Ecosystem-Science & -Engineering Approach toward Conservation of Biodiversity

An Appeal to COP10 Nagoya
from the Ecology and Civil Engineering Society (ECES)

October, 2010

This appeal was finalized through International workshop on "Ecosystem–Science & -Engineering Approach toward Conservation of Biodiversity" on 13-14 th May, 2010.

Contents

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This appeal was discussed through having workshops with ECES members. And, it was finalized at International workshop on "Ecosystem–Science & -Engineering Approach toward Conservation of Biodiversity" on 13-14 th May, 2010.

"Ecosystem-Science and -Engineering Approach toward Conservation of Biodiversity"

An Appeal to COP10 Nagoya
from the Ecology and Civil Engineering Society (ECES)

Action Plan

We strive to carry out action aimed at conserving biodiversity through achieving river basin complex in harmony with nature around three core elements: conservation and restoration of habitat mosaics where critical ecosystem drivers influence their composition, distribution and maintenance; evaluation and rehabilitation of water/material flux networks that link them; and the system (governance) that implements them and the "responsibility of metropolitan leadership" to support them.

We take as our model the Ise Bay river basin complex. This region has characteristics that are valuable in terms of geology and the evolutionary history of life as well as ecology, and the region supports cities that are the nucleus of human activities. These human activities have concentrated economic power, knowledge, and technology in the cities particularly in the metropolis and, at the same time, caused ecosystem degradation such as the loss of biodiversity. With a core comprising the three elements of conserving and restoring landscapes, rehabilitating water/material flux networks, and exercising the responsibility of metropolitan, we will implement action meant to achieve river basin complex in harmony with nature through a challenging approach from ecosystem-science and -engineering and disseminate the results.

1. Significance of Pursuing Biodiversity Conservation

Along with resource depletion and global warming, "loss of biodiversity" is a factor threatening the sustainability of humankind. Providing for sound ecosystems in order to conserve biodiversity facilitates the conversion to an eco-harmonious society that benefits from ecosystem services (the use of biological resources). Another benefit, along with contributing to coping with resource depletion and to mitigating and adapting to global warming, is the ethics and happiness of coexisting with other living things.

2. Structure and Function of Ecosystem

We recognize ecosystem as follows in order to maintain a healthy ecosystem. Ecosystem structure is composed of three subsystems; (A) physical basement by fluvial hydraulics, (B) biotic community and (C) material cycle with particular reference to biophilic elements. And, ecosystem functions are corresponding to the interactions among the subsystems, such as habitat provision and provision of appropriate space for peculiar elementary process in material cycle. The national land must be recognized as a set of scattered landscapes (habitat mosaics) linked by water/material flux networks, and ecosystem at larger scale is postulated there.

3. Focus on "River Basin Complex"

A "river basin" is a region where various landscapes (local ecosystems consisting of the interactions among their physical underpinning and material cycles, plus the various biological workings upon them) are linked by water/material cycles. The evolutionary processes of living things are based on units which are aggregates of multiple river basins that include geology, topography, and climate, as well as their changes throughout geological history. The human activities carried on in river basins have linked together multiple river basins in order to address population increases and improve economic efficiency. A "river basin complex," which is an aggregate of multiple river basins, is a representative scale shared by the activities of both humans and other organisms. And a river basin complex forms a fate with a bay surrounding multiple river basins. Precisely by focusing on the river basin complex, we can find a strategy for biodiversity conservation that pertains to the sustainability of humans and other living things.

4. Awareness of Biodiversity Degeneration

Human activities have expanded in river basin complex and disturbed the health of ecosystems, as seen in the loss of biodiversity, and have become a threat to sustainability, including that of human society. At the same time, human activities, mainly in cities, have brought together pleasant living, wealth, knowledge, and technology.

5. Conservation Strategy Actors

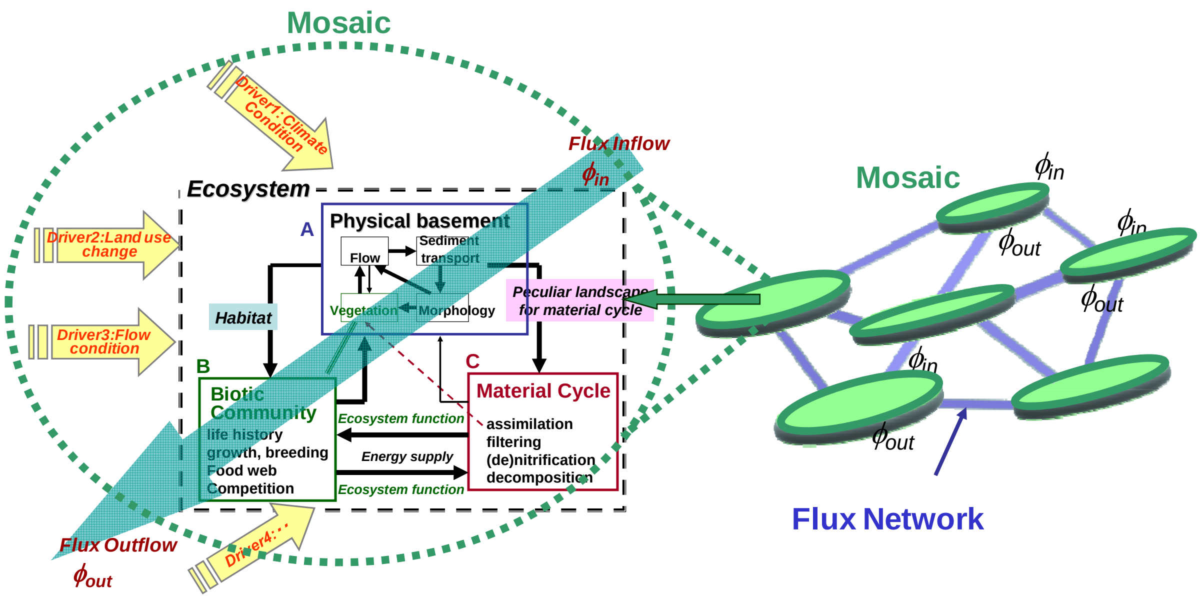
Cities and their citizens, particularly metropolitan, which enjoy the benefits of knowledge, technology, and economic power, stand at the forefront in mitigating the threat to sustainability (responsibility of metropolitan). It is essential to understand the structure and functions of river basin complex through the collaboration and melding of different scientific disciplines, and to have management framework and its practice by means of cooperation among diverse academic disciplines and solidarity among citizens, academics and public administrators. The Ecology and Civil Engineering Society, which has achievements in the collaboration and melding of sciences, mainly ecosystem-science and engineering, will be the motive force that expedites our understanding of the scientific mechanism of river basin complex, and the development of management methods which strive for harmony with nature.

6. Action Plan

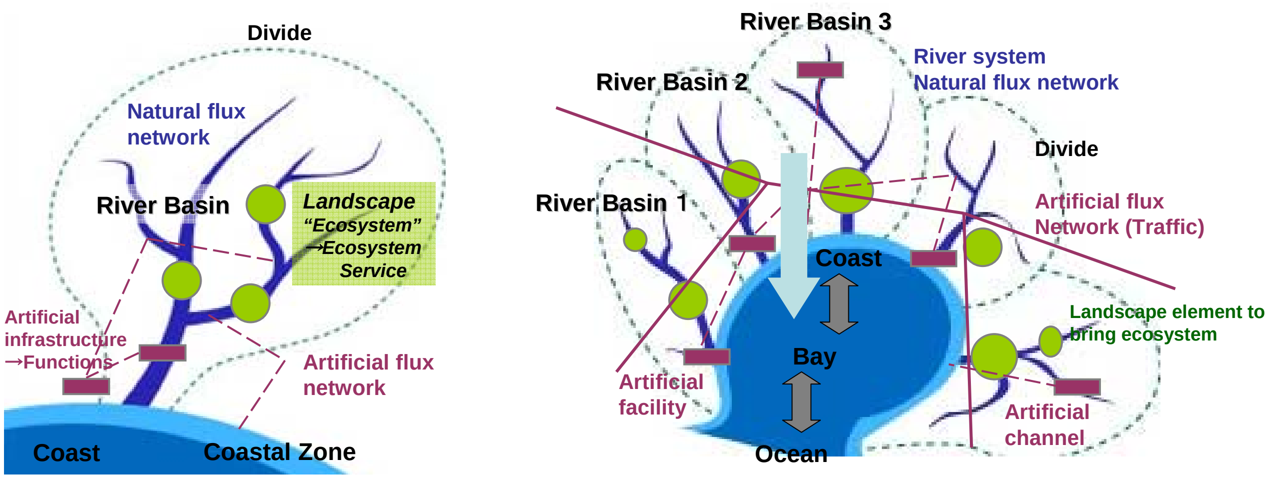
We strive to carry out action aimed at conserving biodiversity through achieving river basin complex in harmony with nature around three core elements: conservation and restoration of habitat mosaics where critical ecosystem drivers influence their composition, distribution and maintenance; evaluation and rehabilitation of water/material flux networks that link them; and the system (governance) that implements them and the "responsibility of metropolitan leadership" to support them.

7. Ise Bay River Basin Complex

We take as our model the Ise Bay river basin complex. This region has characteristics that are valuable in terms of geology and the evolutionary history of life as well as ecology, and the region supports cities that are the nucleus of human activities. These human activities have concentrated economic power, knowledge, and technology in the cities particularly in the metropolis and, at the same time, caused ecosystem degradation such as the loss of biodiversity. With a core comprising the three elements of conserving and restoring landscapes, rehabilitating water/material flux networks, and exercising the responsibility of metropolitan, we will implement action meant to achieve river basin complex in harmony with nature through a challenging approach from ecosystem-science and -engineering and disseminate the results.



