



THE 16th INTERNATIONAL SYMPOSIUM ON RIVER AND LAKE ENVIRONMENTS

“Climate Change and Wise Management of Freshwater Ecosystems”

24-27 August, 2014

Ladena Resort, Chuncheon, Korea



Organized by Steering Committee of ISRLE, Korean Society of Limnology,
Chuncheon Global Water Forum

Sponsored by Japanese Society of Limnology
Chinese Academy of Science
International Association of Limnology (SIL)
Global Lake Ecological Observatory Network (GLEON)
Gangwondo Provincial Government 江原道
Korean Federation of Science and Technology Societies
Korea Federation of Water Science and Engineering Societies
Institute of Environmental Research at Kangwon National University
K-water
Halla Corporation
Assum Ecological Systems INC.

ISRLE-2014 Scientific Program

Schedule	Program
24th Aug. 2014	
15:00 -	Registration
15:00 - 17:00	Bicycle Tour
17:30 - 18:00	Guest Editorial Board Meeting for Special Issue(Coral)
18:00 - 18:30	Steering Committee Meeting(Coral)
19:00 - 21:00	Welcome reception
25th Aug. 2014	
08:30 - 09:00	Registration
09:00 - 09:30	Opening Ceremony and Group Photo
09:30 - 10:50	Plenary Lecture-1(Diamond)
10:50 - 11:10	Coffee break
11:10 - 12:25	Oral Session-1(Diamond), Oral Session-2(Emerald)
12:25 - 13:30	Lunch
13:30 - 15:30	Oral Session-3(Diamond), Oral Session-4(Emerald)
15:30 - 15:50	Coffee break
15:50 - 18:00	Poster Session
17:00 - 18:00	Committee Meeting of Korean Society of Limnology General Assembly Meeting of Korean Society of Limnology(Diamond)
18:00 - 21:00	Dinner party
26th Aug. 2014	
09:00 - 10:20	Plenary Lecture-2(Diamond)
10:20 - 10:40	Coffee break
10:40 - 12:40	Oral Session-5(Diamond), Oral Session-6(Emerald)
12:40 - 14:00	Lunch
14:00 - 16:00	Young Scientist Forum(Diamond), Oral Session-7(Emerald)
16:00 - 16:20	Coffee break
16:20 - 18:05	Oral Session-8(Diamond), Oral Session-9(Emerald)
18:05 - 21:00	Banquet
27th Aug. 2014	
09:00 - 18:30	Excursion (Lake Soyang)

Plenary Session

25 August (09:30 - 10:50)

09:30 - 10:10 Long term change of the trophic state in a deep reservoir (Lake Soyang, Korea): the effects of aquaculture, monsoon, and agriculture

KIM, Bomchul
(President of the Korean Society of Limnology)

10:10 - 10:50 The future role of lakes and other inland aquatic systems in the carbon cycle at local, regional and global scales

PRAIRIE, Yves
(President of the International Association of Limnology, SIL)

26 August (09:00 - 10:20)

09:00 - 09:40 Ecophysiological and toxicological-based understandings of cyanobacterial bloom: necessary for integrated monitoring and control in freshwater lakes

SONG, Li-rong
(Chinese Academy of Science)

09:40 - 10:20 How can we overcome the coming water crises in East Asian Countries?

KUMAGAI, Michio
(President of the Japanese Society of Limnology)

Young Scientist Forum

Time: 2014. 08. 26. Tuesday. 14:00 -16:00

Room: Diamond

Convener: CHANG Kwang-Hyeon (*Kyung Hee University, Korea*)

14:00 - 14:20 Y1-1 Impacts of long-term increase in silicon concentration on diatom blooms in Lake Kasumigaura, Japan

ARAI, Hiroyuki
Tsukuba Univ.

14:20 - 14:40 Y1-2 Rapid gene diversification and impact of *Microcystis* cyanophages in a natural pond

SAKAI-KIMURA, Shigeko
Kyoto University

14:40 - 15:00 Y1-3 Estimating contributions of diets for top predators, *Misgurnus* spp. and predator-piercers in aquatic paddy fields in Korea based on a stable isotope mixing model with fatty acid profiles

YANG, Dongwoo
Ajou University

15:00 - 15:20 Y1-4 Evaluation of impacts of environmental changes on fish communities in streams through ecological informatics approaches

KWON, Yong-Su
Kyung Hee University

15:20 - 15:40 Y1-5 Biodegradability of algal derived organic matter in a large artificial lake

LEE, Yeonjung
Hanyang University

Oral Session

Oral Session-1.

Biogeochemical cycling in freshwater systems under monsoon climates

Time: 2014, 08, 25, Monday, 11:10 - 12:25

Room: Diamond

Convener: IIZUMI, Yoshiko (*International Research Center for Agricultural Sciences, Japan*)

YOH, Muneoki (*Tokyo University of Agriculture and Technology, Japan*)

MARUO, Masahiro (*The University of Shiga Prefecture, Japan*)

11:10 - 11:25 O1-1 Water quality and feeding management in fishponds on the Mekong Delta, Vietnam

IIZUMI, Yoshiko (invited)

International Research Center for Agricultural Sciences

11:25 - 11:40 O1-2 Freshwater ecosystems of the south of the Russian Far East in conditions of a changing climate

BOGATOV, Victor

Institute of Biology and Soil Sciences, FEBRAS

11:40 - 11:55 O1-3 Dissolved iron concentration in rivers throughout Japan and GIS analysis of geographical factorsa

YOH, Muneoki

Tokyo University of Agriculture and Technology

11:55 - 12:10 O1-4 Sediment in Lake Soyang as Integrating Archive of Catchment Process and Potential Effect on Lake Water Quality

KIM, Kiyong

University of Bayreuth

12:10 - 12:25 O1-5 How do weather extremes affect subtropical lake metabolism in a changing climate? An answer to episodic lack of monsoons in Taiwan

TSAI, Jeng-Wei (David) (invited)

China Medical University (Taiwan)

Oral Session-2.

