D Diversity Program

Program Director **KAWABATA Zen'ichiro**

Humanity and nature have evolved together. Nature is the source material of human perception and culture, and nature's rich diversity—both biotic and abiotic—has cultivated cultural diversity. Yet nature is transformed through human activity: it is both source and subject.

Biological diversity composes the planet as we know it; it is the foundation of all society and human reliance on it is inestimable. Meanwhile, cultural diversity, including ideas, languages, technologies, ways of living and systems of belief have been passed from people to people through time, and have enriched human quality of life and understanding of the cosmos. In acknowledging this role of cultural diversity we recognize the basic human rights to safe, healthy, fulfilling lives, peace of mind and just social systems, for these are the essential conditions in which people can live with hope and pride.

In historical context, the current loss of cultural diversity can be seen as part of a large-scale process that threatens biological diversity on Earth, and as an expression of humankind's relationship with nature since the last century. Humanity faces a situation in which the cultures responsible for today's global environmental problems are expelling from the world those that have historically embraced "wise use" and harmony with nature.

The RIHN Diversity Program describes the formation, maintenance and functions of biological and cultural diversity in various environments. It seeks to identify ways to re-vitalize the idea and practice of "wise use" of nature—to prevent exhaustion of resources and preserve ecosystem services—in order to enhance human wellbeing and ecological integrity.

Completed Research	Leader	Title
D-02	**YUMOTO Takakazu**	A New Cultural and Historical Exploration into Human-Nature Relationships in the Japanese Archipelago
Full Research	**Leader**	**Title**
D-03	**OKUMIYA Kiyohito**	Human Life, Aging and Disease in High-Altitude Environments
D-04	**YAMAMURA Norio**	Collapse and Restoration of Ecosystem Networks with Human Activity

A New Cultural and Historical Exploration into Human-Nature Relationships in the Japanese Archipelago

The Japanese Archipelago has been densely populated since the Neolithic Age, and its natural environment has been greatly influenced by human activities. In spite of intensive human intervention in the natural environment, the area is still rich in biota. More recent patterns of interaction between humanity and nature, however, have placed many plants and animals in danger of extinction. This project described the historical evolution of human-nature relationships in the Japanese Archipelago in order to suggest concrete measures for preventing species extinction in the near future.

Project Leader: **YUMOTO Takakazu** RIHN

Project objectives

The main objective of the project was to describe the history of human-nature relationships in the Japanese Archipelago. Project researchers examined how the area's physical environment and biota have changed since the late Paleolithic Age, when human presence was first established. Archaeological, historical and folkloric materials were used to indicate past human perception, knowledge and skills regarding nature in general, and the human effect on key plant and animal species. This combination of biophysical and human cultural history will enrich appreciation of human-environmental history in the archipelago.

Results

In the history of the Japanese Archipelago, there are examples of both long-term sustainability and collapse. The common view that pre-modern or indigenous humans lived in harmony with nature, a harmony disturbed by modern science and technology, is partially true. Human ability to modify nature increased dramatically through time, and the earlier incentives to utilize local bio-resources in a sustainable way were displaced by growing access to global economies and trade. Traditional knowledge does not guarantee sustainable resource utilization, however; traditional systems sometimes have led to over exploitation of resources. Project research found that the level of community governance plays a critical role in sustainable use of ecosystem services: non-local systems of governance frequently led to collapse. Such findings strengthen the case for enhanced support of community or local governance, espcially by the people suffering most from current and future ecosystem service degradation. In some cases, long-term sustainability or recovery from collapse was achieved through collaboration of actors sharing both traditional and scientific knowledge, including, for example, that allowing alignment between local and non-local layers of governance.

Research communication

Project results have been published as Japanese books "35,000 Year History of the Japanese Archipelago" (in Japanese, six volumes). Important conclusions and messages were contributed to the report "Satoyama-Satoumi Ecosystem and Human Well-Being: Socio-ecological Production Landscapes of Japan (Summary for Decision Makers)" for the Convention of Biodiversity (COP10), held in Nagoya, October 2010.