Mosaics and Flux network



River basin and River basin complex

Appendix 1:

Report of International Workshop
"Ecosystem-Science & -Engineering Approach toward Conservation of Biodiversity" on May 13-14, 2010
Nagoya Congress Center, Shirotori Hall

Number of Total Participants: 190

International Workshop Organizing Committee of 'Ecosystem-Science & -Engineering Approach toward Conservation of Biodiversity'

Chairman of Organizing Committee

Tetsuro TSUJIMOTO	(Nagoya University)

Advisors

Jiro KIKKAWA	(Professor emeritus, University of Queensland)
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Koichi FUJITA	(National Institute for Land and Infrastructure Management)
Seiichi MORI	(Gifu Keizai University)
Ikuko MORISHITA	(Institute of Freshwater Biology)
Koichi YAMAMOTO	(Foundation of River & Watershed Environment Management)
Wataru WATANABE	(Water Resources Environment Technology Center)

Main Sponsor

International Workshop Organizing Committee of 'Ecosystem-Science & -Engineering Approach toward Conservation of Biodiversity'

Co-Sponsors

Ecology and Civil Engineering Society (ECES)
Ecological Society of Japan (ESJ)
Japan Society of Civil Engineers (JSCE)

under the Auspices of

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Nagoya Ecology and Civil Engineering Society
Nagoya Hydraulic Research Institute for River Basin Management (NHRI)
Ise Bay Eco-Compatible River Basin Research Project (ERRP)
Aichi-Nagoya COP10 CBD Promotion Committee

Workshop Time Table

May 13, Thu. 2010

9:30 Registration

10:00-10:30 Opening Addresses

10:30-12:00 Introductory Lectures

- Crisis of Biodiversity in Local Scale and Global Scale
  Kazumi TANIDA
- Challenge of "Ecosystem-Science & Engineering" toward Conservation of Biodiversity
  Tetsuro TSUJIMOTO

12:00-13:00 Lunch

13:00-14:45 Session Theme A "Habitat Mosaic Restoration"

- Reconnecting Large River and Floodplain Habitats for Conservation of Biodiversity: Examples from the Lower Missouri River, USA
  David L. GALAT
- Shifting Mosaic in Maintaining River-Floodplain Ecosystem and its Degradation in Japan
  Futoshi NAKAMURA

14:45-15:15 Coffee Break

15:15-17:00 Session Theme B "Flux Network Restoration"

- The Significance of Reestablishing Historic Hydrologic Conditions to Restoration of the River Kissimmee, Florida, USA
  John L. GLENN, III
- Importance of Developing a Practical Framework to Integrate Local Restoration Efforts with River Basin Complex Management
  Koichi FUJITA

May 14, Fri. 2010

8:30	Registration
9:00-10:45	Session Theme C "Responsibility of Metropolitan"

- The Achievement and the Future Prospects of Sustainable Development in Mersey Basin -The role of Mersey Basin Campaign-

  Walter MENZIES

- The Challenge of Toyota City -Initiative toward the Conservation of Biodiversity in the Yahagi Basin-

  Kohei SUZUKI

10:45-11:00	Coffee Break
11:00-12:30	Case Studies (Including Poster Session)
12:30-13:30	Lunch
13:30-15:30	Panel Discussion
15:30-16:00	Coffee Break
16:00-16:30	Wrap up Meeting

- Adopt "An Appeal toward Conservation of Biodiversity through Ecosystem-Science & -Engineering"

Introductory Lectures

Outline :

Reclamation of river basin to support human activities with safety, resources security and favorable environment has on one side apparently brought about a threat of the sustainability through resources depletion, global warming and biodiversity loss. ECES (Ecology and Civil Engineering Society) was born to overcome such crisis through ecosystem-science and -engineering. We will provide two lectures from ECES, by which you will aware the biodiversity crisis even only focusing on aquatic organisms in local site and in global view, and you will touch the new challenge of ecosystem-science and -engineering toward biodiversity conservation in a river basin complex and recognize the three keywords of this workshop: Habitat mosaic restoration, water/material flux networks rehabilitation, and responsibility of metropolitan.

Kazumi TANIDA

Professor, Department of Biological Science, Osaka Prefecture University.
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Research Fields / Background

Ecology, Environment and Living Organisms Diversity, Classification

Abstract

Crisis of Biodiversity in Local Scale and Global Scale

I will provide the geo-historical and bio-geographical scopes of biodiversity and its present crisis using the freshwater biota of Japan Islands as an example. The Japan Islands, extending from south Chishima (Kuril) Islands, Hokkaido, Honshu, Shikoku, Kyushu to Ryukyu Islands, have one of the richest freshwater biota in the world. The islands has several backgrounds to their rich biodiversity, e.g. being situated at the boundary between Palaearctic and Oriental regions, having variable climatic regions from cool temperate to sub-tropical. And the major island arc was separated from the continent by the Japan Rift about 15 million years ago, the isolated islands have been able to maintain some unique and endemic fauna and flora. The rivers and lakes receive huge precipitation by Asian Monsoon Climate. However, the freshwater ecosystems on islands are vulnerable for biological invasion and there exist many invaded plants and animals in Japan. Human influences on Asian rivers and lakes are oldest in the world and the freshwater biodiversity became endangered by dense human population and agricultural development of wetland. Thereafter, eutrophication and chemical pollution by human activities destroyed the biodiversity and environment. Water resource developments by dams in rivers caused serious degradation of the biodiversity and the biological continuity. Water exploitation in natural lakes also damaged the biodiversity of lentic biota. Some Asian people and countries use water resources in sustainable ways for a long time, and freshwater biota have been used as important resources for fishery and food. Today, over-use of water by flow regulation, irrigation, canalization and industrial pollution changed the rivers and lakes severely and rapidly. From Japan's negative legacy and recent trials of the integration of ecology and civil engineering, Japan can provide some useful guideline for water resource management, water quality controls and restoration of biodiversity in rivers, lakes and watersheds.

Tetsuro TSUJIMOTO

Professor, Department of Civil Engineering, Nagoya University.
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Research Fields / Background

Fluvial Hydraulics, River Ecology, Flood Management, River Planning

Abstract

Challenge of "Ecosystem-Science & -Engineering" toward Conservation of Biodiversity

Reclamation of river basin to support human activities with safety, sufficient resources and favorable environment has on one side apparently brought about a threat of the sustainability through resources depletion, global warming and biodiversity loss. In 1997 ECES (Ecology and Civil Engineering Society) was born to develop management technology and supporting science for securing safety and resources with sound ecosystem by fusing ecosystem-science and -engineering, or ecology and civil engineering with mutual understanding. Now we are standing forefront toward a challenge to overcome the threat against the sustainability. Firstly we consider that eco-compatible management of river basin to conserve sound ecosystem is a view to lead the sustainability, where biodiversity will be conserved, and expected ecosystem service will replace fossil fuel consumption and GHG emission to suppress global warming. Conservation of ecosystem is a hot target of ECES and during this decade we have accumulated knowledge for various habitats in rivers, lakes, forest, farm lands, coast and so on. The results have been applied to eco-compatible design of infrastructures and several mitigation means. However, those techniques have been applied rather locally. With widening our goals in space and time, we recognize that habitats are to be linked by water/material flux networks, natural and manmade. River basin is an assembly of natural flux networks but artificial ones connect some of them to river basin complex. Scattered local landscapes inside a river basin have functions to change fluxes and to bless ecosystem service locally. River basin or river basin complex must be recognized as a set of scattered landscapes linked by water/material flux networks and to be described to realize the effects of basin management as well as the damages of human activities. Conservation of biodiversity is resulted as peculiar one of ecosystem services (habitats) integrated in a river basin complex, while most of ecosystem services are considered as anti-global warming scenario to be replaced by fossil fuel consumption and/or GHG gas emission. It is demonstrated how efficiently securing habitats and their connectivity of the species representative to respective categorized local landscapes facilitates the biodiversity in river basin level.

Session Theme A
"Habitat Mosaic Restoration"

Produced by Prof. Seiichi MORI & Prof. Futoshi NAKAMURA

Outline :

River ecosystem is composed both of instream landscape elements (such as riffle and pool structure, braided streams, shore area and local pool around a bend, those are induced by fluvial processes, and complex habitats generated by fallen timers) and of flood plain landscape elements (such as flood plain mosaic, back swamp, natural bank and oxbow lakes).

In the session of "Restoration of Habitat Mosaic", we will clarify how the linkage of landscape elements and variation of them affect on aquatic biota and river ecosystem. The fundamental approach for restoring the lost linkages of landscape elements due to the past development of river basin complex will be discussed based on the experiences in Missouri river and Mississippi river in USA and in Japanese rivers.

David L. GALAT

Associate Professor, Department of Fisheries and Wildlife Sciences, School of Natural Resources, University of Missouri, USA.
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Research Fields / Background

Large River Ecology, Native Fish Ecology, Restoration Ecology

Abstract

Reconnecting Large River and Floodplain Habitats for Conservation of Biodiversity: Examples from the Lower Missouri River, USA

The importance of annual reconnection of large rivers with their floodplains has been widely demonstrated since the seminal Flood-pulse Concept paper. Lateral connectivity, the exchange pathways of water and materials between the active channel and its floodplain, contributes to the rich habitat mosaic and high biodiversity of unaltered river-floodplain wetland ecosystems. Large river systems have also long been centers of human development and transport. Reservoirs, flood-control levees, bank stabilization, and channelization associated with agriculture and urbanization have largely severed the hydrogeomorphic linkage between the channel and its floodplain in many of the world's large rivers. Recognition of the importance of natural river processes has stimulated efforts to restore lateral connectivity to enhance social-ecological resilience.

I use the Missouri River, the longest river in North America, to illustrate landscape-scale ecosystem science and engineering approaches being applied in the United States to conserve and restore river-floodplain biodiversity. Attributes of connectivity in large rivers are first reviewed and historical changes in lateral connectivity of the lower Missouri River summarized. Catastrophic flooding during the 1990s breached levees, reconnecting the floodplain, and provided opportunities to evaluate ecological responses including forest succession, native fish spawning and nursery use of floodplain water bodies, and migrating shorebirds foraging in shallow water or exposed mudflats. Voluntary sales of flood-damaged agricultural lands converted over 20,000 ha of floodplain to public ownership along the lower Missouri River. Examples of post-flood channel-floodplain rehabilitation efforts are illustrated along a passive-active continuum including experimental flow–pulses to benefit endangered pallid sturgeon. Evidence indicates that naturalizing both a flow pulse and channel form is necessary to increase river-floodplain connectivity and the aquatic-terrestrial transition zone along with the ecological services they provide. Application of flood-pulse theory to what is realistic within an adaptive management framework in a politically charged agriculture and urban landscape is discussed.