Modeling physical and ecological processes in rivers and lakes

Time: 2014, 08, 25, Monday, 11:10 - 12:25

Room: Emerald

Convener: HAMILTON, David (*University of Waikato, New Zealand*)

CHUNG, Sewoong (*Chungbuk National University, Korea*)

- 11:10 - 11:25** O2-1 Modelling physical and chemical processes in lakes: Opportunities enabled by GLEON
HAMILTON, David (invited)
University of Waikato, New Zealand
- 11:25 - 11:40** O2-2 Modelling effects of temperature changes on the behavior of golden apple snails
PARK, Young-Seuk
Kyung Hee University
- 11:40 - 11:55** O2-3 Three-dimensional modeling of basin-scale motions in a deep and stratified lake
CHUNG, Sewoong (invited)
Chungbuk National University
- 11:55 - 12:10** O2-4 Modeling buoyancy control and surface bloom of *Microcystis* in a stratified reservoir
CHUNG, Sewoong (invited)
Chungbuk National University
- 12:10 - 12:25** O2-5 The effect of flood frequency and edaphic condition on the nitrogen fixation at the flood plain
ASAEDA, Takashi
Saitama University

Oral Session-3.

Management of freshwater ecosystem

Time: 2014, 08, 25, Monday, 13:30 - 15:30

Room: Diamond

Convener: CHOUNG, Yeonsook (*Kangwon National University, Korea*)

KIM, Hyun Woo (*Sunchon National University, Korea*)

- 13:30 - 13:45 O3-1 Total phosphorus thresholds for regime shifts are nearly equal in subtropical and temperate shallow lakes with moderate depths and areas
KIM, Hyun Woo (invited)
Institute of Hydrobiology, Chinese Academy of Sciences
- 13:45 - 14:00 O3-2 Status report on wetland plants occurring in Korean Peninsula
CHOUNG, Yeonsook (invited)
Kangwon National University
- 14:00 - 14:15 O3-3 Effect of hydrologic condition on phytoplankton succession in Lake Poyang, the biggest freshwater lake in China
CHEN, Yuwei
Chinese Academy of Sciences
- 14:15 - 14:30 O3-4 The influence of the weir on the community shift of zooplankton in the middle part of Yeongsan River, Korea
KIM, Hyun Woo (invited)
Sunchon National University
- 14:30 - 14:45 O3-5 Trends in a satellite-derived vegetation index and its relationship with environmental variables in the restored lagoon system: Chilika lagoon, India
KIM, Ji Yoon
Pusan National University

- 14:45 - 15:00 O3-6 Assessment of the lake biomanipulation mediated by piscivorous rainbow trout and herbivorous daphnids using self-organizing map: a case study in Lake Shirakaba, Japan
HA, Jin-Yong
Toyama Prefectural University
- 15:00 - 15:15 O3-7 Impact of large-scale weir construction on the fish community structure and diet of top-predator fish in a large river ecosystem (Nakdong River, S. Korea)
JO, Hyunbin
Pusan National University
- 15:15 - 15:30 O3-8 Effects of added nutrients on the early growth of *Pueraria lobata* in the floodplain of a regulated river
RASHID, Md Harun
Saitama University

Oral Session-4.

Application of stable isotopes in aquatic ecology and environment

Time: 2014, 08, 25, Monday, 13:30 - 15:30

Room: Emerald

Convener: SHIN, Kyung-Hoon (*Hanyang University, Korea*)

SAKAI, Yoichiro (*Kyoto University, Korea*)

- 13:30 - 13:45 O4-1 Application of stable isotopes to examine life history of benthic aquatic organism: implication from research on ontogeny of marine benthic organism
WON, Nam-Il
Korea Water Resources Corporation

- 13:45 - 14:00 O4-2 Tracing the environmental change in artificial lake Shihwa: the application of $\delta^{13}\text{C}$, $\delta^{15}\text{N}$, $\delta^{34}\text{S}$ isotope analysis
KIM, Min Seob
Environmental Measurement & Analysis Center
- 14:00 - 14:15 O4-3 Intraspecific differences in vertical habitat and food utilization by crustacean zooplankton: stable isotopic evidence
SAKAI, Yoichiro
Kyoto University
- 14:15 - 14:30 O4-4 Summer monsoon effects on trophic source shifts in diets of secondary producers in a shallow reservoir food webs, Korea: Evidence from stable C-N isotopes
OCK, Giyoung
Hanyang University
- 14:30 - 14:45 O4-5 Effect of the monsoon on the food web structure according to the size of reservoir; Application of C and N stable isotope ratio
GAL, Jong Ku
Hanyang University
- 14:45 - 15:00 O4-6 Feeding strategy of nutria (*Myocastor coypus*) as semi-aquatic herbivore on off-season using stable isotope analysis
HONG, Sungwon
Pusan National university
- 15:00 - 15:15 O4-7 Characteristics of multiple organic matter sources in the upstream waters of an artificial coastal lake (Shihwa), Korea
LEE, Yeonjung
Hanyang University
- 15:15 - 15:30 O4-8 Trophic position of aquatic organisms determined by nitrogen stable isotope of individual amino acids
SHIN, Kyung-Hoon (invited)
Hanyang University

Oral Session-5.

Microbial processes in limnetic systems with special reference to biodiversity, food web dynamics and material cycling

Time: 2014, 08, 26, Tuesday, 10:40 - 12:40

Room: Diamond

Convener: NAKANO, Shin-ichi (*Kyoto University, Japan*)

SHEN, Hong (*Chinese Academy of Sciences, China*)

- 10:40 - 10:55 O5-1 Microbial ecology in Lake Biwa with special reference to production and decomposition of dissolved organic matter
NAKANO, Shin-ichi (invited)
Kyoto University
- 10:55 - 11:10 O5-2 Response of *Daphnia magna* population growth to differential algal food provision
JEONG, Kwang-Seuk
Pusan National University
- 11:10 - 11:25 O5-3 Ecological importance of kinetoplastid flagellates in the hypolimnion of Lake Biwa with special reference to the limitation of molecular techniques
MUKHERJEE, Indranil
Kyoto University
- 11:25 - 11:40 O5-4 The role of heterotrophic bacteria in the formation of *Microcystis* colonies
SHEN, Hong
Chinese academy of Sciences
- 11:40 - 11:55 O5-5 Diversity of zooplankton with spatial and temporal dispersion in irrigation reservoir
JEONG, Hyungi
National Institute of Environmental Research

- 11:55 - 12:10 O5-6 Seasonal variation of coastal zooplankton community in a eutrophic-brackish reservoir, Saemangeum
NAKANO, Sho
Kyung Hee University
- 12:10 - 12:25 O5-7 Bacterial community composition and enzyme activities from Yasu River to Lake Biwa, Japan
FUJINAGA, Shohei
Kyoto University
- 12:25 - 12:40 O5-8 A Study of the distribution and behavior pattern of pelagic- and epiphytic cladoceran associated with macrophyte types using field and microcosm approaches
CHOI, Jong-Yun
Pusan National University

Oral Session-6.