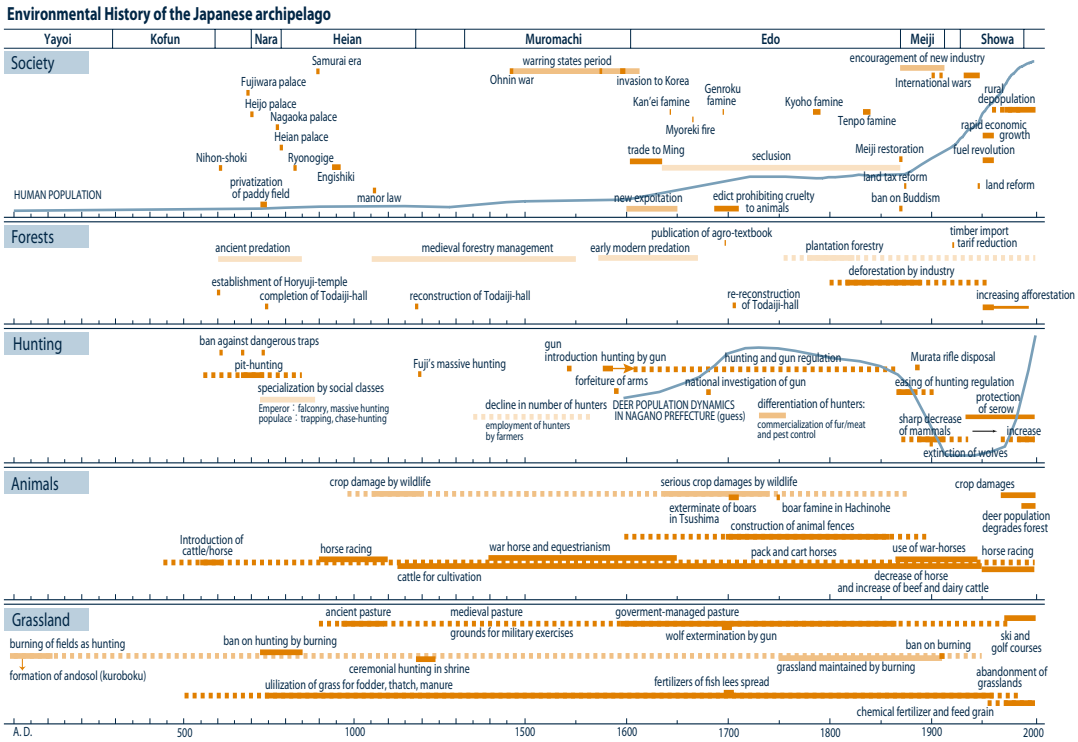

Figure 1
Chronological chart showing the history of 2000 years of human-nature relations in the Japanese Archipelago

Human Life, Aging and Disease in High-Altitude Environments: Physio-Medical, Ecological and Cultural Adaptation in "Highland Civilizations"

This project examines how humans have adapted to high-altitude environments physiologically, ecologically and culturally. Project researchers document the health status of elderly highlanders, and explore possible factors associated with lifestyle-related diseases in this population. Finally, we investigate the impact of modern development over the past 50 years on high altitude lifestyles and environments, and assess how these changes affect the quality of life (QOL) of elderly highlanders. Study sites have been selected from four areas in the Himalaya-Tibet region, the Ladakh region in India, the Arunachal Pradesh State in India, Khaling in Bhutan, and the Qinghai Province in China, and each of which has distinct ecological and socioeconomic conditions.

Project Leader
OKUMIYA Kiyohito RIHN

Dr. Okumiya is a medical doctor with a degree from Kochi Medical College. He has adopted a novel approach to field medicine, including cultural and environmental factors in the study of community-dwelling. He has published on field medicine, geriatrics, and neurology.

Sub-Leader

SAKAMOTO Ryota	RIHN

Core Members

ANDO Kazuo	Center for Southeast Asian Studies, Kyoto University
INAMURA Tetsuya	School of Foreign Studies, Aichi Prefectural University
KAWAI Akinobu	Faculty of Liberal Arts, The Open University of Japan
KOSAKA Yasuyuki	RIHN
SHIGETA Masayoshi	Graduate School of Asian and African Area Studies, Kyoto University
TAKEDA Shinya	Graduate School of Asian and African Area Studies, Kyoto University
TSUKIHARA Toshihiro	Faculty of Education and Regional Studies, University of Fukui
MATSUBAYASHI Kozo	Center for Southeast Asian Studies, Kyoto University

Project objectives

This project explores new perspectives on human lifestyle in high-altitude environments where oxygen levels are low and natural resources are limited. Project research focuses on aging problems and lifestyle-related diseases, which are regarded as manifestations of global environmental issues evident in the human body. We aim to clarify the concept of "highland civilization", defined in relation to social, ecological and cultural adaptations to high-altitude environments, and to examine human physiological adaptations to high altitude environments and how recent changes in lifestyle have affected the health and quality of life (QOL) of the elderly.