Futoshi NAKAMURA

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Research Fields / Background

Stream Ecology, Forest Ecology, Forest Ecosystem Management

Abstract

Shifting Mosaic in Maintaining River-Floodplain Ecosystem and its Degradation in Japan

River-floodplain ecosystem is spatiotemporally dynamic under frequent and intensive geomorphic disturbances, characterized by its fluctuating habitat availability. The species inhabiting there adapt themselves to the shifting habitat mosaics by developing various life-history traits. In regulated rivers, however, suppressed disturbance and habitat dynamics threaten the disturbance-dependent communities. Floodplain tree species have developed life-history strategies to increase the likelihood of arriving regeneration sites, where disturbance regimes are closely linked to the spatial and temporal availability of regeneration sites. River damming and channel modification severely diminish the critical function of geomorphic disturbance sustaining habitat diversity and abundance. Channel migration ceases in flow-regulated rivers, which may temporarily promote expansion of pioneer forest in the active channels. However, new geomorphic surfaces suitable for establishment of seedlings are no longer created because of altered peak flows and sediment supply, thereby threatening the recruitment opportunity and ultimate survival of their populations. Suppression of geomorphic disturbance also leads to the degradation of in-stream fauna. Natural meandering rivers develop deep pool habitats at outer bends for fish communities, and shallow edge habitat with low hydraulic stress along inner bends, providing stable substrate for macroinvertebrate communities and juvenile fish. Fallen trees provided by lateral erosion also promote macroinvertebrate colonization and become in-stream cover and habitat for fish communities. Channel straightening for flood control, however, particularly simplifies geomorphic features of a river reach and diminishes longitudinal and lateral habitat diversity in stream and floodplains. Flood control reduces inundation habitat and disrupts hydrologic connectivity between floodplain habitats (e.g., backwater and oxbow lakes), impacting fish and benthic invertebrates that require those habitats in their various life stages. Sediment control dams and gravel mining in rivers and floodplains is causing sediment starvation which results in a rapid degradation of riverbed. Consequently, river and floodplain become independent ecosystems, and forest expansion on bars and floodplains becomes prominent in Japan. In order to restore the connectivity, we should allow lateral migration of stream channels and promote aggradations by removing revetments from low flow channel and keeping sediment production from headwater basins, and should harmonize flow regime with life history traits of stream biota by mimicking natural flow regime.

Session Theme B
"Flux Network Rehabilitation"

Produced by Prof. Yukihiro SHIMATANI & Dr. Koichi FUJITA

Outline：

Local ecosystems scattered in river basin complex are interrelated each other through connecting the flux network of water and materials in the river basin complex. Recent development of human activities has required the resources and energy from surrounding basin area and the natural flux network have been changed and modified by installing the artificial facilities, consequently affecting the local ecosystems. Therefore the rehabilitation of flux network is essentially important to conserve and restore the biodiversity in the river basin complex. On the other hand, the rehabilitation of flux network has faced a difficulty of manifesting the relation of local ecosystems to an overall perspective due to the largeness of the flux network compared with local ecosystem scale.

In the session of "rehabilitation of flux network", we aim to discuss and clarify why, how far and how we should consider the rehabilitation of flux network of river basin complex for restoring local ecosystems through the experiences of Kissimmee river restoration project in USA and Ise bay river basin complex research project in Japan.

John Lawrence GLENN, III

Director, Kissimmee Division, South Florida Water Management District, USA.
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Research Fields / Background

Distributions and Community Structure Attributes of Floodplain, River Channel, and Larval Fish Assemblages

Abstract

The Significance of Reestablishing Historic Hydrologic Conditions to Restoration of the River Kissimmee, Florida, USA

Channelization of the Kissimmee River, located in central Florida, USA, dramatically altered hydrologic conditions of the system. Resulting impacts included drainage or obliteration of approximately 8,000 hectares of floodplain wetlands, elimination of in-stream and overbank flow, and isolation of the river from its floodplain. These alterations prompted shifts in dominant vegetation communities occurring in river channels and on the floodplain and associated decline in habitat conditions appropriate for fish and wildlife species present in the natural system. Specifically, use of floodplain marshes by wintering waterfowl decreased by 90% and once diverse wading birds communities became dominated by cattle egret. Sport fish assemblages declined as species tolerant of low levels of dissolved oxygen became more abundant. In 1976, the Kissimmee River Restoration Act called for restoring historic hydrologic conditions to the river and floodplain. Over the next 20 years, numerous studies were conducted to determine the hydrologic conditions required to restore ecologic integrity to the river-floodplain ecosystem. Results of tests using a physical model of the system, constructed at the University of California at Berkeley, identified 5 hydrologic conditions as necessary drivers for environmental change. These conditions included continuous flow, in-channel flow velocities, recession rates on the floodplain, and annual variability of in-channel flow and floodplain inundation hydroperiods. Construction of the restoration project designed in four phases to reestablish historic hydrologic conditions began in 1999 and will be completed 2015. Ecological response to restored flow in the Phase I area since completion in 2001 has been dramatic. Physical changes include formation of point bars and flushing of accumulated organics from the river bed. Dissolved oxygen levels approximate historic conditions. Marsh vegetation is being reestablished on the floodplain. Sport fish once again dominate the river fish assemblage and wading bird and waterfowl diversity and density have greatly increased.

Koichi FUJITA

Research Coordinator for Watershed Management, River Department, National Institute for Land and Infrastructure Management, Ministry of Land, Infrastructure, Transport and Tourism.
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Research Fields / Background

River Basin Management, River Planning, River Engineering

Abstract

Importance of Developing a Practical Framework to Integrate Local Restoration Efforts with River Basin Complex Management

Although it is essential to immediately improve an individual on-site situation for restoring local ecosystems impaired, we should also pay attention to surrounding areas affecting sites concerned by a flux network of water and various materials driven by hydrological cycles. The most important spatial unit to envelop those areas is a river basin complex composed of various landscapes and manmade elements connected by a flux network. It is, therefore, inevitable to incorporate river basin complex management into conserving biodiversity, so that local ecosystem restoration efforts will be well-coordinated, effective over long-term and linked to the resolution of environmental, societal and economical issues in regional and global scale.

However, it is quite challenging to relate local ecosystems with their river basin complex, because the influence of the flux network on local ecosystems are often multiple and hierarchical with a wide range of strength. Once we look at a river basin, the number and the diversity of stakeholders greatly increase. In order to tackle these difficulties, we need to develop a practical framework with which people can grasp with reality how local and river basin scale phenomena are interrelated.

Ise Bay Eco-compatible River Basin Research Project (2006-2010) is a good example for the discussion on how to build such framework. The project has developed a method of eco-compatibility assessment to be tested for the Ise Bay river basin complex, where enormous anthropogenic stresses including a population increase of 4.6 million had been added in recent 50 years, resulting in the environmental deterioration of various landscapes over the complex. The method is equipped with a flux network model, an ecosystem model, and an evaluation model according to integrated indices based on ecosystem services or fossil fuel consumption, etc. Through the application to diagnosis and policy assessment for the Ise Bay river basin case, the method is expected to serve to establish the framework.

Session Theme C
"Responsibility of Metropolitan"

Produced by Dr. Kotaro TAKEMURA & Dr. Yuichi KAYABA

Outline :

Alteration of landscape elements, exploitation of natural resources such as water, material and energy and the resulting environmental loads, which have been preliminary induced by the growth and expansion of cities, lead to the loss of biodiversity in river basin complex. At the same time, cities are the centers of human activities in river basin complex, where economic power, human resources, information and technology are concentrated. Therefore, cities have both responsibility and ability against the crisis of biodiversity in river basin complex.
In the session of "Responsibility of Metropolitan", in order to conserve and restore biodiversity in river basin complex, environmental governance for the management of anthropogenic impacts induced by cities will be discussed through the experiences of the Yahagi River in Japan and the Mersey River in the United Kingdom based on the understanding of the responsibility of cities.

Walter MENZIES

Chief Executive, Mersey Basin Campaig (MBC), UK.
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Research Fields / Background

MBC was a unique third sector partnership dedicated to sustainable economic development through the improvement of waters, the regeneration of watersides and the engagement of communities and businesses in the process.

Abstract

The Achievement and the Future Prospects of Sustainable Development in Mersey Basin -The Role of Mersey Basin Campaign-

The River Mersey played a central role in the industrialisation of Northwest England, the World and the globalisation of trade. The River and its Ship Canal link the two great cities of Liverpool and Manchester. By the nineteen eighties, the river system and the Mersey Estuary were severely polluted and famously described as "a disgrace to a civilised society". Rioting in Liverpool led to government led urban regeneration including the establishment in 1985 of the Mersey Basin Campaign as a pioneering partnership. Its focus was and is on water quality improvements, sustainable waterside regeneration and the widest possible engagement in the necessary transformation. By 1999 the scale of the achievement was recognised worldwide: the inaugural World River prize was awarded to the Mersey Basin Campaign.

In the context of the sustainable development of a densely populated river basin the paper examines: the governance, management and achievements of the partnership that is the Campaign; the roles of the actors in the process; issues around partnership working across the sectors; communications and engagement; critical success factors derived from almost twenty five years experience.

The European Water Framework Directive requires a new approach to river basin management in member states of the European Union. Public participation is essential. Good ecological quality is the objective.

The Mersey Basin Campaign ended in March 2010 having completed its planned 25 years. Much of its experience however is directly relevant to this new approach.

Kohei SUZUKI

Mayor, Toyota City.
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Research Fields / Background

Toyota city is working to promote environmental initiatives that take its urban characteristics into account - in term of developing transportation infrastructure and cultivating forests.

Abstract

The Challenge of Toyota City -Initiative toward the Conservation of Biodiversity in the Yahagi Basin-

The Yahagi River flows through Aichi Prefecture, central Japan, and drains into Mikawa Bay. The length of the main stream is 118 km and the drainage area is 1,830 km^2. Toyota City is located at the center of the Yahagi Basin. The Yahagi River historically supports our life and allows us to develop river transportation, agriculture, fishery, hydro-electric generation, and automobile industry. There is long history of the resident activity that has conserved the environment in the Yahagi River. When the water quality was severely polluted during the high economic growth period from 1960's to 1970's, communities, fishermen and farmers organized the water quality watchdog group. Later, Toyota City established the fund to maintain the water source forest by raising water rates, and forest management bylaw to conserve the basin forest. In addition, the Yahagi River Institute was founded by the City, fisheries cooperative and agricultural organization to seek the conservation of nature and healthy aquatic environment in the basin. Collaboration with the City, the citizens are addressing the maintenance of the devastated artificial forest, the conservation activity of the river, and the depopulation and aging problems of hilly and mountainous areas.

Toyota City was appointed as an environmental model city in 2009 by the government. The city is aiming regionally-based sustainable development of the Yahagi Basin by introducing the environmental policy, such as the achievement of low-carbon society, the conservation of biodiversity in the basin, and the development of human resources to lead environmental activities.

Session "Case Studies"

Convened by Dr. Yuji TODA

Session "Case Studies": List of Poster Presentations

I. **Ise-Bay River Basin Research Project**

P-01, 02: Research and development in assessment and restoration for eco-compatible management of river basin complex around Ise bay

Tetsuro Tsujimoto(Nagoya University)

P-03 Comparison between forest ecosystem services and its artificial consumptions in the Yahagi river basin

Makoto Ooba (National Inst. Env. Studies)

P-04 The role of paddy field water areas for fishes

Akiko Minagawa et al. (National Inst. Rural Engrg.)

P-05 Population viability analysis of a migrating crustacean species for conservation of its habitat network

Masatoshi Denda et al. (Public Works Research Inst.)