River ecosystem health assessment: the value in the management and restoration

Time: 2014, 08, 26, Tuesday, 10:40 - 12:40

Room: Emerald

Convener: HWANG, Soon-Jin (*Konkuk University, Korea*)

JANG, Min-Ho (*Kongju National University University, Korea*)

- 10:40 - 10:55 O6-1 Prospects of using aquatic ecosystem health assessment to support water environment management in Korea
HWANG, Soon-Jin (invited)
Konkuk University
- 10:55 - 11:10 O6-2 Biodiversity, assemblage structure and environmental relation of macroinvertebrates in Korean streams and rivers
JUN, Yung-Chul
Konkuk University

- 11:10 - 11:25 **O6-3 Aquatic ecosystem health 'of the people, by the people and for the people'; application of citizen science in management and conservation of the rivers and streams**
PARK, Jung-Hwan
Konkuk University
- 11:25 - 11:40 **O6-4 Testing the non-linear relationship between water quality and urban land uses using Generalized Additive Model**
HWANG, Sun-Ah
Konkuk University
- 11:40 - 11:55 **O6-5 Characterizing spatial and temporal changes of biological indices in Korean streams**
KWON, Yong-Su
Kyung Hee University
- 11:55 - 12:10 **O6-6 Evaluation of Korean stream characteristics using Habitat and Riparian Index (HRI) : past accomplishment and future direction**
JOO, Gea-Jae
Pusan National University
- 12:10 - 12:25 **O6-7 Distribution patterns of Korean freshwater fish in relation to environmental gradients**
LEE, Jin Woong
Kongju National University University
- 12:25 - 12:40 **O6-8 Diagnostic evaluation of the rivers based on the riparian vegetation in Korea**
LEE, Chang Seok
Seoul Women' s University

Oral Session-7.

Ecology and biology of freshwater biota

Time: 2014, 08, 26, Tuesday, 14:00 - 16:00

Room: Emerald

Convener: LEE, Eun Joo (*Institute of Korean Algaetech, Korea*)

KANG, Myounghee (*Gyeongsang National University, Korea*)

14:00 - 14:15 07-1 Exploratory methodology for understanding fish length and their swimming pattern using an acoustic camera and echo sounder

KANG, Myounghee (invited)

Gyeongsang National University

14:15 - 14:30 07-2 New sight on genesis of the Lake Biwa malacofauna

PROZOROVA, Larisa

Institute of Biology and Soil Science FEB RAS

14:30 - 14:45 07-3 Changes of phytoplankton community in Kyoungpo lake

LEE, Eun Joo (invited)

Institute of Korean Algaetech

14:45 - 15:00 07-4 Impact of a land-based fish farm effluent discharges on rotifer community in a shallow lake in the Yangtze River basin, China

WANG, Qidong

Chinese academy of sciences

15:00 - 15:15 07-5 Environmental factors affecting germination of akinete of *Anabaena* and cellular regrowth of *Microcystis*

PARK, Chae-Hong

Konkuk University

15:15 - 15:30 07-6 Evaluation of the oxidative stress in submersed macrophyte; *Myriophyllum spicatum* in response to oxygen redox potential in substrate sediments

ATAPATHTHU, Keerthi

Saitama university

15:30 - 15:45 **O7-7 Response of Physico-chemical characteristics of Pond water in Fish Production and algal growth in northern Bangladesh**

ISLAM, Md. Jahidul (invited)

Hajee Mohammad Danesh Science and Technology University

15:45 - 16:00 **O7-8 East Fork Owyhee River Salmon and Steelhead Recovery Project**

SEO, Jinwon (invited)

Director of Fish, Wildlife, & Parks Dept, in Shoshone-Paiute Tribes

Oral Session-8.

Eutrophication Processes in Lake and Reservoir

Time: 2014, 08, 26, Tuesday, 16:20 - 18:20

Room: Diamond

Convener: ZHU, Guangwei (*Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences, China*)

JOO, Gea-Jae (*Pusan National University, Korea*)

16:20 - 16:35 **O8-1 Response of phytoplankton to nutrient reduction in Shahe Reservoir, China**

ZHU, Guangwei (invited)

Chinese Academy of Sciences

16:35 - 16:50 **O8-2 Water usage and water quality of several types of artificial water storage ponds in the urban and rural area of Khulna, Bangladesh**

NAKAJIMA, Jun (invited)

Ritsumeikan University

16:50 - 17:05 **O8-3 The physiological responses of *Vallisneria natans* to epiphytic algae with the increase of N and P in water bodies**

SONG, Yuzhi

Nanjing University of Information Science & Technology

- 17:05 - 17:20 O8-4 The effects of temperature and light conditions on the buoyancy of a harmful cyanobacterium *Anabaena circinalis*
KWON, DaeRyul
Konkuk University
- 17:20 - 17:35 O8-5 Nutrients and chlorophyll a responses to water level fluctuations in Poyang Lake: the largest Yangtze River-connected lake of China
LIU, Xia
Chinese Academy of Sciences
- 17:35 - 17:50 O8-6 Research on the recruitment of cyanobacteria from the sediments in the eutrophic Shanzi Reservoir
SU, Yuping
Fujian Normal University
- 17:50 - 18:05 O8-7 Annual Variation of nutrient and Chlorophyll-a and their driving factors in Lake Taihu(China) based on daily observation
ZHU, Mengyuan
Chinese Academy of Sciences
- 18:05 - 18:20 O8-8 A scientometric study of the ISRLE society: inference of research collaboration and core topics based on publication network
JOO, Gea-Jae (invited)
Pusan National University

Oral Session-9.

