal flat. Especially, little is known about the role and contribution of microbial organic matter in sediment formation. It is quite likely that Microbial organic matter is potential food source of macro benthos and contribution of sediment formation in tidal flat. Recently, fatty acid has been used as biomarkers to trace the origin and flow of organic matter in marine ecosystem. The purpose of this study was to examine contribution of microbial organic matter in sediment formation with different tidal flat type. As a result, according to the regression models of FA concentration versus TOC, the microbial OM and LCFAs are relevant to contribution of sediment formation ($p<0.05$). On the other hand, the phytoplankton of marine and riverine has not contributed to the formation of sediment ($p>0.05$).

Woo-Seok SHIN (E-mail:swoosuk@eco.civil.tohoku.ac.jp)
Post Doctor. Tidal flat played an important role in estuarine and coast zone. Therefore, it is necessary to study about the dynamics of organic matter for environment conservation. However, The dynamics of organic matter in estuarine tidal flats have been intensively studied, questions still remain regarding the origin of sources, fate and role of organic mater in the benthic ecology of estuaries. Especially, not only the amount of sediment but also understanding to the quality is very important for proper conservation and restoration of coastal ecosystems to occur. I am investigating the origin of organic matter and food web of benthos in tidal flat.

Allelopathically Inhibiting Potential shown by *Potamogeton pusillus* Community Against *Microcystis aeruginosa*

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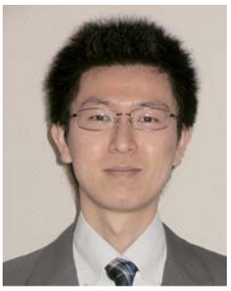
Allelopathic potential by a submerged macrophyte *Potamogeton pusillus* against *Microcystis aeruginosa* in actual ponds was evaluated. The culture filtrate of *P. pusillus* inhibited the growth of *M. aeruginosa*, suggesting that *P. pusillus* released allelochemicals. For the evaluation of allelopathic potential in actual ponds, water samples collected in and out of vegetated mesocosm were examined by a novel bioassay method. Also, allelopathic potential of water obtained from vegetated and unvegetated mesocosm was compared. As a result, water in *P. pusillus*-vegetated mesocosm showed an obvious growth-inhibiting effect on *M. aeruginosa* but not in unvegetated mesocosm and out of mesocosm. The water obtained from two ponds, Yamanokami and Bessho Pond, confirmed these effects. The results indicated allelopathic effect by *P. pusillus* community worked in actual ponds or lakes and the effect lasted as long as *P. pusillus* inhabited.



Fumihiko Takeda (E-mail: takeda@eco.civil.tohoku.ac.jp)
Postdoctoral fellow. Eutrophication in ponds or lakes is responsible for water bloom, which has a bad effect on scenery, water utilization and aquatic ecosystems. Some aquatic macrophytes are known to exhibit allelopathically growth-inhibiting effect on cyanobacteria. This research aims to utilize allelopathic effect to control microalgal biomass in lakes, especially to inhibit the formation of water-bloom.

Organizing Committee

Kazunori Nakano (E-mail: knakano@eco.civil.tohoku.ac.jp)
Associate Professor. Natural environments have effective purification systems that do not require external energy for their operation and maintenance. By strengthening the natural functions of constructed wetlands water purification is effected with minimum energy input. In this program, we conduct research on the experimental wetlands established at Kawatabi Field Center to investigate water purification in connection with rhizosphere microorganic activity enhanced by hydraulic manipulation.

Akira Goto (E-mail: agoto@mail.pharm.tohoku.ac.jp)
Assistant Professor. Damaging ecosystems could trigger emergence or re-emergence of pathogens and concomitant high utilization of antibiotics also causes drug resistances. One of the alternative solutions to this vicious cycle problem is to make use of the potential powers of innate immunity which is the pillar of immune system for both vertebrates and invertebrates. To understand how organisms adapt to environmental changes including infections, I am currently investigating the molecular mechanisms of innate immune responses using *Drosophila melanogaster* (fruit fly) as model organism and further looking for alternative solutions to infectious diseases and pest control.