Ecological and cultural adaptation to the high-altitude environment and recent lifestyle change

Subsistence lifestyle and economic conditions were studied in three ecologically distinct zones in Himalaya-Tibet region: a forest in Arunachal Pradesh and Bhutan, the Ladakh oasis, and the grasslands of Qinghai. Distribution of vegetation, ethnic groups, patterns of subsistence and alien plant invasion were described from 200 to 4000 m in Arunachal Pradesh (Kosaka 2010). Detailed household interviews and analysis of satellite imagery revealed a recent decrease in the number of livestock, increasing use of chemical fertilizer, and an expanding pattern of abandoned land at Domkhar village in Ladakh (Fig. 4). Shortage of fodder, heavy snowfall, and limited access to social services were identified as causes of outmigration of pastoral people from the Changthang highland to Leh city in Ladakh. In Ladakh, researchers assessed the risk of glacial lake collapse, documented damage due to flood (Yamaguchi 2011) and analyzed the role of climate as a cause of natural disaster (Fig. 3).

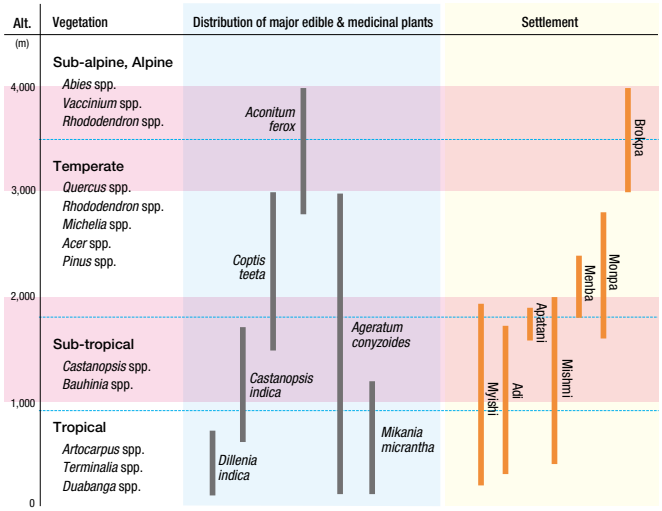

Figure 1 **Vertical distribution pattern of edible and medicinal plants**

Trade networks of ethnic groups distributed important edible and medicinal plants throughout the steep Arunachal Pradesh landscape (Kosaka et al., 2011).

The "Himalaya model of lifestyle-related diseases": Interaction between long-term physiological high-altitude adaptation and recent lifestyle change

We have documented a relationship between physiological hypoxic adaptation and lifestyle-related diseases. Han people had higher hemoglobin concentration compared with Tibetans in Qinghai. Increasing prevalence of diabetes mellitus was strongly associated with increases in hemoglobin levels related to adaptation to hypoxia in Ladakh, Yushu, and Arunachal (Okumiya 2010).

There is association between high-altitude and lifestyle-related diseases. High blood sugar, pulmonary disorder caused by dust, sleep disorder (in Ladakh), hypertension and hyperlipidemia (in Arunachal) were more prevalent among higher-altitude dwelling people (Ishimoto 2011).

There was association between ecological context, globalization and food diversity. Food diversity was highest in humid Arunachal, moderate in semi-arid Qinghai and lowest in arid Ladakh. Rural areas in Ladakh show less food diversity than urban areas.