P-06 Habitat utilization of the amphidromous freshwater shrimp Caridina leucosticta in agricultural drainage channels connected to the Furu River, Aichi, central Japan

Kazuyoshi Nakata et al. (Public Works Research Inst.)

P-07 Function of Brackish Lake Aburagafuchi to reduce pollution loads from half-urbanized basin to Ise Bay

Saori Akimoto et al. (Public Works Research Inst.)

P-08 Seasonal change of horizontal larval distribution patterns of Asari clam (Ruditapes Philippinarum) in Ise Bay: 2008-2009.

Nariaki Inoue et al. (Fisheries Research Agency)

II. Research Activities in Ise Bay River Basin Complex

P-09 Relationship between water quality of irrigation ponds and environmental factors in Chitahanto Peninsula, Central Japan

Toshikazu Kizuka (Nagoya University)

P-10 Ecological understanding of changes in river-floodplain systems

Junjiro Negishi et al. (Hokkaido University)

P-11 Environmental conditions affect winter fish assemblage structure in backwaters of the Kiso River

Manabu Kume et al. (Aquatic Restoration Research Center)

III. Enlightenment

P-12 Activities of the Ecology and Civil Engineering Society, Nagoya

ECES Nagoya

IV. Disaster history of Ise bay area

P-13-17 Posters of historical disasters in the Ise bay area & posters of Hurricane Katorina

Public Assoc. Chubu Region Construction Service

V. Case studies in China & Korea

P-18,19 DongTan Wetland of Chongming Island, Shanghai: An Approach for Restoration of the Ecological Environment with Ecotourism

Takashi Tashiro (NHRI, Nagoya University)

P-20 The Four Major Rivers Restoration

Seung K. KIM (Ministry of Land, Trans. and Maritime Affairs)

VI. Interdisciplinary scientific activities between biology & civil engineering

P-21 Information of the 8th International Symposium on Ecohydraulics 2010

Panel Discussion & Wrap-up

Coordinator: Prof. Tetsuro TSUJIMOTO

Panelists: Prof. David GALAT, Prof. Hutoshi NAKAMURA,
Dr. John Lawrence GLENN, Dr. Koichi FUJITA,
Mr. Walter MENZIES, Dr. Yuichi KAYABA

Panel Discussion and Wrap-up

Coordinator:
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Panelists:
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The appeal from ECES (Ecology and Civil Engineering Society) to COP10-Nagoya is demonstrating an importance of "ecosystem-science and -engineering approach toward conservation of biodiversity" based on the recognition that loss of biodiversity threats our sustainability as well as resources depletion and global warming. And here are picked up the following three key words: "Conservation and restoration of habitat mosaics", "rehabilitation of water/material flux network" which connects the habitat mosaics, and "responsibility of metropolitan" as conservation strategy actors. Then, we organized the three sessions in this workshop corresponding to these three key words.

Session A : Habitat Mosaic
By Dr. Galat and Prof. Nakamura

Morphological mosaic (landscape unit)
  characterized by relation with hydrograph → linkage, connectivity
    frequency, duration, timing of inundation
  synchronized with life history of biota

Variety of mosaics → species richness, diversity

Advantage (Disadvantage) of connectivity

Mosaic Restoration → Restoration of connectivity

<u>Active</u> restoration and <u>Passive</u> restoration

hard engineering	soft
high cost	
dense human activity	sparse
	string with beads analogy

Catastrophic flood may become a trigger of restoration

In session A where the theme is "conservation and restoration of habitat mosaics", we enjoyed the presentations by Profs. Galat and Nakamura. Firstly they reported the physical underpinnings formed, maintained and updated by fluvial processes bring ecological functions as habitats and introduced several restoration strategies.

In riparian ecosystem, we can focus on geomorphic mosaics or landscape units formed and maintained as fluvial processes and they are intimately connected with habitats through hydraulic regime of rivers. Frequency, magnitude, duration period, stage varying rate of flood, furthermore forecasting ability for organisms are important factors for connectivity. When they synchronize to life history of organisms, physical landscape units become ecological habitat mosaics. Then, the diversity of habitat mosaics must guarantee the richness of species and biodiversity. When the process to correlate landscape units and ecological functions is understood, the habitat restoration strategy may become reality. Prof. Galat introduced a view as “string with beads analogy”. However, against some species the connectivity plays disadvantage.

There are two approaches for habitat mosaic restoration: One is active one by artificial assistance, and the other is passive where nature plays mainly. Effective selects are depending on the difference of human population and activity. Sometimes, catastrophic disasters such as major floods may provide a trigger of large scale restoration of ecosystem. Reconstruction from disaster may become an opportunity for restoration of ecosystem.

Session B : Flux Network
By Dr. Glenn and Dr. Fujita

Kissimmee Project (Dr. Glenn)

Channel restoration : re-curved channels, etc.
↓
Mosaic restoration (habitat restoration)

Restoration of “function”
Mandate

River basin complex eco-compatible management (Dr. Fujita)
Flux network water, sediment, materials (nutrient)

Varieties of local demands (requirements, environmental goals,…)

Flux network is route for influences to propagate

Consensus in locally diverse requirements

Efficient tool for finding drivers and their interrelations→prioritization
How to cope with a lack of data

In session B where the theme is “rehabilitation of water/material flux network”, Drs. Glenn and Fujita presented their views.

Dr. Glenn introduced the Kissimmee project of nature restoration in US, where the target space is very wide in homogeneity. When nature restoration was carried out by re-meandering of previously straightened river (channel), various habitat mosaics were restored. Channel is a conveyance of water and various materials and thus it is a flux network, then tits rehabilitation brought about restoration of habitat mosaics. In this sense, one can say that Kissimmee experience is a flux network rehabilitation rather than individual habitat mosaics restoration. In Kissimmee project, wider space compared to individual habitat mosaics is targeted and thus the rehabilitation of flux network is strongly recognized. On the other hand, even in session A, flux network is certainly recognized as connectivity of each habitat mosaic.

Dr. Fujita introduced river basin management in Ise-bay area, where wide area from headwater to river mouth is treated. It is more significant that it includes heterogeneous mosaics connected by flux networks than that simply wide area is treated. He emphasized that not only water but also sediment and materials like nutrients should be considered as flux networks. Heterogeneity is not only in geomorphic and ecological aspects nut also in human activity. The effect of human activity at different sites are propagated and affected in whole the area of river basin. The human demands at local sites are various, and consensus making procedure is necessary in basin management. In audience of the floor, one has opinion that social problem should not included in scientific approach but the other that to find solution in a "destiny" is most urgent issue. We have to look for methodologies and how to certificate the availability of them from the data. The concept of "adaptive management" must be a key to relate scientific approaches and humanity problems.

Session C : Responsibility of Metropolitan
By Mr. Suzuki and Mr. Menzies

Presentation by Mayor of Toyota City（Mr.Suzuki)
(Yahagi river basin)
Leadership in governance
Supported by Historical background
Policy menus depending on local characteristics

Mersey Basin Campaign （Mr. Menzies)
public health wealth – poverty connected to river
environmental, social, economic

simple Vision
various Players to participate *many sectors (mosaic)*
Partnership - Leadership
communication = flux network

EU Water Framework Directive ⇔ Individual Water Policy

New technology Tidal energy plant

adapting landscape
climatic change

Session C is the theme "Responsibility of metropolitan", where governance to implement approaches to conservation of biodiversity is discussed. Following to the guiding speech by Dr. Kayaba and Messrs. Suzuki and Menzies introduced citizen's activities for environment and ecosystem restoration.

Mr. Suzuki, Mayor of Toyota City, introduced citizen's activities for environment and ecosystem restoration in Yahagi river basins. It is more important that municipality recognize those activities, and that they are supporting them. We have recognized a leadership of the municipality for the citizen's activity. And we understand a background that it is supported by long history of citizen's activity. He emphasized that citizen action and local policy are not necessary national standard but different from it depending on local characteristics and circumstances.

Mr. Menzies introduced "Mersey Basin Campaign", regional efforts for river and basin restoration. In Mersey Basin, recognizing serious environment, social and economic situations to bring decline of public health and wealth-poverty problems after industrial revolution, "Mersey Basin Campaign" was organized by participation from citizen, academia and industries and supported by local government like an umbrella. Its implementation has been induced by a simple and clear vision "come back salmon" and its activity has been continued.

The important key common to the both examples is participation of many members from wide sectors (players), partnership among the players, and a leadership to maintain them.

Mutual communication is one more factor to maintain the participation and partnership among players as well as a leadership. The various sectors to provide players are just mosaics in such a process while the communication is flux network. In this sense, the restoration of mosaics and rehabilitation of flux networks are important keys even here.

The fact that Mersey Basin Campaign has peculiar aspects though EU water framework directive is standard in Europe has a similar to the local characteristics in Yahagi basin experience. In addition, Yahagi and Mersey basin have a common property that they have big industries in their basins which support them financially. But more important fact is that those industries participate the campaigns as the players, not only financial supporters for implementation of environment conservation. Though they are now successful, we never forget the fact that serious environmental decline had proceeded just in front of catastrophe.

Through the panel discussions in those sessions, we have confirmed that the two key words proposed by ECES, restoration of habitat mosaics and rehabilitation of flux networks, are understood and recognized widely. And we have confirmed that the ecosystem-science and engineering approach is a powerful approach to conservation of biodiversity. Though it is still important to exactly recognize enormous numbers of species have been loosed and to bring an action to conserve each species, the present appeal would show how we should act scientifically. In this workshop, our interests have been concentrated not to how many species have been loosed but to how we should do for sound ecosystem to assure the biodiversity.

In the wrap-up meeting, we discussed a draft of the appeal from ECES to COP10-Nagoya prepared by ECES group in this March. Firstly, the discussion was concentrated to the habitat and flux networks. A strong opinion was that we have to focus the driver to change habitat mosaics, and its influence is coming through the flux network. On the other hand, the flux network is significant when it passes through mosaics. It is the same image with "string of beads" mentioned by Prof. Galat. As these discussions demonstrate, the mosaics and the flux networks cannot be separated, and we recognize that more kind explanation is necessary in the appeal. We have promised to modify the sentence related to these discussions. Particularly, it is added in the explanation of mosaics that the driver affects the composition, distribution, and maintenance of mosaics.