Convergence of Geoscience and Aquatic science

Time: 2014, 08, 26, Tuesday, 16:20 - 17:50

Room: Emerald

Convener: LIM, Jaesoo (*Korea Institute of Geoscience and Mineral Resources, Korea*)
SEO, Jinwon (*Director of Fish, Wildlife, & Parks Dept. in Shoshone-Paiute Tribes, USA*)

- 16:20 - 16:35** **09-1 Variations of Total, Dissolved, and Particulate Hg Concentration affected by rain event at the Three Sites in Korea**
CANCEL
KIM, Pyungrae
Kangwon University
- 16:35 - 16:50** **09-2 Holocene environmental change at the southern coast of Korea and its link to monsoon and sea-level changes**
LIM, Jaesoo
Korea Institute of Geoscience and Mineral Resources
- 16:50 - 17:05** **09-3 Distribution and source of uranium in Okinawan Rivers, Japan**
MOCHIZUKI, Akihito
Kyoto University
- 17:05 - 17:20** **09-4 Comparison of the lipid content and fatty acid profiles of topmouth culter (*Culter alburnus* Basilewsky) populations in six lakes, China**
FAN, Hourui
Chinese academy of sciences
- 17:20 - 17:35** **09-5 Efficiency of two different types of fishway, Ice-harbor and nature-like type, installed in the Geum River, South Korea**
BAEK, Seung Ho
Kongju National University
- 17:35 - 17:50** **09-6 Detecting a potential for toxin and off-flavor material production of cyanobacteria using molecular genetic methods**
KIM, Keonhee
Konkuk University

Poster Session

Poster Session 1

Biogeochemical cycling in freshwater systems under monsoon climates

P1-1 Woody Debris export from forested watershed during rain storms in Korea

CHOI, YoungSoon
Kangwon National University

P1-2 Development of a Frequency Analysis Tool of Environmental Extreme Events

LEE, Sanguk
K-water Institute

P1-3 Potential effect of water temperature rise on cyanobacterial harmful algal blooms in freshwater lakes and rivers, Korea

YOU, Kyung-A
National Institute of Environmental Research

P1-4 Long-term variation of water quality and effect of climate change in Lake Soyang

JUNG, Sungmin
Kangwon National University

P1-5 Projection of the effects of climate change on the thermal stability of Juam reservoir, Korea

YOON, Sung Wan
Chungbuk National University

P1-6 Monitoring cyanobacteria in lake using remote sensing

LYU, Heng
Nanjing Normal University

P1-7 Characterization of highly strong metal binding ligands in waters of natural lakes in Japan and Korea by electroanalysis

MASAHIRO, Maruo
The University of Shiga Prefecture

- P1-8 Dynamics of dissolved oxygen and physical properties over an annual cycle in the Youngsan Lake, Korea**
LEE, Dahye
Mokpo National Maritime Univ.
- P1-9 Using Solution-State ¹H NMR to Characterize Particulate Organic Matter in Floodplain and Lake Bottom Sediments in North Han River Watershed, South Korea**
KIM, Sun-Hye
Ewha Womans University
- P1-10 Using fluorescence EEMs and PARAFAC to compare optical characteristics and biodegradability of dissolved and particular organic matter in a multiple land-use watershed, Korea**
YANG, Boram
Ewha Womans University
- P1-11 Distribution and chemical characteristics of dissolved organic matter in Lake Biwa extracted by hydrophobic adsorbents**
RIKA, Utsumi
University of Hyogo
- P1-12 Distribution and chemical characteristics of dissolved organic matter in Lake Biwa extracted by activated alumina**
RIKA, Utsumi
University of Hyogo

Poster Session 2

Modeling physical and ecological processes in rivers and lakes

- P1-1** The effects of sampling frequency on the results of water quality modeling during the rainy season in Lake Soyang, Korea
JUNG, Sungmin
Kangwon national university
- P2-2** Assessment of Water Quality Changes of the Gunwi Reservoir after Dam Impoundment
LEE, Sanguk
K-water Institute
- P2-3** Water Quality Simulation of Trial Dam Impoundment of the Boohang Reservoir
LEE, Sanguk
K-water Institute
- P2-4** Comparison of spatial characteristics of algae occurrence in Daecheong reservoir and Chungju reservoir during the summer season using ELCOM-CAEDYM
CHONG, Suna
K-water
- P2-5** A study on development of prediction system for algal-derived taste and odor compounds using two dimensional model
CHONG, Suna
K-water

Poster Session 3

Application of stable isotopes in aquatic ecology and environment

- P3-1** Distribution and sources of organic matter in the surface sediments of the three rivers (Han River, Guem River and Younsan River) estuaries, western coast of Korea

YOON, Suk Hee

Environmental Measurement & Analysis Center

- P3-2** Effects of removal efficiency with an atyid shrimp (*Caridina denticulata*) and a bagrid catfish (*Pseudobagrus fulvidraco*) on cyanobacteria *Microcystis eruginosa*) bloom : in situ mesocosm experiment

KIM, Min Seob

Environmental Measurement & Analysis Center

- P3-3** Microcystin (LR and RR) accumulation of three freshwater bivalves in *Microcystis aeruginosa* bloom through dual isotope tracer experiment

KIM, Min Seob

Environmental Measurement & Analysis Center

- P3-4** Spatial and temporal variation in zooplankton $\delta^{13}\text{C}$ depending on autochthonous organic matters

JANG, Changwon

Kangwon National University

- P3-5** Vertical distribution and sources of dissolved organic matter stable isotope composition in Lake Soyang

JANG, Changwon

Kangwon National University

- P3-6** The seasonal dynamics of Saemangeum food web in relation with desalination and eutrophication

NAKANO, Sho

Kyung Hee University

P3-7 Inorganic nitrogen uptake by heterotrophic bacteria and phytoplankton in the Yeongsan River, Korea

LEE, Yeonjung

Hanyang University

Poster Session 4

Microbial processes in limnetic systems with special reference to biodiversity, food web dynamics and material cycling

P4-1 Studies on nitrification in the riparian zone of Longmenkou reservoir in Tai'an, China

TIAN, Weijun

Ocean University of China

P4-2 Development of a new cultivation technology, I-tip, for studying microbial diversity and its application to freshwater sponges of Lake Baikal, Russia

AHN, Tae Seok

Kangwon National University

P4-3 Feeding efficiency of cladoceran (*Daphnia* and *Simocephalus*) and ostracod species on blue-green algal bloom

CHANG, Kwang-Hyeon

Kyung Hee University

P4-4 Spatial and temporal distribution of plankton community and its relation with water quality and fish community in recently created reservoir by multi-purpose dam