There was association between settlement, livelihood change and lifestyle-related diseases. Lifestyle-related diseases were more prevalent in urban area of Yushu than rural area of Haiyan in Qinghai (Okumiya 2010). Official workers and monks had higher prevalence of obesity,

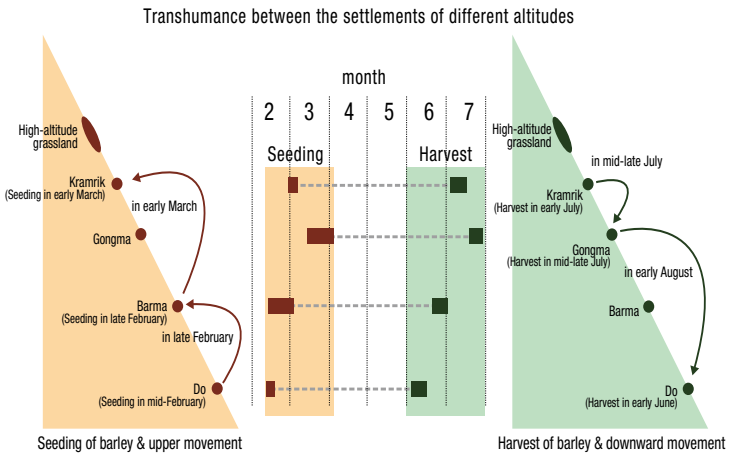

Figure 2 **Agro-pastoral linkage**

Transhumance of Ladakh pastoralists is closely linked to the agricultural cycle at each settlement of different altitudes (Hirata 2011).

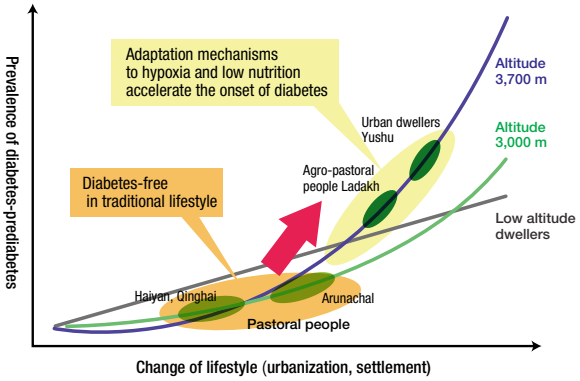

Figure 5 **Diabetes acceleration hypothesis**

In high altitude Himalaya regions, after rapid changes in lifestyle, adaptation mechanisms to hypoxia and low nutrition may have accelerated the onset and aggravation of diabetes. This is "the Himalaya model of lifestyle-related diseases" -"diabetes acceleration hypothesis" (Okumiya 2011).

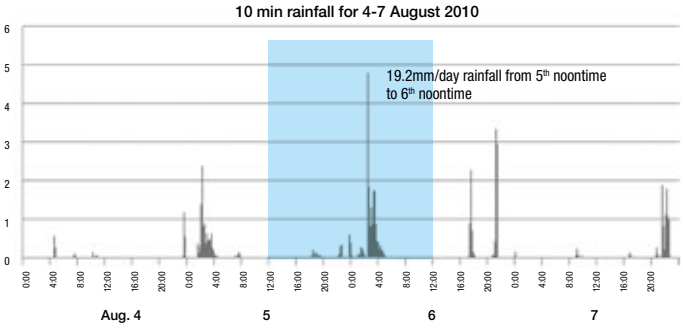

Figure 3 **Vulnerability and flexibility in relation to disaster**

Analysis of weather-monitoring data indicated the vulnerability of less vegetated oasis zones to mudflow disaster even with moderate rainfall in Ladakh (Yatagai et al., 2011). On the other hand, health examinations detected fewer mental stresses among disaster victims there than in other regions, which suggested a psychological coping capacity related to the sense of value and flexible social support in Ladakh (Ishikawa 2011).

Photo 1 **Local participants and health staff in a medical camp in Domkhar, Ladakh**

Follow up monitoring of body weight, physical activity and blood pressure is now underway.