Next, the discussion has moved to the third key word "Responsibility of Metropolitan". Through the discussion in session C, the principle concept was understood and we had a common concept. The principle is participation from various sectors from wide aspects and partnership among them. We have also recognized that powerful leadership is necessary and sometimes a governmental umbrella has a preferable effect. On the other hand in the appeal, the word "responsibility of metropolitan" has strong impression and we cannot have a common feeling to this term. We intended that metropolitan who accumulate power like fund, knowledge, technology and human power should be responsible to play an important role for sustainability. Furthermore, the metropolises like Tokyo, Osaka and Nagoya are facing the most serious problems against sustainability. However, actually, they cannot do without all other sectors and thus a word "leadership" is added in the appeal. Furthermore, the metropolis is not only a real city but also it suggests "ecosystem-science and engineering" where different disciplines of sciences are accumulated to have potential to solve many issues.

When we discuss the term "metropolitan" internationally, the feeling to the word is somehow subjective and we are facing a barrier of language. We often feel sympathetically but among Japanese for the word "destiny" or "fate when we discuss the river basin, but it must be difficult to be understood. Though we discussed in the wrap-up meeting, we cannot to explain the word reasonably. Unfortunately it is modified by using a simple word "linkage".

Through concentrated discussions with many researchers, scientists and engineers including distinguished guests from foreign countries, we have confirmed that our appeal, "Ecosystem-Science and Engineering Approach to Conservation of Biodiversity" must be a good gift to COP10-Nagoya and future generation of global citizens.

"Ecosystem-Science and -Engineering Approach toward Conservation of Biodiversity"

An Appeal from the Ecology and Civil Engineering Society (ECES)
(Draft)
March 2010

Action Plan

We strive to carry out action aimed at conserving biodiversity through achieving river basin complex in harmony with nature around three core elements: conservation and restoration of ~~scattered local "landscapes"~~ ~~(~~habitat mosaics~~),~~ where critical ecosystem drivers influence their composition, distribution and maintenance; evaluation and rehabilitation of water/material flux networks that link them; and the system (governance) that implements them ~~or~~and the "responsibility of metropolitan leadership" to support them.

We take as our model the Ise Bay river basin complex. This region has characteristics that are valuable in terms of geology and the evolutionary history of life as well as ecology, and the region supports cities that are the nucleus of human activities. These human activities have concentrated economic power, knowledge, and technology in the cities particularly in the metropolis and, at the same time, caused ecosystem degradation such as the loss of biodiversity. With a core comprising the three elements of conserving and restoring landscapes, rehabilitating water/material flux networks, and exercising the responsibility of metropolitan, we will implement action meant to achieve river basin complex in harmony with nature through a challenging approach from ecosystem-science and -engineering and disseminate the results.

1.Significance of Pursuing Biodiversity Conservation

Along with resource depletion and global warming, "loss of biodiversity" is a factor threatening the sustainability of humankind. Providing for sound ecosystems in order to conserve biodiversity facilitates the conversion to an eco-harmonious society that benefits from ecosystem services (the use of biological resources). Another benefit, along with contributing to coping with resource depletion and to mitigating and adapting to global warming, is the ethics and happiness of coexisting with other living things.

2. Structure and Function of Ecosystem

We recognize ecosystem as follows in order to maintain a healthy ecosystem. Ecosystem structure is composed of three subsystems; (A) physical basement by fluvial hydraulics, (B) biotic community and (C) material cycle with particular reference to biophilic elements. And, ecosystem functions are corresponding to the interactions among the subsystems, such as habitat provision and provision of appropriate space for peculiar elementary process in material cycle. The national land must be recognized as a set of scattered landscapes (habitat mosaics) linked by water/material flux networks, and ecosystem at larger scale is postulated there.

3. Focus on "River Basin Complex"

A "river basin" is a region where various landscapes (local ecosystems consisting of the interactions among their physical underpinning and material cycles, plus the various biological workings upon them) are linked by water/material cycles. The evolutionary processes of living things are based on units which are aggregates of multiple river basins that include geology, topography, and climate, as well as their changes throughout geological history. The human activities carried on in river basins have linked together multiple river basins in order to address population increases and improve economic efficiency. A "river basin complex," which is an aggregate of multiple river basins and receiving bays, is a representative scale shared by the activities of both humans and other organisms. A river basin complex forms a linkage with a bay surrounding multiple river basins. Precisely by focusing on the river basin complex, we can find a strategy for biodiversity conservation that pertains to the sustainability of humans and other living things.

4. Awareness of Biodiversity Degeneration

Human activities have expanded in river basin complex and disturbed the health of ecosystems, as seen in the loss of biodiversity, and have become a threat to sustainability, including that of human society. At the same time, human activities, mainly in cities, have brought together pleasant living, wealth, knowledge, and technology.

5. Conservation Strategy Actors

Metropolis and citizens, which enjoy the benefits of knowledge, technology, and economic power, stand at the forefront in mitigating the threat to sustainability (responsibility of metropolitan leadership). It is essential to understand the structure and functions of river basin complex through the collaboration and melding of different scientific disciplines, and to have management framework and its practice by means of cooperation among diverse academic disciplines and solidarity among citizens, academics and public administrators. The Ecology and Civil Engineering Society, which has achievements in the collaboration and melding of sciences, mainly ecosystem-science and engineering, will be the motive force that expedites our understanding of the scientific mechanism of river basin complex, and the development of management methods which strive for harmony with nature.

6. Action Plan

We strive to carry out action aimed at conserving biodiversity through achieving river basin complex in harmony with nature around three core elements: conservation and restoration of habitat mosaics where critical ecosystem drivers influence their composition, distribution and maintenance; evaluation and rehabilitation of water/material flux networks that link them; and the system (governance) that implements them and the "responsibility of metropolitan leadership" to support them.

7. Ise Bay River Basin Complex

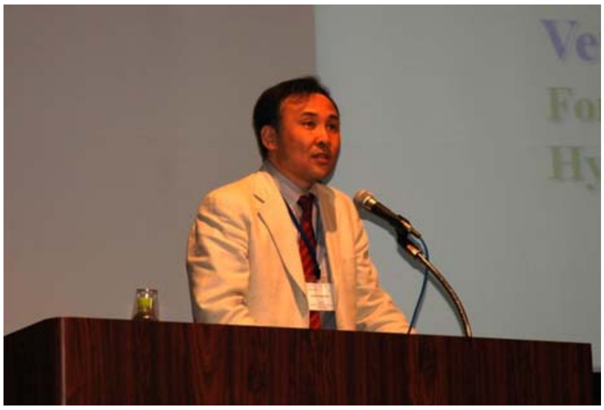
We take as our model the Ise Bay river basin complex. This region has characteristics that are valuable in terms of geology and the evolutionary history of life as well as ecology, and the region supports cities that are the nucleus of human activities. These human activities have concentrated economic power, knowledge, and technology in the cities particularly in the metropolis and, at the same time, caused ecosystem degradation such as the loss of biodiversity. With a core comprising the three elements of conserving and restoring landscapes, rehabilitating water/material flux networks, and exercising the responsibility of metropolitan, we will implement action meant to achieve river basin complex in harmony with nature through a challenging approach from ecosystem-science and -engineering and disseminate the results.

Photo Gallery


Pre-Excursion


Prof. TSUJIMOTO


Prof. GALAT


Prof. NAKAMURA


Dr. GLENN


Mr. MENZIES


Case Studies


Panel Discussion

Appendix 2:

Pre-Discussion on
"Ecosystem-Science and -Engineering Approach toward Conservation of Biodiversity"

Pre-Discussion on
"Ecosystem-Science and -Engineering Approach toward Conservation of Biodiversity"

The Ecology and Civil Engineering Society (ECES)

March 2010

Exposition Contents

1. Background Awareness on the Biodiversity Crisis

Biodiversity is defined as "variability among all organisms, including diversity within species, diversity between species, and ecosystem diversity." Over the 4 billion years since life appeared on Earth, living things have formed diverse ecosystems while in mutual relationships with diverse inorganic environments formed on the Earth. In this process, various organisms with genetic variation have undergone speciation while adapting to diverse environments. The Earth now has a variety of different landscapes, such as forests, rivers, wetlands, and coral reefs, which have formed unique ecosystems that are integrated wholes as landscapes. These diverse ecosystems are now habitats for species which are said to number in the tens of millions and which have all manner of genetic variation.

Living things bring many blessings to humans, and they have underpinned our survival. Without those blessings our lasting survival would be difficult. Biodiversity is the foundation that supports the living things that bestow these many blessings; it contributes to the clean water and air, and to the supply of different kinds of food and of wood that human beings need; and it contributes to climate mitigation and limiting erosion and soil runoff. In recent years diverse genetic resources have been in the spotlight as, for example, potential resources for new pharmaceuticals and for plant breeding. Additionally, biodiversity gives us "comfort" and "peace of mind," and the sustainable use of nature by humans, which has continued amid trial and error through the ages, has fostered unique regional cultures.

But biodiversity is in crisis. The impacts of human activities cause ecosystem degradation, a decline in the number of species, and genetic disruption, and biodiversity is rapidly being lost. For example, it is said that currently about 40,000 species are lost each year, and judging by the fast rate of extinction, our era is sometimes called the "sixth great extinction period," being likened to the five great extinctions experienced since the advent of life.

The "National Biodiversity Strategy of Japan" summarizes the crises of biodiversity as: 1) a crisis caused by human activities and development, 2) a crisis caused by the downscaling of certain human activities, and 3) a crisis caused by things introduced by humans. It further sees climate change associated with global warming as aggravating these biodiversity crises. Specific causes cited are: 1) rapid population growth and the expansion of cities to absorb it, as well as changes and greater efficiency of land use, which have supported the expansion of economic activities, the development of resources and energy, and the conversion of farmland and forests to monocultures; 2) the impoverishment arising from the downscaling of economic activities such as satoyama and their coastal-zone analogs, which have since ancient times been maintained as habitats while being sustainably used; and 3) disruption of biota and ecosystems peculiar to their localities, which is caused by the introduction of exotic species that are intentionally or unintentionally brought from other countries or from other regions within the country. Biodiversity loss is a factor which, along with resource depletion and global warming, threatens the sustainability of humankind and natural systems, and arresting it is a matter of great urgency.

2. Current State of Initiatives for Biodiversity Conservation

Because it is difficult to comprehensively facilitate the conservation of biodiversity under the Convention on International Trade in Endangered Species of Flora and Fauna, which regulates trade in endangered species, and under the Ramsar Convention, which provides for the conservation of certain areas and species, the Convention on Biological

Diversity was adopted in 1992 at the UN Conference on Environment and Development as a new framework. At present over 190 countries and regions have signed this convention, whose purposes are: (1) conserving the Earth's diverse organisms and their habitats, (2) making sustainable use of biological resources, and (3) fairly and equitably allocating the benefits derived from using genetic resources. All governments are required to develop national strategies for aimed at the conservation and sustainable use of biodiversity.