Go, Sunmi

Kyung Hee University

Poster Session 5

Ecosystem health, management and conservation

- P5-1 The impact of land uses on benthic macroinvertebrate diversity in the coastal ecosystem of Lake Biwa**
SAKAI, Yoichiro
Kyoto University
- P5-2 Fish resources change trend in the Hanjiang River and the Danjiangkou Reservoir, China**
YUAN, Jing
Institute of hydrobiology, Chinese academy of sciences
- P5-3 Distributional Characteristics of Alien plants in Riparian Zone of the North Han River, Korea**
KONG, Hak-Yang
National Institute of Environmental Research
- P5-4 Relationship between epilithic diatom and environmental variables using four different gradient analysis : A case study in Han River, South Korea**
SHIN, Yuna
National Institute of Environmental Research
- P5-5 Influence of land use of riverside area on the species structure of epilithic diatom assemblage : A case study in Han River, South Korea**
SHIN, Yuna
National Institute of Environmental Research
- P5-6 Classification of Lake Ecosystems Based on Vegetation Communities and Physico-chemical Factors in South Korea**
LEE, Yonghak
Kangwon National University
- P5-7 Analysis of non-point source pollution reduction project effect in Lake Doam and improvement ways**
CHOI, Jonghwan
Kangwon National University

Poster Session 6

Ecology and biology of freshwater biota

- P6-1 Random Forest Simulation of the Epilithic Diatom Communities in Geum River Large Influencing Area of South Korea**
KIM, Baik-Ho
Hanyang University
- P6-2 Spatial and Temporal Distribution of Epilithic Diatom Communities in Major River Mouth of Korean Peninsula**
KIM, Baik-Ho
Hanyang University
- P6-3 Changes of fish fauna after weir construction in the South Han River, Korea**
BYEON, MyeongSeop
National Institute of Environmental Research
- P6-4 Variation in fungal activity due to changes in habitat characteristics along a river continuum**
CHUNG, Namil
Kyung Hee University
- P6-5 Study on Zooplankton dynamics in different lakes of Southern portion of South Korea**
JEONG, Hyungi
National Institute of Environmental Research
- P6-6 Species diversity of the cladocera (Crustacea: Branchiopoda) on the Korean Peninsula and Jeju Island**
JEONG, Hyungi
National Institute of Environmental Research
- P6-7 Ecological Characteristics on the Habitat of Manchurian Trout (*Brachymystax lenok tsinlingensis*) Populations in Gyeong Stream and Naerin Stream, Korea**
CHOI, Jun kil
Sangji Univ, Wonju, Kangwondo

- P6-8 An Evaluation of Habitats for Freshwater Bivalve Unionid Mussels in terms of Water Qualities in Brooklets Running through Rice Paddy Fields in Himi City, Japan**
TANAKA, Hitoshi
Center for Environmental Science in Saitama
- P6-9 Chironomid fauna of Fuji Five Lakes**
HIRABAYASHI, Kimio
Shinshu University
- P6-10 Community Structure and Fluctuation of Benthic Macroinvertebrate in 8 Weir Constructions of Nakdong River**
KWON, Hyeokyeong
Andong National University
- P6-11 Community Structure of Benthic Macroinvertebrates in 9 Artificial Lakes of Nakdong River System**
KIM, Jaehun
Andong National University
- P6-12 Community Fluctuation of Benthic Macroinvertebrates in Upper Nakdong River**
LEE, Mijin
Andong National University
- P6-13 Maternal transfer and multi-generational toxicity of waterborne of copper to apple snail**
ZHUANG, Hui Lin
China Medical University, Taiwan
- P6-14 Altitudinal distribution of macroinvertebrates in Seom River in Korea**
SIM, Youn-Bo
Konkuk University, Seoul, Korea
- P6-15 Diet composition of predatory fish species in relation with predator size class in a lentic freshwater ecosystem, South Korea**
LEE, Eunkyū
Pusan National University

- P6-16 A Molecular phylogeny of Japanese Planorbidae (Gastropoda, Pulmonata): Investigation of Japanese Planorbid fauna**
SAITO, Takumi
Tohoku University
- P6-17 Appearance of filamentous green algal Mougeotia due to water quality restoration in Lake Suwa, Japan**
FUTATSUGI, Noriko
Shinshu university
- P6-18 Benthic macroinvertebrates in the small and shallow Lake Nakatsuna, Nishina Three Lakes, Japan**
ICHIKAWA, Makoto
Shinshu University
- P6-19 Occurrence pattern and classification of phytoplankton community during cold seasons in the Yeongsan Lake, Korea**
LEE, Dahye
Mokpo National Maritime University
- P6-20 Inhibition of Myriophyllum spicatum on Bloom-causing Cyanobacteria and Other Phytoplankton Species in a Coexistence Experiment**
JEONG, Seon Ah
Ajou University
- P6-21 Aquatic molluscan fauna of the Upper Yenisei River basin (The Republic of Tuva, Russia)**
SHARYI-OOL, Mariana
Institute of Biology and Soil Science Far East Branch of the Russian Academy of Sciences

Poster Session 7

Eutrophication Processes in Lake and Reservoir

- P7-1 Relationship between a Dense Population of Cyanobacterium Anabaena spp. and Rainfalls in the North Han River System in 2012 and 2013**
KIM, Baik-Ho
Hanyang University
- P7-2 Development of a water quality index model for lakes and reservoirs**
LEE, Yunkyung
Kangwon National University
- P7-3 Export characteristics of non-point pollutants from agricultural watershed with dammed streams**
CHOI, Kwangsoon
Korea Water Resources Corporation
- P7-4 Algae-derived particulate organic matter in the upper regions of a brackish Lake Sihwa**
CHOI, Kwangsoon
Korea Water Resources Corporation
- P7-5 A study on the cause of algal bloom and water quality improvement method in Tongyeong Yokji Island, Korea**
KIM, Youngsung
K-water
- P7-6 The absorption character of inland entrophic water based on optical classification**
LI, Yunmei
Nanjing Normal University
- P7-7 Response of phytoplankton to the cessation of aquaculture in a subtropical lake: a case study**
JI, Gaohua
Shanghai Ocean University

- P7-8 Carbon contents of suspended particulate matter in stream and reservoirs**
EUM, Jaesung
Kangwon National University
- P7-9 Assessment of Water Quality Variations Under Non-rainy and Rainy Conditions by Principal Component Analysis Techniques in Lake Doam Watershed, Republic of Korea**
BHATTRAI, Bal Dev
Kangwon National University
- P7-10 Water quality variation of Gyeongpo Lake before and after submerged weir removal**
KWAK, Sungjin
Kangwon National University
- P7-11 Changes of trace elements vertical distribution associated with the appearance of all anoxic layer in Lake Fukami-ike**
NOBORI, Megumi
Aichi Institute of Technology

Poster Session 8

Plankton Dynamics in the Asian River Ecosystem

P8-1 Dynamics of Phytoplankton from major Lakes in the Yeongsan River system

NA, Jeongeun

Yeongsan River Environment Research Center

P8-2 Effect of long-term water quality improvements on zooplankton community in at urban river (Geum-ho River, South Korea)

KIM, Seong-Ki

Pusan National University

P8-3 Seasonal distribution of phytoplankton community in estuarial lakes in the Yeongsan river, Korea.