Hai-Liang Song (E-mail: shl@eco.civil.tohoku.ac.jp)
Assistant Professor. Aquatic ecosystems are increasingly being affected by human- derived emerging organic micro-pollutants such as pharmaceutically active compounds, personal care products, hormonally active agents. In addition to fundamental researches concerning the fate of the above human-derived micro- pollutants in natural aquatic ecosystems, we are particular interested in developing engineered wetland ecosystems to reduce the potential ecological risk caused by the human-derived micro-pollutants.

Hiromi Kato (E-mail: katee@ige.tohoku.ac.jp)
Postdoctoral Fellow. Disturbances in environments are known to drastically influence structures and functions of microbial community. Microbial community is a suitable example to observe effect of the environmental stress on the biodiversity. Using molecular biological approaches, we investigate the succession of soil bacterial communities and functions induced by chemical pollution.

Tomokazu Yamazaki (E-mail: yamat@ige.tohoku.ac.jp)
Postdoctoral Fellow. My interest is how plants adapt to their surroundings changing various ranges of physicochemical stresses, which are caused by light strength, temperature, and water amount, and so on. Of the adaptation mechanisms, hydrotropism in plant roots is a system to avoid water shortage with sensing moisture gradient followed by altering growth direction to high-humidity region. In the project of GCOE, I aim at elucidating the molecular base of hydrotoropism.

Researchers in GCOE Program

Tohru Nakashizuka (E-mail: toron@mail.tains.tohoku.ac.jp)
Professor and Program Leader. We conduct a wide range of fundamental research on the forest ecosystem, from biodiversity through sustainable management. Topics include forest dynamics, natural & human disturbance, canopy ecology in tropical forest, plant-animal interaction, human-nature interaction, forest utilization and biodiversity. Field studies are conducted both in international and domestic research sites and explore both the basic and applied aspects of forest ecology.

Masakado Kawata (E-mail: kawata@mail.tains.tohoku.ac.jp)
Professor and Program Sub-Leader. My research focuses on evolutionary mechanisms creating biodiversity and ecosystems. My research includes the evolutionary response of populations/communities to environmental change, evolution of species range and distribution, evolvability and robustness of organisms and ecosystems in response to various factors such as infectious disease, global climate change and human-induced environmental change.

Jotaro Urabe (E-mail: urabe@mail.tains.tohoku.ac.jp)
Professor. We conduct a variety of laboratory and field studies to understand how local, regional and global environmental changes alter lake and stream ecosystems. Our research includes ecological stoichiometry of aquatic organisms, effects of warming and rising CO_2 on biological interactions, mechanisms regulating the food web and functional roles of biodiversity in biogeochemical cycling and ecosystem stability.

Kouki Hikosaka (E-mail: hikosaka@mail.tains.tohoku.ac.jp)
Professor. We study plant response to environmental change: analyzing the impact of warming and atmospheric CO_2 increase on photosynthesis, plus growth and reproduction on various spatial and temporal scales. We conduct research on the evolution of plants inhabiting CO_2 spring ecosystems, where they have been exposed to high CO_2 concentrations on an evolutionary time scale.

Satoshi Chiba (E-mail: schiba@biology.tohoku.ac.jp)
Associate Professor. We examine how various organisms exhibit evolutionary response, community-level response and interactions between organisms to direct or indirect human activity. Using the archipelago as a model we also analyze evolutionary processes, invasive species, the response of native species to invasion, and mitigation and ecosystem protection against radical environmental change.

Masataka Tsuda (E-mail: mtsuda@ige.tohoku.ac.jp)
Professor. Our goal is to understand the behavior and evolution of environmental bacteria from the standpoints of molecular genetics, molecular biology, structural and functional genomics and molecular ecology. Particular emphasis is placed on understanding bacteria able to degrade environmental pollutants.

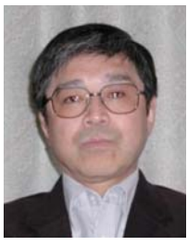
Hideyuki Takahashi (E-mail: hideyuki@ige.tohoku.ac.jp)
Professor. We look at the way in which sessile land plants avoid stress and adapt to their surroundings in response to various environmental cues. For example, plants adjust their morphology and growth orientation in response to light, temperature, water, gravity, and mechanical stimuli, all of which helps them to obtain light energy and water for survival. Our research aims at elucidating the molecular and genetic bases of these adjustments.