About every two years the parties convene a Conference of the Parties (COP) and develop an international framework. At the Biodiversity Convention's COP4 an "ecosystem approach" was proposed, and the importance of "adaptive management" of nature was recognized in the general scheme. COP6 in 2002 adopted the "Bonn Guidelines on Access to Genetic Resources and on Fair and Equitable Sharing of Benefits Arising out of their Utilization," and COP7 in 2004 adopted the "Addis Ababa Principles and Guidelines" on the sustainable use of biodiversity. In 2005 the United Nations released the "Millennium Ecosystem Assessment," which clearly defined the concept of ecosystem services and used that concept to illuminate the relationship between ecosystems and human activities. Further, at COP9 in 2008 the spotlight was trained on "cities and biodiversity," and the "Bonn Call for Action" was adopted. With this theme, municipalities are asked to play an important role in conserving and managing biodiversity in their regions and worldwide, in view of the fact that resource consumption in cities affects ecosystems around the world. This approach categorizes ecosystems into a number of landscape types such as forests, farmland, and cities, and has used the ecosystem approach, adaptive management, and other methods, as well as indicators such as ecosystem services, to perform specific tasks relating to the monitoring and assessment of each biodiversity type, resulting in the building of a framework capable of scientifically tracking biodiversity.

Incidentally, COP6 in 2002 set the so-called 2010 Biodiversity Target, which aims to "achieve by 2010 a significant reduction in the current rate of biodiversity loss," and set a specific biodiversity conservation target. But the "Millennium Ecosystem Assessment," which assessed the current world state of biodiversity, and the "Global Biodiversity Outlook 2 (GBO2)," which was released in 2006 by the Biodiversity Convention secretariat, reported that the decline in biodiversity continues unabated. As such, the prevailing view is that achieving the 2010 target will be difficult. There have been various initiatives relating to the Biodiversity Convention, but many have been based primarily on monitoring and assessing biodiversity in landscapes such as forests, farmland, cities, rivers, or marine areas. For this reason there is no strong awareness of the ties between individual landscapes, which are linked through water/ material flux networks, and there are not many initiatives for conserving and managing biodiversity in large regions that straddle individual landscapes. In particular, human activities in cities exert heavy impacts on their peripheries, but the relevancy of that to biodiversity loss has not necessarily been recognized as a major theme. Reducing the rate of biodiversity loss requires that we are aware of the links among individual landscapes, and carry out the monitoring and assessment, as well as the conservation and management, of biodiversity by including consideration of the vast areas which contain cities.

3. The Perspective of River Basin Complex

3.1 What Is a River Basin Complex?

Starting as rainfall, water gathers in a river basin (catchment, or watershed) surrounded by divides, and then flows to the sea via rivers, groundwater, and lakes. Within a river basin area themselves are various landscapes. Looking closely at individual landscapes, we can see formed in each are topographies and spatiotemporal distributions of water and materials that are based on their unique physical processes. We can see that elementary processes of material cycle systems arise in response to these distributions, and that these provide organisms with a variety of habitation necessities including habitats, and form landscapes. Further, ecosystems which are based on these individual landscapes have, linked as they are through intra-basin networks of water/material cycles, formed basin-wide ecosystems through interconnections, and have continued to supply us with many blessings (ecosystem services).

As one can see, a river basin can be considered a unit used to conceive ecosystems, but more important for understanding of biodiversity is the concept of "river basin complex," which comprises multiple adjoining river basins that share a common coastal zone. In many cases a river basin complex is based on the same geo-historical process, sharing similar climate, topography, surface geology, and potential vegetation, and engendering the evolution of organisms adapted to them. A river basin complex will often have more homogeneous ecosystems than others, similar communities, and about the same extent of genetic variation. For that reason, if one stands the perspective of river basin complex and on a geo-historical time scale, one's understanding of the biodiversity will be further improved.

Meanwhile, rapidly growing populations and the cities that absorb them have ballooned beyond the confines of respective single river basins. Additionally, economic activities have expanded and improved efficiency, and have sought to satisfy new demand for resources and energy in adjoining river basins and have modified water/material cycle networks by adding artificial facilities. Further, human activities covering multiple river basins ultimately reached the sea, and have, along with direct human activities in coastal zones, been strongly influenced by coastal environments. Therefore, to assess biodiversity loss, which has increased rapidly in recent years, and to understand its causes, instead of focusing on the impacts of human activities in single river basins one must take into account the impacts of human activities and the propagation of the impacts in a river basin complex.

As the above discussion shows, a "river basin complex," which is an integrated group of multiple adjacent river basins, is a representative scale shared by both biodiversity and the human activities closely involved with it, and has a fate shared by all areas through the media of water and materials. Accordingly, when considering the environmental degradation (loss of biodiversity) of a river basin complex including its cities, one must focus on the fact that ecosystems have arisen with material cycle systems, which are driven by the water cycle.

3.2 Technologies for Conservation and Management of Biodiversity in River Basin Complex

Monitoring and assessing biodiversity in individual landscapes are insufficient for effectively conserving biodiversity. What we must do, within the spatial scale of the river basin complex, is be aware of the processes by which human activities have induced biodiversity loss, take into consideration the links among individual landscapes and the systems that they have formed, develop management scenarios (scenarios for eco-harmony) that provide for arresting biodiversity loss and for repairing and revitalizing biodiversity, and create the biodiversity conservation and management technologies needed to make this a reality.

Not only is this approach effective in facilitating the conservation and management of biodiversity in river basin complex, it also shows the possibilities of strengthening integrated water resource management in countries like Japan, where much of the flood plain area has been used to grow rice, and allocation of water resources has been adjusted across multiple river basins. Further, this will perhaps also be an effective method for assessing the impacts of human activities in response to not only climate change but also future population change, and in making the results useful in appropriate land use distribution and in improving networks of water/material cycles in a river basin complex.

3.3 The Responsibility of Metropolitan

It is safe to say that the center of human activities in a river basin complex is the cities, in particular the metropolis, which has swelled while absorbing population increases. Ballooning cities and expanding economic activities have invited the development of the areas on city peripheries, and distorted the networks of water/material cycles on a large scale across vast areas. Also, they have induced the contraction of human activities in peripheral areas (like in *Satoyama*), and have been the main cause of biodiversity loss in a river basin complex. In view of these facts, under new eco-harmony scenarios that should be created, it will be necessary to predict and assess the impacts of urban human activities on biodiversity and to practice appropriate conservation and management, and, in some cases, control the scale and scope of urban human activities.

At the same time, cities are the centers of human activities in a river basin complex; their economic power is greater than that of surrounding areas, and they are also places in which human resources, information, and technology are concentrated. Monitoring and assessing the loss of biodiversity and the state of ecosystem service degradation in a river basin complex, and creating eco-harmony scenarios against the backdrop of advanced technologies for conserving and managing biodiversity make it essential to have human resources, knowledge, and wealth, and cities or metropolis play a major role as their center.

In this sense, cities or metropolitans are the main factor when considering eco-harmony scenarios in a river basin complex, and at the same time are the principal actors in developing scenarios. Cities have responsibilities on both sides.

3.4 Working toward a Sustainable World

Bringing about a sustainable society requires building not only an eco-harmonious society that helps conserve biodiversity, but also a cyclical, low-carbon society. Approaches in which the responsibility of cities in a river basins are considered and in which eco-harmony scenarios are developed and implemented include limiting resource and energy demands based on the control of human activities in cities, whose purpose it is to enjoy ecosystem services to the maximum, and the building of sound networks of water/material cycles in a river basin complex. For that reason, such approaches can also be initiatives aiming to bring about cyclical, low-carbon societies, that is, to build sustainable societies.

Considering the high probability that two adjacent river basins are, to a greater extent than two river basins that are far apart, based on geohistorically similar processes and have similar natural and social systems, building a sustainable society in one river basin provides nearby river basins with an appropriate model for building a sustainable society. An aggregate of sevaral river basins in proximity to one another may be able to present a sustainable model to another adjacent aggregate (river basin complex). In other words, eco-harmonious river basin complex are basic places for building a sustainable world in the 21st century.

3.5 Ise Bay River Basin Complex

Take for example the Ise Bay river basin complex, which straddles the three prefectures of Mie, Gifu, and Aichi. It has an overlapping of north and south biota owing to the repeated changes in ancient Tokai Lake starting several million years ago and to ice-age changes in river systems; especially with regard to freshwater fish, there is a cohesiveness in the population genetic structure engendered by the ancient Kiso River system of several ten thousand years ago. Also, the broad flood plain ecosystem consisting mainly of the Nobi Plain, and the spring zones at the edge of the alluvial fan and the right bank of the Ibi River support the formation of characteristic biological communities in their respective individual landscapes. The biological evolution that derived from such geo-historical changes and diverse water environments made the Ise Bay river basin complex into a biodiversity "hot spot," and even now there are not a few areas which still have rich natural landscapes.

At the same time, cities in the Tokai region have formed and continued to grow across a number of basins of rivers emptying into Ise Bay and Mikawa Bay, including the Miya River, Kushida River, Suzuka River, Kiso River, Shonai River, Yahagi River, and Toyo River. Farmland and forests have been made more efficient and monotonic, and dams have been aggressively used for developing water resources and hydropower; these changes in individual landscapes have caused the loss of habitats, and the loss of continuity of water flow has hampered the movement of organisms. What is more, developed water resources are redistributed to individual landscapes inside and outside the respective river basins via main water conveyances, including the Mie Water Project, Miyata Water Project, Aichi Water Project, Meiji Water Project, and Toyogawa Water Project. Because of this, the temporal and spatial distribution of water to each of the individual landscapes in the river basin complex has changed greatly. This is seen as the cause of, for example, river flow rate smoothing and decrease in gravel river beds, and the increase in sessile organisms. The changes in flows, sediment flux, organic matter, nutrients, and trace metals occurring because of human activities in the river basin complex are seen as causes of water quality deterioration in Ise Bay and Mikawa Bay and the loss of tidal flats and seaweed beds, as well as the decrease of biodiversity in the bays.

The Ise Bay river basin complex maintains natural landscapes to an appropriate degree as human activities are carried on vigorously mainly in the cities, and the region also has topographical diversity and climate conditions peculiar to monsoon Asia. It is an excellent place for creating and implementing a strategy for biodiversity conservation based on integrated management of river basin complex.

4. The Role and Mission of the Ecology and Civil Engineering Society

4.1 Background of the Ecology and Civil Engineering Society

It is necessary to secure the functions of disaster prevention, resources, and the environment for proper land management that will support the sustainability of human activities. However, the search for the direction must take place in linkage with ecosystem conservation problems and other challenges that jeopardize sustainability. In 1997, the Rivers Law was amended, and the conservation of the environment was given a place among the purposes of river management. In that year Environmental Impact Assessment Law was passed, and ecosystem assessment was incorporated. It was at that time, just when these laws required scientific support, that we launched the Ecology and Civil Engineering Research Society, which looks for and implements ways for civil engineering and ecology to collaborate. It later developed into the "Ecology and Civil Engineering Society (ECES)."