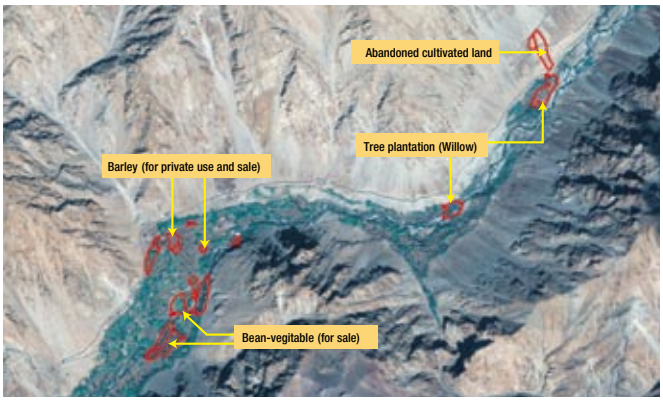

Figure 4 **Land use in a household with cases of lifestyle-related diseases**

This household in Ladakh had one case with polycythemia and high blood sugar and another case with obesity and hypertension. Nutritional survey revealed high intake of carbohydrate, lipid and salt. A land use survey revealed cultivation of cash crops and abandoned land related to labor shortage. Elderly agro-pastoral people adapted to hypoxic conditions suffered from lifestyle-related diseases associated with changes of diet and activity (Nose, Takeda 2011, Fukutomi, and Kimura 2011).

hypertension and diabetes than agro-pastoral local people in urban areas of Yushu and Leh.

The prevalence of diabetes was low among pastoral peoples following the traditional lifestyle in Arunachal and Haiyan (3000 m. altitude). In Ladakh (2900-3800 m) the prevalence of prediabetes in Ladakh was high, however. The difference may be related to the scarcity of natural resources in Ladakh, and their fragility in relation to contemporary change in lifestyle. There was greater prevalence of high hemoglobin level and high blood sugar with obesity and hypertension in Yushu (3600 m) than in Ladakh. Rapid change of lifestyle in hypoxia-adapted people may accelerate lifestyle-related diseases, as according to our "Diabetes-acceleration hypothesis" (Fig. 5).

Aging with high QOL: Health care design for the highland elderly

With the collaboration of local health staff in Ladakh we initiated follow-up monitoring of blood pressure, body weight and amount of exercise (Photo 1). Comprehensive geriatric functional analysis in all elderly people in Khaling, Bhutan was conducted and we are developing a geriatric care system in collaboration with local health staff, including traditional medical practitioners and monks, to promote health, high spirituality and quality of life (Sakamoto 2011).

Schedule in 2011/2012

Global environmental changes associated with socioeconomic globalization and climate warming are manifest in the human bodies of highland peoples. In the coming period of research, we will examine the difference between adaptation and maladaptation in relation to our hypotheses of Himalaya lifestyle-related diseases and diabetes acceleration. In this task, we will continue to integrate the research and findings of the medical and cultural/ecological teams. In describing a model of health care that is culturally and ecologically suited to the challenges of highland civilizations, and that is based in the wisdom of the elderly concerning quality of life, aging, and death, we will reflect on present lifestyles and the future of not only highland civilization but also modern civilization.

Collapse and Restoration of Ecosystem Networks with Human Activity

Many ecosystems have been seriously degraded by human activities and are now in critical condition. Nevertheless, most ecological research on ecosystem degradation has primarily focused on its direct cause and effect in a particular place. This project applies new network science to the problem of ecosystem deterioration and collapse, and to the prospect of ecosystem restoration. The project examines social-environmental interactions in two distinct areas where humans are dramatically altering ecosystems, and attempts to identify general characteristics leading to productive and destructive ecological change.

Project Leader
YAMAMURA Norio RIHN

My research field is mathematical ecology. I have studied various theoretical problems in population and evolutionary ecology. I am now trying to construct mathematical models of social-ecological systems, for example, modeling population migration between urban and rural areas, and different use of private and common lands. I like football, and still play with the RIHN researchers on our small field sometimes.

Sub-Leader

SAKAI Shoko	RIHN

Core Members

ISHII Reiichiro	Frontier Research Center for Global Change
FUJITA Noboru	RIHN
ICHIKAWA Masahiro	Graduate School of Agriculture, Kochi University
KAMIMURA Akira	Tokyo University of Foreign Studies
ICHIOKA Takao	Graduate School of Human and Environmental Studies, Kyoto University
MATSUOKA Masayuki	Graduate School of Agriculture, Kochi University
HYODO Fujio	Center for New Technology, Okayama University

Project background

Degradation of ecosystems, including loss of biodiversity and ecosystem functions, is widely viewed as a serious global environmental problem. To date, much research has focused on the direct causes and effects of ecological degradation in a particular place. Few studies have adopted network-based analytical frameworks capable of describing the indirect and cascade effects characteristic of human-driven ecosystem change. Still fewer studies incorporate a social science perspective on ecological networks, even though environmental problems occur as a consequence of interactions between nature and human societies.