Tatsushi Muta (E-mail: tmuta@biology.tohoku.ac.jp)
Professor. To understand ecological adaptability and robustness, it is necessary to understand host defense mechanisms against pathogenic microorganisms. We investigate the activation mechanisms and physiological functions of innate immunity present in all multicellular organisms from plants through mammals. Using human and mouse cells and genetically engineered mice we are currently analyzing the innate immune system with a variety of techniques including: biochemistry, molecular biology, cell biology, immunology, and developmental engineering.

Koji Tamura (E-mail: tam@biology.tohoku.ac.jp)
Professor. Adaptation and response to environmental change differ between species. We research the morphology of vertebrates in order to understand their flexibility and robustness as the basis of adaptivity. We use development/ regeneration of tissues and organs in vertebrates as an experimental model to assess morphogenetic ability.

Shoichiro Kurata (E-mail: kurata@mail.pharm.tohoku.ac.jp)
Professor. We analyze the molecular mechanisms of “development and regeneration” and “innate immunity” to better understand how organisms adapt to environmental change. These studies utilize *Drosophila* as the model organism. We are also developing compounds that act on insect immunity to control vector-born diseases such as malaria and sleeping sickness, the transmission of which has expanded due to climate changes.

Akihiro Kijima (E-mail: a-kijima@mail.tains.tohoku.ac.jp)
Professor. We are interested in understanding the causes of change in distribution of organisms around the Sanriku coast. This represents a location in which warm and cold sea currents meet and is a north/south boundary for distribution of a number of species. We conduct research on changes in species distribution, adaptation, and the mechanism of recent climate change. We are also interested in evaluating future risk and strategies to mitigate risk.



Yoshinari Endo (E-mail: yendo@bios.tohoku.ac.jp)
Professor. Global warming is likely to increase ocean stability, diminish nutrient enrichment and reduce primary productivity. Increased CO2 in the oceans renders them more acidic, making it more difficult for some plankton to build and maintain calcium carbonate shells. In addition to fundamental studies of marine plankton, we are interested in understanding the impact of such radical environmental changes on marine plankton and the physiological and ecological strategies that these organisms use to survive.

Yukio Agatsuma (E-mail: agatsuma@bios.tohoku.ac.jp)
Associate Professor. Global warming extends over the ocean and accelerates kelp deforestation in rocky subtidal communities, resulting in expansion of barren ground “Isoyake” dominated by crustose coralline red algae. Alternation from kelp forest to fucoid forest is also seen. Production of herbivorous sea urchin is reduced due to these changes, and our main area of study focuses on the systemic adaptations of primary consumer/ altered producer through species interaction.

Yoshihisa Suyama (E-mail: suyo@bios.tohoku.ac.jp)
Associate Professor. We study the molecular ecology of forest trees: in particular, genetic diversity, ecological adaptation, ecosystem function, and conservation as part of a forest ecosystem. We use a combination of molecular and ecological approaches for both domestic and international projects. In ongoing projects, we conduct large-scale field experiments using artificial wetlands and riparian forest to clarify the relationship between biodiversity and ecosystem function.

Junya Fukumoto (E-mail: fukumoto@plan.civil.tohoku.ac.jp)
Associate Professor. We research ecological governance, i.e. how social systems adapt to drastic changes in the ecological environment. We propose a novel mechanism that collates human ecological knowledge, coordinates the interests of different stakeholders, and tries to implement mutually beneficial eco-strategies. Our main concern is to apply ICT to ecological governance.

Nariaki Fujisaki (E-mail: fujisaki@mail.kankyo.ac.jp)
Professor. In order to shed light upon various aspects of water resource problems, we recently started an interdisciplinary research project focusing on a river basin in West Java, Indonesia. While the level of deterioration of the watershed ecosystem, changes in water flow and water quality degradation in the region will be assessed scientifically, several factors related to industrialization and urban development, such as access to water supply and sewerage, establishment of environment-related laws and ordinances, and provision of administrative and environmental management services, will be analyzed from a social science viewpoint.

Osamu Nishimura (E-mail: osamura@eco.civil.tohoku.ac.jp)
Professor. The restoration of rivers, lakes, wetlands, tidelands and seaweed beds damaged by human activity is a critical requirement of ecosystem conservation. To restore and sustain ecological services, we research and develop technologies using constructed wetlands and tidal flatlands to remove pollutants and enhance biodiversity.