The goals of ECES are “coexistence of humanity and nature,” “conservation of biodiversity,” and “maintenance of healthy ecosystems.” ECES is an organization that embraces a wide range of academic disciplines and includes engineers and even people in public administration. It serves as a place for basic research, applied research, and practical activities for ecology and civil engineering. There have been expectations that ECES will help mutual understanding among different fields and create a new science that links ecology and civil engineering. In our activities over the last 10-odd years, the integration of various scientific fields has progressed, including efforts aimed at understanding the structures and functions of ecosystems (not only understanding the physical mechanisms and material cycles, but also illuminating and describing the biological and ecological functions) and technologies for evaluation for ecosystem functions and for prediction of its behaviors not seen as merely physical mechanisms of ecosystem. This has led to ambitious initiatives that have in mind ecosystem management technologies and their implementation (development of assessment methods and adaptive management methods).

4.2 Development of Ecosystem-Science and -Engineering through Activity of the Ecology and Civil Engineering Society

Understanding ecosystems in river basin complex as scattered unique landscapes linked by water/material cycle networks is becoming the perfect research area for ecosystem-science and -engineering through the activity of the Ecology and Civil Engineering Society. Research originally consisted mainly in illuminating the functions of the ecosystems of existing individual landscapes, and representative results were suitability assessments of individual landscapes as habitats, and habitat restoration technologies based on the assessments. Subsequently, research expanded to encompass the improvement of habitat environments (such as flow discharge for environmental maintenance) with an awareness of water/material cycle processes and flux networks, and progress has been made in accumulating basic knowledge on ecosystem management. In recent years there are also approaches that perform objective assessments, such as of ecosystem functions as “ecosystem services.” In this way, in addition to integrated assessments in vast spaces such as river systems and river basins, now there is also research performed from integrated perspectives, such as approaches that attempt to assess ecosystems while joining a variety of aspects.

As shown above, the development of ecosystem -science and -engineering or the activity of the Ecology and Civil Engineering Society has contributed to the advancement of ecosystem assessment and management technologies while connecting existing methods in different fields (combining the analysis of places using the methods of hydrology and hydraulics, and simplification of biological and ecological knowledge into habitat suitability and population dynamics). There are increasing numbers of researchers and engineers who can understand and use these technologies, and progress is being made in solving problems in individual locations, but establishing general-purpose technologies to assess and manage ecosystems, which are complex interactions of the biological, the physical, and the chemical, requires innovative research that is a further fusion of various disciplines.

5. A Biodiversity Conservation Strategy Based on Ecosystem-Science and -Engineering Approach

5.1 Conservation Strategy Actors

Cities and their citizen in particular metropolitan shoulder the responsibility as the cause of biodiversity loss and, as the entities with the capability to monitor and respond to this loss, the responsibility to carry out a recovery. City administrators and citizens must be aware of the fact that the city's burden induces biodiversity loss and threatens its sustainability, and they must collaborate in taking action for biodiversity recovery and to remove the threats to its sustainability. Also, the extent of biodiversity loss and its causes must be determined from a scientific point of view, and those in scientific fields must set forth appropriate guidelines on actions that should be taken for building sustainable societies.

The Ecology and Civil Engineering Society to develop and disseminate ecosystem-science and -engineering, which is a fusion of diverse sciences built mainly around ecology and engineering, is a duty to form the core for working toward biodiversity conservation and building sustainable societies. In the future, together with providing for collaboration with other academic fields such as the social sciences and humanities, and with public administrators and the public, discussion on governance and the development of various technologies relating to biodiversity conservation and management will intensify and turn to practice.

5.2 Action Plan

In addition to technologies for achieving the conservation of scattered "landscapes," our plan is to regulate the water/material cycle networks that link those landscapes and establish technologies that provide for sound ecosystems. Through understanding the characteristics of biodiversity, revealing biodiversity loss and its causes, and applying technologies that have been developed, we seek to take action to achieve sustainable societies in the Ise Bay river basin complex, which was the venue of COP10. In this process it is necessary to provide for collaboration with public administrators and citizens, and with other academic fields, and flesh out the mechanism for conserving biodiversity in the Ise Bay river basin complex.

Appendix 3:

Rational and Activities of Ecology and Civil Engineering Society

Rational and Activities of Ecology and Civil Engineering Society

The Ecology and Civil Engineering Society (ECES) founded in 1997 to advance the inter-discipline science(s) across ecology and civil engineering.

Rationale

The Ecology and Civil Engineering Society was established in 1997 to develop a multidisciplinary approach to an ecologically sustainable future by concerned ecologists and civil engineers in Japan. In particular, the Society aims to promote scientific means by which to achieve 'coexistence of humanity and nature', 'conservation of biodiversity' and 'maintenance of healthy ecosystems'.

With economic stability and high living standards, the Japanese people now recognise that environmental conservation is indispensable for the health and wealth of people. The government has introduced the Environment Impact Assessment Law to ensure that any major engineering work in future will not adversely impact the environment. The River Law has been revised also to give due consideration to the natural environment of the river basins in Japan.

Science has lagged behind. The effects of civil engineering works on natural ecosystems have not been understood properly, and there are few examples of attempts to consider ecosystem functions in construction work. As yet, no established method exists for assessing the impact of such works on the environment. There is an urgent need to gain ecological understanding of the environment under threat, to provide a scientific basis for the conservation measures to be undertaken and to evaluate heritage and service values of the ecosystems to be affected by the development. In all of these endeavours harmony with nature is paramount and ecological sustainability must be considered.

The Ecology and Civil Engineering Society will explore ways of bringing together expertise of relevant disciplines with an aim of establishing a system of theory, knowledge and technology to be used in developing an ecologically sustainable future.

Activity

Now, only less than one year from the founding of ECES, more than 1,200 persons and 53 companies and organizations participate the society.
Up to present, we hold 2-3 seminars or workshops on ecology, conservation biology and river hydraulics for members every year.
We also held several open lectures on ecology and conservation biology.
We publish 2 issues of the journal either in Japanese; "Ecology and Civil Engineering" and more than 4 issues of newsletters (in Japanese).
The annual meeting was held in September or October every year.

Appendix 4:

ECES Activities toward COP10 Nagoya

ECES Activities toward COP10 Nagoya

The following open forums were organized to focus on the topic of "Ecosystem-Science and -Engineering Approach toward Conservation of Biodiversity" through ECES activities toward COP10 Nagoya.

1st Forum Biodiversity and River Basin Complex

May 18, Wed. 2009

(1) Introductory Lecture Tetsuro TSUJIMOTO (Nagoya University)
(2) Lecture 1
Subject: How do Diverse Life to Flourish?
Satoshi YAMAGISHI
(Director General, Yamashina Institute for Ornithology)
(3) Lecture 2
Subject: Seeking Techniques for Measuring Ecosystem
Ikuko MORISHITA (Institute of Freshwater Biology)

2nd Forum Biodiversity and River Basin Complex

July, 29 Wed. 2009

(1) Introductory Lecture Subject : River Basin Complex and Biodiversity
Tetsuro TSUJIMOTO (Nagoya University)
(2) Lecture1
Subject: Contribution of Biodiversity to Ecosystem Services
Tohru NAKASHIZUKA (Tohoku University)
(3) Lecture2
Subject: Fishery Management and Integrated Biodiversity Assessment
Hiroyuki MATSUDA (Yokohama National University)
(4) Lecture3
Subject: Advance a Legal System toward for Conservation Biodiversity
Noriko OOKUBO (OSAKA University)

3rd Forum Biodiversity and River Basin Complex

August, 4 Tue. 2009

(1) Introductory Lecture
Subject: Management of River Basin Complex Using Biodiversity Indicators
Tetsuro TSUJIMOTO (Nagoya University)
(2) Lecture 1
Subject: Biodiversity Conservation and the Way of Human Society
Tetsukazu YAHARA (Kyushu University)
(3) Lecture 2
Subject: An Environmental Diagnosis on Watershed Ecosystems
: Stable Isotope Approach
Toshi NAGATA (The University of Tokyo)
(4) Lecture 3
Subject: Conservation of Biodiversity at the View Point of River Basin Complex
Toshio TORII (Ministry of the Environment)

4th Forum Biodiversity and River Basin Complex

October 1, Thu. 2009

(1) Introductory Lecture Tetsuro TSUJIMOTO (Nagoya University)

(2) Lecture 1

Subject: Seeking for Biodiversity

Jiro KIKKAWA (University of Queensland)

Ecology and Civil Engineering Society :13th annual meeting, Open forum

September 25, 2009

Subject: Perspective of River Basin Complex and Biodiversity

Ecology and Civil Engineering Society :14th annual meeting, Open forum

September 23, 2010

Subject: Biodiversity Conservation from River Basin Complex Management

Appendix 5:

Research and Development in Assessment and Restoration for Eco-Compatible Management of River Basin Complex around Ise Bay

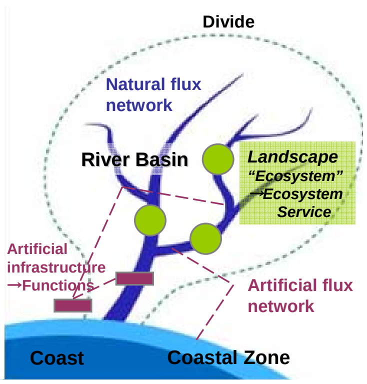
Special coordination fund for promoting science and technology for sustainable national land management (2006-2010) supported by Ministry of Education, Culture, Sports, Science and Technology, Japan.

“Research and development in assessment and restoration for eco-compatible management of river basin complex around Ise bay”

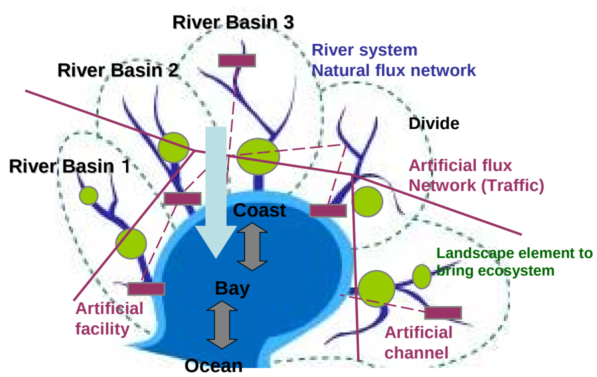
Perspective:
Possible scenario to sustainable society is to restore and manage a river basin complex as eco-compatible system, and assessment and development techniques supporting the scenario are studied.