CHO, Hyeon Jin

Chonnam national university

Poster Session 9

Ecotoxicology and environmental chemistry

- P9-1** Phytotoxicity of Engineered nanoparticles nano-titanium dioxide and silver nanoparticle on submerged aquatic plants

SONG, Uham

Jeju National University

- P9-2** Impacts of low-level pollution by pesticides on freshwater ecosystem structure

HA, Jin-Yong

Toyama Prefectural University

- P9-3** Ecological risk assessment of waterborne copper to freshwater zooplankton community by mesocosms experiment using DGT (gel sampler)

HA, Jin-Yong

Toyama Prefectural University

- P9-4** Hydrogen sulfide in water and interstitial water in Lake Youngrang and Lake Hwajinpo

SUGAHARA, Shogo

Shimane university

- P9-5** Microcystin accumulation in marine Mollusca, *Crassostrea gigas*

MABUCHI, Rie

Shinshu University

- P9-6** Inhibitory effects of the plant secondary metabolites growth of *Microcystis aeruginosa*

FUNAYAMA, Kei

Shinshu University

- P9-7** Determination of the intra- and extracellular cylindrospermopsin produced by the filamentous blue-green algae

ODA, Shoko

Shinshu University

P9-8 The influence of N:P ratio on toxin and off-flavor production of different cyanobacteria isolated from Han River: Comparison of *Anabaena*, *Microcystis* and *Aphanizomenon*

SEO, Wan Bum

Konkuk University

P9-9 Effects of the temperature and light intensity on the growth and production of geosmin and microcystin-LR of cyanobacteria

KWON, DaeRyul

Konkuk University

Poster Session 10

Restoration of lakes (reservoirs) and rivers

P10-1 Habitat restoration for the promotion of biological diversity in artificial lake

HEO, Woomyung

Kangwon National University

P10-2 Changes in nutrients before and after building a breakhead maintenance construction in Lake Fukami-ike, Japan

YAGI, Akihiko

Aichi Institute of Technology

P10-3 Long-Term Runoff Simulation in Gamcheon Watershed using SWAT and K-DRUM Models

NOH, Joonwoo

K-water

P10-4 Habitat restoration plan and applied technology for the river ecology

KIM, Dong-sup

K-water

- P10-5** Development and application of fish habitat block and methods applied to reservoirs and streams
KIM, Dong-sup
K-water
- P10-6** Establishment of biological habitat data base (DB) for aquatic ecosystem restoration
KIM, Dong-sup
K-water
- P10-7** Fluorescence characteristics of dissolved organic matter(DOM) at inflow streams with different land uses
KIM, Sea Won
Korea Water Resources Corporation
- P10-8** Environmental improvement plans of the Moshui River in Qindao City, China, to reduce pollutants into the Yellow Sea
CHOI, KwangSoon
Korea Water Resources Corporation
- P10-9** Engineering technologies for high efficiency green-tide harvesting system at the water-bloom of river
KIM, Sea Won
Korea Water Resources Corporation
- P10-10** Water Quality Projection in the Geum River Basin in Korea to Support integrated Basin Wide Water Resources Management
NOH, Joonwoo
K-water Institute
- P10-11** Application of HEC-RAS for the purpose of flood routing in the Ara Waterway
NOH, Joonwoo
K-water Institute
- P10-12** Measurements of Velocity Distribution at the Entrance of Hydro Power Plant at Sejong Weir
KIM, Youngsung
K-water

- P10-13** Fields Measurements on Conversion Factor between Surface Velocity and Average Velocity of Discharge Measurement Using Microwave Water Surface Current Meter
KIM, Youngsung
K-water
- P10-14** Initial effects of large artificial structure construction on South Han River ecosystem, Korea
YOU, Kyung-A
National Institute of Environmental Research
- P10-15** Evaluation of Sediment Oxygen Demand on river
LEE, Yosang
K-water
- P10-16** Water quality impact assessment of river sediment
LEE, Yosang
K-water
- P10-17** Improvement of Microwave Water Surface Current Meter for Efficiency on Discharge Measurements
KIM, Youngsung
K-water
- P10-18** The removal efficiency for unicellular and colonial *Microcystis* sp. and the effect of electrode materials by electrochemical oxidation
Jeon, Bongseok
Shinshu University
- P10-19** Cyanobacterial cell damage and cyanotoxin release by alum treatment
HAN, Jisun
Shinshu University
- P10-20** Habitat preference in epilithic diatom using CART analysis : A case study in Han River, South Korea
SHIN, Yuna
National Institute of Environmental Research

Poster Session 11

Biotechnology and environmental application

P11-1 A study on the optimum installation plan of algae fence at yeoncho dam water intake tower in Geoje, Korea

KIM, Sea Won

Korea Water Resources Corporation

P11-2 A comparison and intercalibration of phytoplankton chlorophyll a concentrations determined by two spectrophotometric methods: the trichromatic method and the acidification method

JANG, Changwon

Kangwon National University

P11-3 Algal growth characteristic in anaerobic digestion effluent of aquatic weed

HIROYO, Takee

The University of Shiga Prefecture

Poster Session 12

Alternative stable states and management of macrophytes in shallow lakes

P12-1 Long Term Changes in the Dominat Species in Lake Biwa, Japan

HAMABATA, Etsuji

University of Shiga Prefecture

P12-2 Macrophyte reaping affects macrophyte community at south Lake Biwa

MARUNO, Shinya

University of Shiga Prefecture

Poster Session 13

Other aspects of aquatic sciences

- P13-1 Characterizing geophysicochemical features of lakes and reservoirs associated with plankton composition and carbon biomass**
KIM, Hyun Woo
Sunchon National University
- P13-2 Bioaccumulation of mercury from seston to fish through the food web in Lake Biwa**
BAN, Syuhei
University of Shiga Prefecture
- P13-3 Species composition and primary production of benthic algae in two shallow blackish lakes located in the northern area along the eastern coast of Korea**
ISHIDA, Noriko
Nagoya Women's University
- P13-4 Primary production and litter decomposition of macrophytes in the Sihwa Constructed Wetlands**
CHOI, KwangSoon
Korea Water Resources Corporation
- P13-5 Impact on water quality from submerged soil by impoundment of dam reservoirs**
LEE, Seungyoon
Korea Water Resources Corporation(K-water)
- P13-6 Early Holocene sea level rise and geomorphological development of the Yeongsan River, Korea**
NAHM, Wook-Hyun
Korea institute of geoscience and mineral resources
- P13-7 Acoustic simulation for CAT deployment and now-casting system implementation in Lake Biwa (Jp)**
AUGER, Guillaume
Ritsumeikan University
- P13-8 3-Dimensional Hydrodynamic Simulation of Reservoir Sedimentation and Flushing Operation**
Noh, Joonwoo
K-water Institute