Yasuhisa Hayashiyama (E-mail: yhaya@econ.tohoku.ac.jp)
Professor. Our social and economic activities are subject to the laws of nature, and our economic activities cause environmental problems. We research the interactions between socio-economic activity and the natural environment. More concretely, we try to quantify the impact of environmental policy on our social and economic systems, and measure environmental services in monetary term.

Atsushi Yoshimoto (E-mail: yoshimoa@ism.ac.jp)
Visiting Professor, The Institute of Statistical Mathematics. Our research focuses on mathematical models for predicting and controlling natural and socio-economic resource change within deterministic and stochastic frameworks. Through field survey, we conduct research on sustainable forest resource management as a socio-economic system. One of our current projects concerns risk evaluation and economic analysis of sustainable forest resource management.

Noriko Takemoto (E-mail: takemoto@m.tains.tohoku.ac.jp)
Professor by Special Appointment and Senior Business Adviser. After helping set up a company in direct marketing and founding another in IT education, I became involved in a citizens' project to fund wind generator turbines in Hokkaido and, then, more generally, with CSR and the design of goods consonant with the philosophy and practice of environmental sustainability. I now serve on a couple of committees charged with looking at ecological sustainability with regard to business, and join this Center as its business liaison adviser.

Takehiro Sasaki (E-mail: sasa@m.tains.tohoku.ac.jp)
Takehiro is a Postdoctoral Fellow in the Ecosystem Adaptability Global COE program at Tohoku University. His research mainly focuses on nonlinear vegetation dynamics in arid and semi-arid ecosystems, including the patterns and processes of nonlinear vegetation responses to grazing, and the mechanisms how local extinctions in communities impact ecosystem functioning. For more information, please visit http://homepage3.nifty.com/landscape_ecology/.

Hiroko Kurokawa (E-mail: hiro@m.tains.tohoku.ac.jp)
Assistant Professor. Hiroko is a plant ecologist, generally interested in how plant functional diversity affects above- and belowground interactions, ecosystem functioning, and eventually feedbacks to plant community structure. She has worked at tropical rain forests in Borneo, an invaded flood plain in New Zealand, subtropical islands and subalpine forests in Japan.

Hiroshi Tomimatsu (E-mail: htomi@bios.tohoku.ac.jp)
Assistant Professor. Hiroshi has joined the GCOE program in April, 2009. His research primarily focuses on the dynamics of plant populations and communities, with a particular emphasis on the influence of human activities such as habitat loss and fragmentation and anthropogenic dispersal. He received a Ph.D. from Hokkaido University, and he was a JSPS postdoctoral fellow at Tokyo Metropolitan University and at the University of British Columbia.

Seiji Ishida (E-mail: ishidaseiji@m.tains.tohoku.ac.jp)
Assistant Professor. My research interest is how quaternary glaciations and recent anthropogenic impact have altered biodiversity of freshwater species in the northern hemisphere. I conduct phylogeographic and taxonomic studies on freshwater zooplankton to reveal population history and invasion. I also conduct interdisciplinary research relating to paleolimnology and gene functions of freshwater zooplankton, *Daphnia*.

Takashi Makino (E-mail: tamakino@m.tains.tohoku.ac.jp)
Assistant Professor. We are interested in genetic factors related to evolvability contributing to extent of species distributions, and focus on genome structures of *Drosophila* species for the issue by comparative genome analysis. Our point of view is important for considering how ecological system shifts by change in environment such as global warming. We also expect that the research outcomes are applicable to species conservatory.

Yasuyoshi Kanari (E-mail: kanari@life.biology.tohoku.ac.jp)
Assistant Professor. Several host genes control retroviral replication and pathogenesis. I have conducted association study about Italian cohort to reveal HIV resistant host genetic factors focusing on immune response. The understanding of the mechanisms of natural protection from or spontaneous resistance to viral infections may contribute to the development of treatment of infectious disease based on Ecosystem Adaptation. Now, I am researching how the cells recognize the pathogen and response for exclusion of pathogen at molecular level to understand the mechanism of natural protection more deeply.