Basic Concepts:
River basin is a unit of natural runoff process and in this sense it is an assembly of flux network of water and various materials including sediment and nutrients. Inside a river basin, various landscapes are distributed. Landscape is composed of physical background, bio-chemical actions (material cycle) and biological aspects with various organisms, and thus it is a set of ecosystem. When the fluxes pass through a landscape, they are changed in quantity and quality and bring about various ecosystem services, which had supported social development. Due to population increase and economic efficiency with urbanization, artificial facilities and flux networks have been added to connect multiple basins. These artificial systems have consumed fossil fuels, emitted green house gas, and degraded ecosystem. Outflow fluxes from multiple rivers degrade our facing coastal area in particular bay area. Multiple river basins connected with artificial flux networks, including a facing bay area, is here called river basin complex, where eco-compatible management methodology is required.

River basin

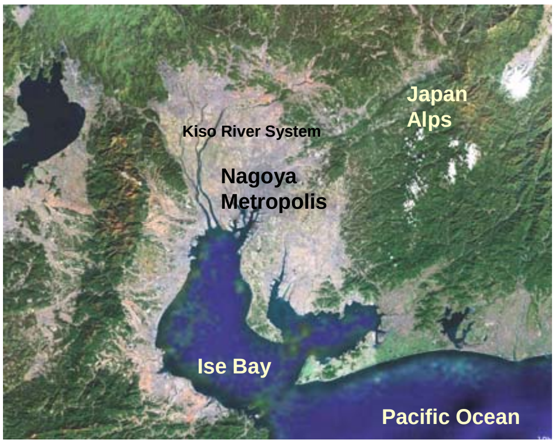


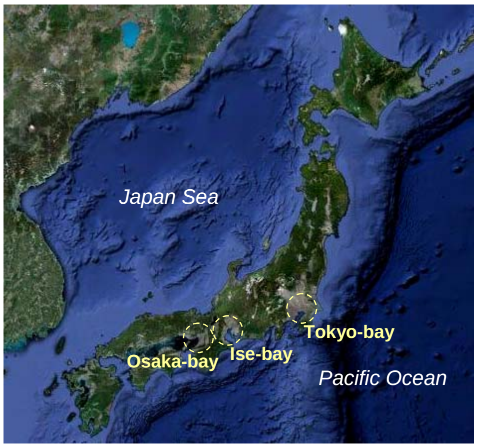
River basin complex



Study field and Organization:
We have organized a research project team by special coordination fund for promoting science and technology for sustainable national land management (2006-2010) supported by Ministry of Education, Culture, Sports, Science and Technology, Japan. As a study field, we have chosen a river basin complex surrounding Ise-bay, where 10 river basins of class-A and Nagoya metropolis are included. Dynamic geographic features and monsoon climate are driving force to support eco-compatible basin complex with higher human activities.

The research project team is composed of several national institutes related to the ministries governing land management as well as university, as follows:
NHRI=Nagoya Hydraulic Research Institute for River Basin Management, Nagoya University; NILM=National Institute for Land and Infrastructure Management; PWRI=Public Works Research Institute; NIES=National Institute for Environmental Studies:NIRE=National Institute for Rural Engineering; NRIA=National Research Institute for Aquaculture;NIRFE=National Research Institute for Fisheries Engineering.



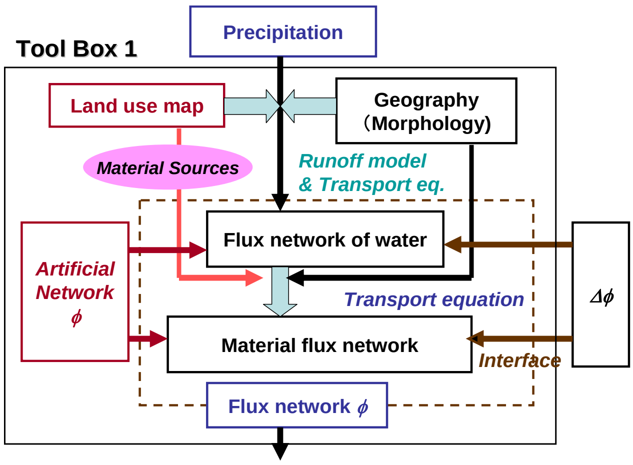


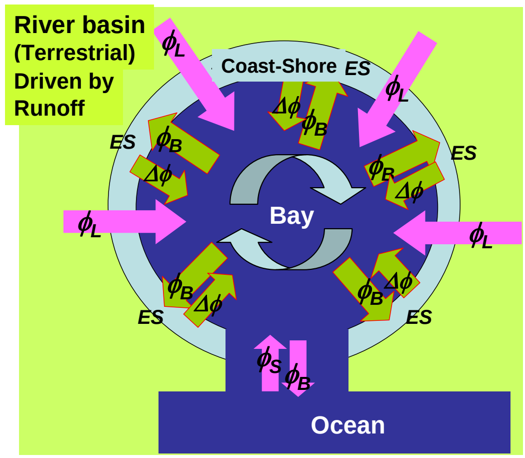
Research Program:

<u>Status description of river basin complex</u>

The followings should be prepared: (i) tool box to express the flux networks of water and various materials in river basins and in a bay area [TB1]; (ii) tool box to describe the structure and function of local ecosystem (landscapes) [TB2]; and (iii) tool box to standardize and integrate various ecosystem services accumulated in spatially distributed landscapes [TB3].

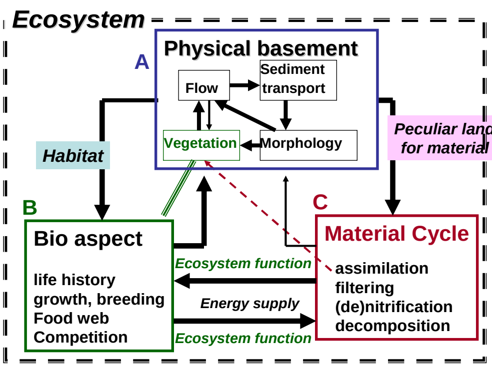
TB1 for river basin is based on the so-called “run-off model” for water and various materials and it has proper interfaces to connect with artificial networks and those for feedback from TB2; while the one for the bay area is rather a model to describe dynamic behavior of water and various material influenced by inflows from river basins as well as from the ocean, wind, tide and so on.

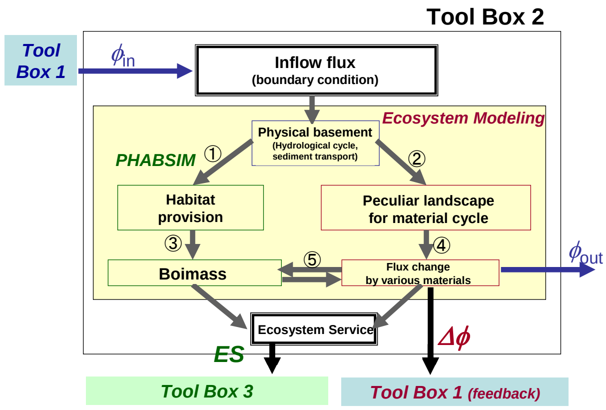


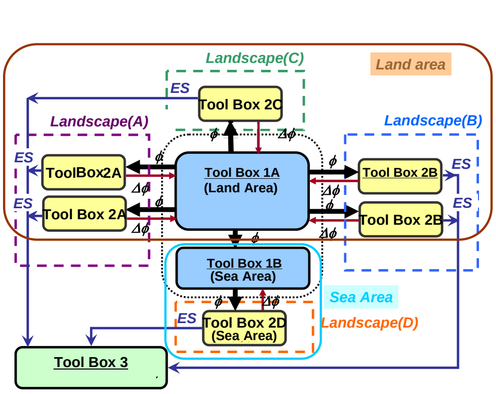


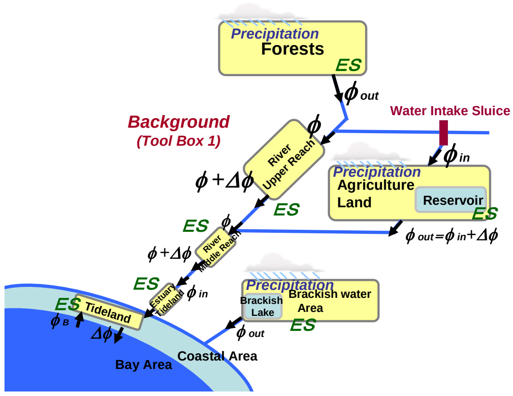
The structure and function of ecosystem is peculiar for each landscape, but it can be categorized in some patterns: “categorized landscapes”. For each categorized landscape, structure and mechanism of ecosystem is assumed to be similar and they can be described in unified manner. Several research teams are studying in typical fields to propose TB2 for several categorized landscapes. Requirements for TB2 are to evaluate the flux change (Δf) and the ecosystem service (*ES*) depending on the inflow fluxes.

The out put from TB2 is fed back to TB1, and it describes the status of river basin complex. The ecosystem service accumulated locally will be standardized and integrated for assessment in eco-compatibility by using TB3. Among the ecosystem service, some can be converted to replacement of fossil fuel consumption 0r GHG emission for alternative facilities or transportation for artificial trade. Another service is how much local landscape restoration and/or rehabilitation of natural flux network relief the loss of biodiversity in river complex scale.









<u>Recognition of status transition of river basin complex</u>

For standard year in this decade, the today's status of river basin complex is reproduced (verification of TB1). Then, the status transition in this half century is traced, within which the population, land-use, infrastructures and so on have been changed remarkably. We can recognize that the sustainability has been threatened by resources exhaustion (fossil fuels), global warming wit GHG emission and loss of biodiversity.

<u>Assessment Framework and scenarios as combinations of policy menus</u>

We require (i) safety, (ii) resources ad (iii) comfortable environment for human activity, and under these requirements, we have to overcome the threats against the sustainability as above mentioned. Eco-compatible river basin management is a backbone of vision toward the sustainability because sound ecosystem can bring ecosystem service which can replace the consumption of fossil fuels, suppress the emission of GHG and conserve the biodiversity. We prepare several scenarios as combination of policy menus. Policy menus can be categorized as follows: (A) change of population, land-use, industrial activities and so on, (B) changes in life style, agricultural or industrial management and so on, (C) local ecosystem restoration. This study will prepare an assessment frame work to show which scenario is superior from the viewpoint of sustainability. As for sustainability index, ecosystem service is employed. Local ecosystem service will become a motivation of local people, and simultaneously it supports the integrated target as river basin complex.

Then, we will estimate the status of river basin complex after 50 years for example with various scenarios for eco-compatible management, and then the resultant sustainability will be compared with one another.

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