The key concept of our project is the ecosystem network, a concept describing ecosystem change in relation to a linked set of subsystems comprised of interacting social and ecological phenomena. Two ecosystem networks are investigated: those describing forest ecosystems in Sarawak and pastures in Mongolia (Fig. 1). Land-cover degradation is associated with intensifying land-use in both networks. Project research involves diversified field surveys, remote sensing and examination of existing literature in order to identify the most significant components and interactions causing degradation in each network. These indices then allow description of several possible future scenarios. As a whole, the two area studies enable construction of a general theory of ecosystem conservation.

Research sites

Field research takes place in tropical rainforests in Sarawak, Malaysia, and the grasslands of Mongolia. Export of raw materials is central to both economies. In the last few decades, social and environmental conditions in both places were profoundly affected by resource extraction, which has recently intensified in relation to new global economic demand. The ecological characteristics of these two places, including regeneration time of vegetation and position of humans in the food web, are quite different, but both ecosystems are critical to local livelihoods. Ecosystem degradation therefore dramatically affects local practices and prospects.

Research progress to date

In Mongolia, pasture degradation, especially near Ulan Bator, is the most serious environmental problem; it is caused by overgrazing linked to increasing populations of livestock, especially goats (Photo 1A). We observed patterns of livestock movement in order to understand

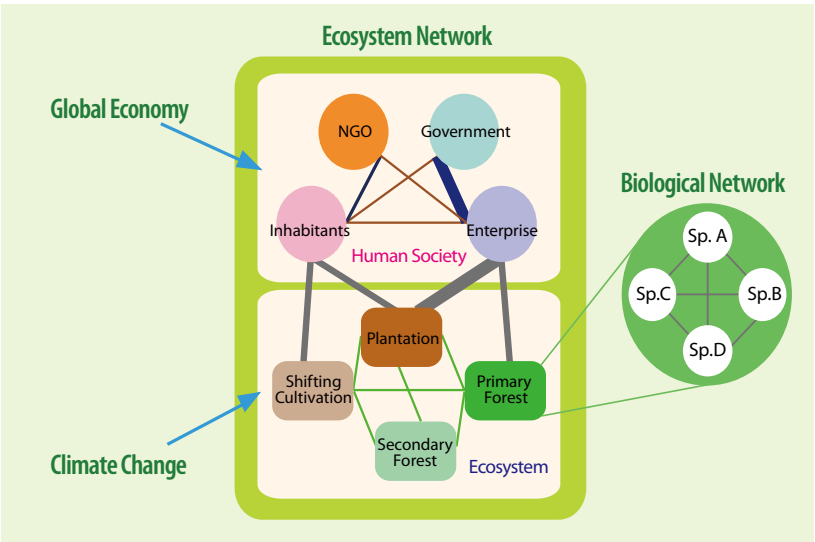

Figure 1
The ecosystem network concept

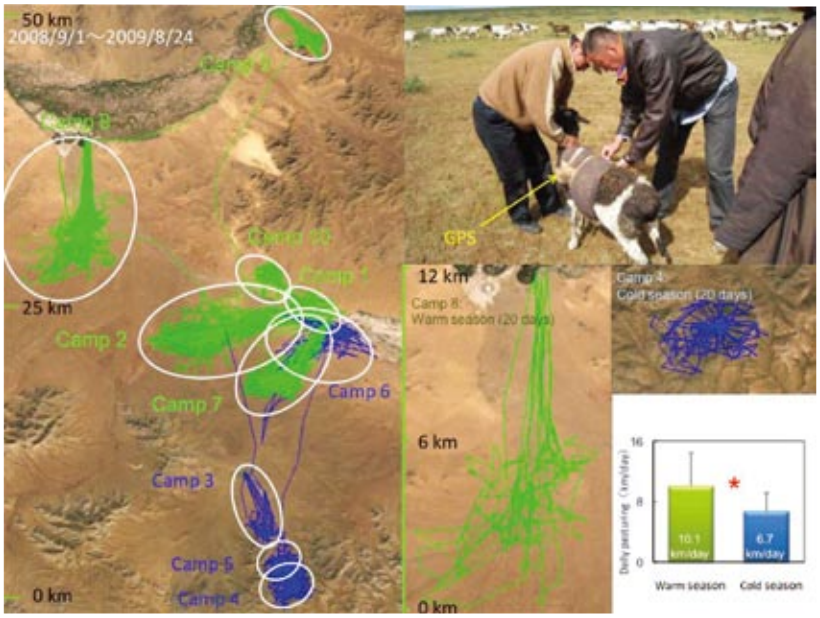

Figure 2 **Spatial patterns in nomadic life with livestock**

Mongolian nomadic people move livestock seasonally to maximize access to plants and water. Pasturing patterns were monitored by GPS installed on sheep. Daily pasturing distance was significantly greater in the warm seasons.