Masakazu Inagaki (E-mail: m-inagaki@m.tains.tohoku.ac.jp)
Assistant Professor. We are interested in the relation between consideration to environment and economic activity. Especially, we analyze the economic effect of environmental education by attitude behavior change model. We also research the market of environment-conscious type products by using statistical methods.

Motoko R. Kimura (E-mail: m-kimura@m.tohoku.ac.jp)
Postdoctoral Fellow. I have been assigned to a postdoctoral fellow of the GCOE program from this October. My current research primarily focuses on criteria of biodiversity and ecosystem services, especially for sustainable land use of business sites and biodiversity offsets. To promote biodiversity-conscious land use at business sites and build ecological networks in urban areas, now I am trying to establish an integrated guideline and evaluation tools through cooperation with members of JBIB (Japan Business Initiative for Conservation and Sustainable Use of Biodiversity).

Katsuhito Nohara (E-mail: k-nohara@econ.tohoku.ac.jp)
Assistant Professor. My research interest is the economic valuation of environment. In most instances the environmental service does not have a price. Therefore, the value of environmental service must be inferred through the relationship between market goods and the environmental service. I focus on the relationship between travel and environment and develop the evaluation theory of recreation benefit using revealed preference data and applying the household production function approach. I also conduct an empirical study using that theory.

Past Members

Kazunori Nakajima

Research at GCOE: We conduct research on economic evaluations of impacts of environmental policies, biodiversity conservation policies and climate stabilization policies on our socio-economic systems from view points of efficiency, equity as well as sustainability, through developing/using economic models such as a dynamic optimization model and a computable general equilibrium model.

(Current affiliation: Lecturer, School of Human Science and Environment, University of Hyogo; E-mail: nakajima@shse.u-hyogo.ac.jp)

Masashi Konoshima

Research at GCOE: My research interest lies in examining natural resource, especially forest resource, management decisions over space and time. In order to examine the complex tradeoffs associated with natural resource management decisions, I have developed integrated models that combine ecological/biological/ physical models and economic models. I have applied GIS and optimization models for spatial natural resource economic analysis, which is one of the emerging areas of natural resource and environmental economics. The current research topics include: management of natural disturbances, wildlife habitat protection, and invasive species.

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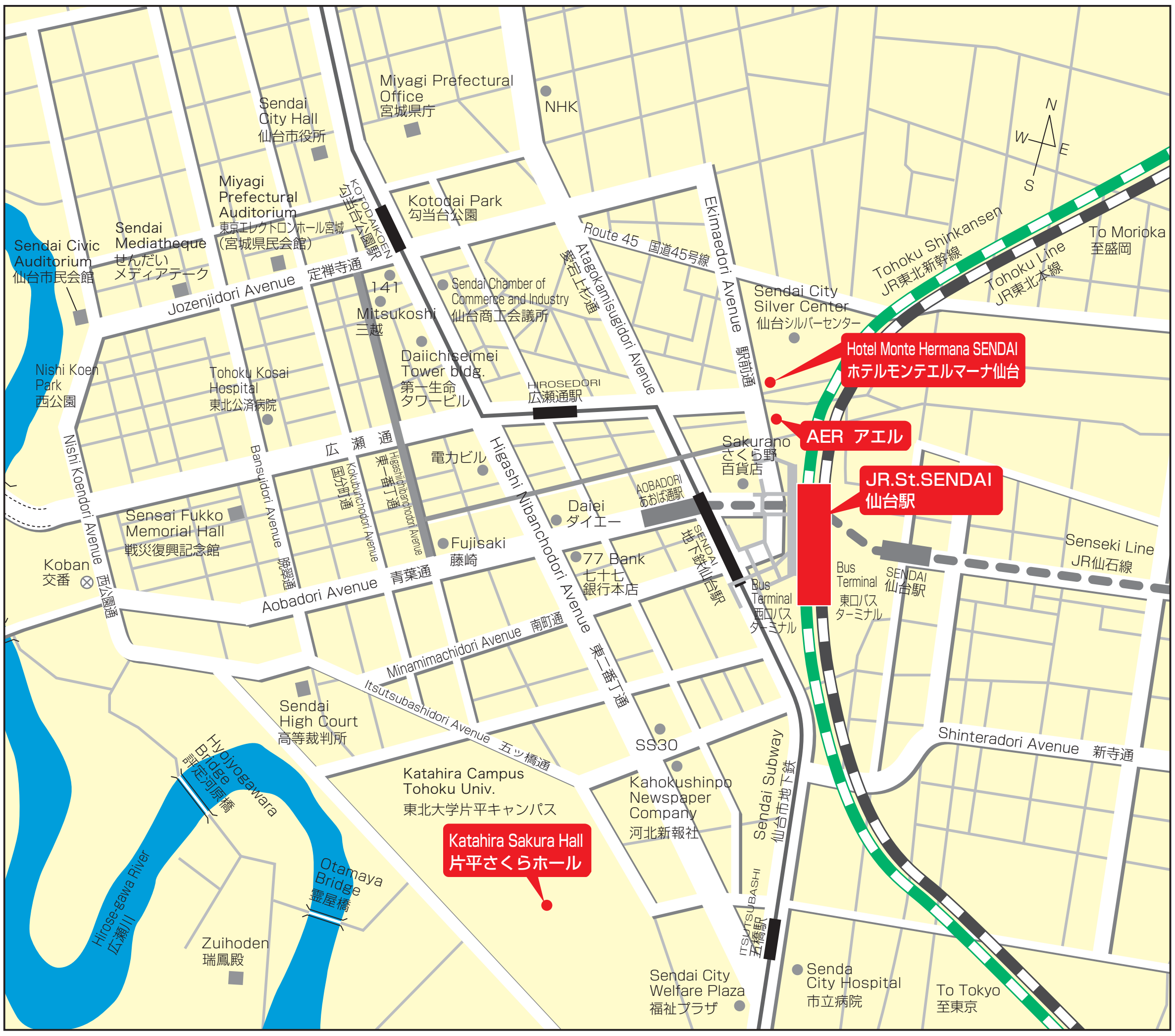
Map