- P13-9** Is nutritional quality of faeces of freshwater fish, *Danio rerio* upgraded by protozoa?
FUJIBAYASHI, Megumu
Tohoku University
- P13-10** Re-assessment of dissolved organic matter in Lake Biwa using UV absorbance and fluorescence spectra
HAYAKAWA, Kazuhide
Lake Biwa Environmental Research Institute
- P13-11** Construction of environmental friendly algal harvesting system (AHS) to mitigate blue-green algae bloom in reservoir, Korea
CHONG, Suna
K-water
- P13-12** Understanding the historical degradation of floodplain wetlands in the lower Nakdong River, South Korea
IM, Ran-Young
Pusan National University
- P13-13** Village ponds as important landscape components in Eastern India (1) Chilika Lagoon Basin : Patterns of distribution
JOO, Hogyeum
State University of New York at Stony Brook
- P13-14** Comparison and assessment of the fish community impacted by Newtown development in the Jwa-gwang stream, Busan Metropolitan City, South Korea
GIM, JeongSoo
Pusan National University
- P13-15** Fish utilization of Ice harbor-type fishway installed in the Gongju weir by time periods using a trap sampling method
LEE, Jin woong
Kongju National University
- P13-16** Fish utilization of fishway installed in the Sejong weir by time periods using a trap sampling method
PARK, Sang hyeon
Kongju National University
- P13-17** optically stimulated luminescence dating of Nakdong River deltaic sediments and their accumulation rate, southeastern Korean Peninsula
KIM, Jin Cheul
Korea Institute of Geoscience and Mineral Resources



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* 2014 강원도사회단체보조금지원사업

* This work was supported by the Korean Federation of Science and Technology Societies Grant funded by the Korean Government.

제 16차 국제하천호수환경 심포지엄

THE 16TH INTERNATIONAL SYMPOSIUM
ON RIVER AND LAKE ENVIRONMENT (ISRLE2014)

[기후변화와 담수생태계의 올바른 관리]

Climate Change and Wise Management
of Freshwater Ecosystems

24-27 August , 2014
Chuncheon, Korea

주관 : 한국하천호수학회, 춘천국제물포럼
주최 : 日本陸水學會, 中國科學院, 강원도, 국제호수학회(SIL),
국제호수생태관측네트워크(GLEON), 한국과학기술단체총연합회
(사)한국물학술단체연합회, 강원대학교 환경연구소
후원 : K-Water, (주)한라, (주)아섬

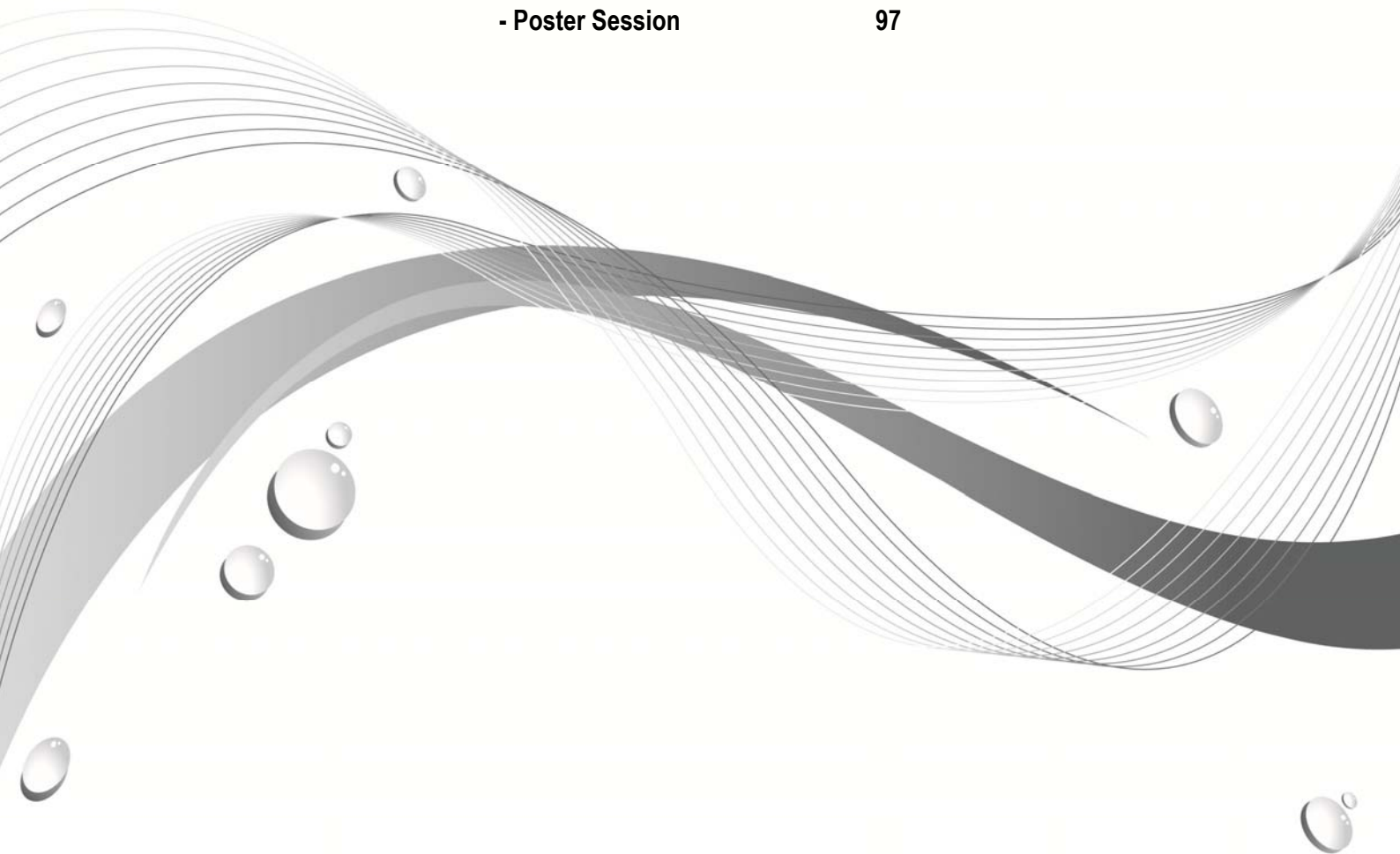
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International Association of Limnology (SIL)
Global Lake Ecological Observatory Network (GLEON)
Korean Federation of Science and Technology Societies
Korea Federation of Water Science and Engineering Societies
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Assum Ecological Systems INC.