Photo 1 **Recent environmental problems *in Mongolia and Sarawak***

A. The number of livestock, especially goats, is increasing rapidly, leading to degradation of pastures (photo by A. Maekawa). **B**. The number of oil-palm plantations is increasing all around Sarawak, and palm oil products are readily available (photo by S. Sakai).

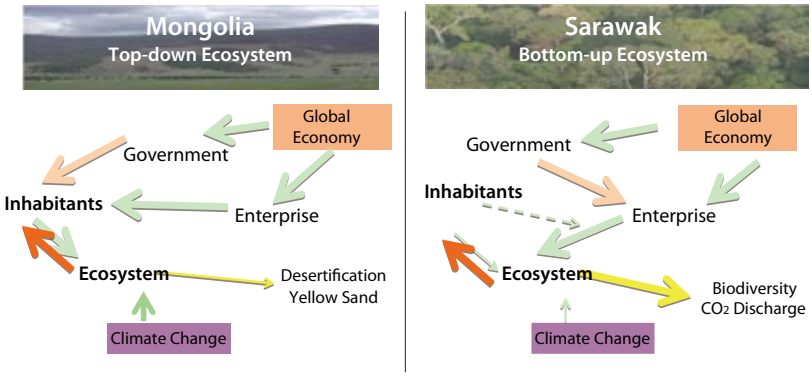

Figure 3 **Different ecosystem networks in Mongolia and Sarawak**

actual utilization of grasslands (Fig. 2) and documented the social factors leading to concentrations of livestock near urban areas, causing pasture degradation. We also analyzed climate data in order to describe how forests and shrubs affect pastures, and conducted scenario analysis of the effects of several possible policies affecting use of pasture, such as limiting the total number and movement of grazing livestock, on pasture degradation.

In Sarawak, expansion of palm plantation and its negative effect on biodiversity and forest resources available to local inhabitants, is the most serious environmental problem (Photo 1B). Research therefore entailed questionnaire surveys in communities located along the Rajang and Baram rivers, two of the main rivers in Sarawak, in order to identify the factors allowing plantation expansion in those areas. We also conducted surveys in order to describe the effect of plantation expansion on local biodiversity, and noted a decrease in biodiversity in areas of higher intensity human activity. Finally, we conducted scenario analysis of the effects of several contemporary endeavours, such as forest certification and bio-prospecting, in mitigating plantation development.

We have begun to develop a general theory of ecosystem network conservation based on the Mongolia and Sarawak case studies. We note remarkable difference in grassland and forest ecosystem networks (Fig. 3). In Mongolia, grassland vegetation itself has no direct value to humans: its value is realized in livestock that feed on the grasses. Global demand for livestock products, especially cashmere, therefore affects the behaviour of dispersed local inhabitants, leading to overuse of the vegetation and degradation of the grassland. In this case, an effective solution to grassland degradation should involve behaviour-change of land managers, but this change is clearly linked to their collective position within the cashmere commodity-chain. In Sarawak, economic value resides directly in the forest trees. There is great economic incentive in clearing forest, with clear negative impact on biodiversity and the amount of forest available to inhabitants. Effective solutions in this case should involve direct regulation of enterprises and governments, perhaps linked to greater recognition of the indirect economic value of forests.

Future issues

We have identified several potential scenarios in each ecological network under study, and now attempt to describe key scenario features, including prevalence of biodiversity, economic status of inhabitants, and continuation of traditional cultural practices related to long-term forest utilization. Even with extensive background data, predicting ecosystem network change is a challenge, as networks are dynamic and complex in themselves and also susceptible to external forces. General theories of ecosystem change will be improved through continual comparative analysis.