Miyagi Prefectural Office
宮城県庁
NHK
Sendai City Hall
仙台市役所
Miyagi Prefectural Auditorium
東京エレクトロンホール宮城
(宮城県民会館)
Kotodai Park
勾当台公園
Sendai Mediatheque
せんだい メディアテーク
Sendai Civic Auditorium
仙台市民会館
Jozenjidori Avenue
定禅寺通
Route 45 国道45号線
Ekimaedori Avenue
駅前通
Atagokamisugidori Avenue
愛宕上杉通
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第一生命タワービル
HIROSEDORI
広瀬通駅
Sendai City Silver Center
仙台シルバーセンター
Tohoku Shinkansen
JR東北新幹線
Tohoku Line
JR東北本線
To Morioka
至盛岡
Hotel Monte Hermana SENDAI
ホテルモンテエルマーナ仙台
AER アエル
JR.St.SENDAI
仙台駅
Nishi Koen Park
西公園
Tohoku Kosai Hospital
東北公済病院
広 瀬 通
電力ビル
Higashi Nibanchodori Avenue
Sakurano
さくら野百貨店
AOBADORI
あおば通駅
Daiei
ダイエー
Fujisaki
藤崎
77 Bank
七十七銀行本店
Sendai Fukko Memorial Hall
戦災復興記念館
Nishi Koendori Avenue
西公園通
Bansuidori Avenue
Koban
交番
Aobadori Avenue
青葉通
Minamimachidori Avenue
南町通
Bus Terminal
西口バスターミナル
Bus Terminal
東口バスターミナル
SENDAI
仙台駅
Senseki Line
JR仙石線
Itsutsubashidori Avenue
五ッ橋通
東二番丁通
Sendai High Court
高等裁判所
SS30
Katahira Campus Tohoku Univ.
東北大学片平キャンパス
Kahokushinpo Newspaper Company
河北新報社
Katahira Sakura Hall
片平さくらホール
Sendai Subway
仙台市地下鉄
Shinteradori Avenue
新寺通
Hyojyogowara Bridge
評定河原橋
Otamaya Bridge
霊屋橋
Hirose-gawa River
広瀬川
Zuihoden
瑞鳳殿
Sendai City Welfare Plaza
福祉プラザ
Sendai City Hospital
市立病院
To Tokyo
至東京
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