* 2014 강원도사회단체보조금지원사업

* This work was supported by the Korean Federation of Science and Technology Societies Grant funded by the Korean Government.

ISRLE-2014 Scientific Program

- Plenary Session	07
- Young Scientist Forum	13
- Oral Session	21
- Poster Session	97



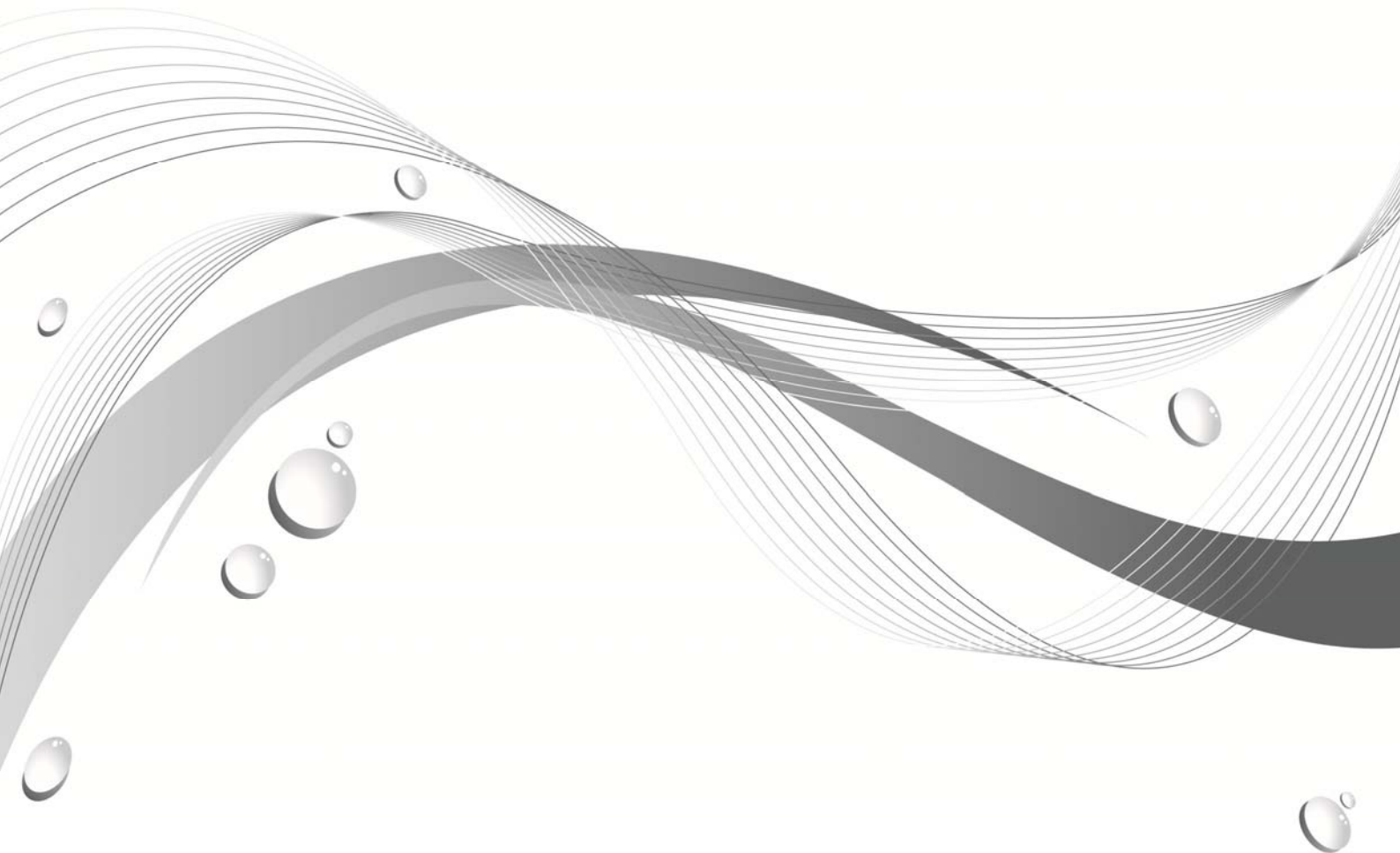
ISRLE-2014 Scientific Program

Schedule	Program	Note
24th Aug. 2014		
15:00 –	Registration	
15:00 – 17:00	Bicycle Tour	
17:30 – 18:00	Guest Editorial Board Meeting for Special Issue(<i>Coral</i>)	
18:00 – 18:30	Steering Committee Meeting(<i>Coral</i>)	
19:00 – 21:00	Welcome reception	
25th Aug. 2014		
08:30 - 09:00	Registration	
09:00 - 09:30	Opening Ceremony and Group Photo	
09:30 - 10:50	Plenary Lecture-1(<i>Diamond</i>)	
10:50 - 11:10	Coffee break	
11:10 - 12:25	Oral Session-1(<i>Diamond</i>), Oral Session-2(<i>Emerald</i>)	
12:25 - 13:30	Lunch	
13:30 - 15:30	Oral Session-3(<i>Diamond</i>), Oral Session-4(<i>Emerald</i>)	
15:30 - 15:50	Coffee break	
15:50 - 18:00	Poster Session	
17:00 - 18:00	Committee Meeting of Korean Society of Limnology General Assembly Meeting of Korean Society of Limnology(<i>Diamond</i>)	
18:00 - 21:00	Dinner party	
26th Aug. 2014		
09:00 - 10:20	Plenary Lecture-2(<i>Diamond</i>)	
10:20 - 10:40	Coffee break	
10:40 - 12:40	Oral Session-5(<i>Diamond</i>), Oral Session-6(<i>Emerald</i>)	
12:40 - 14:00	Lunch	
14:00 - 16:00	Young Scientist Forum(<i>Diamond</i>), Oral Session-7(<i>Emerald</i>)	
16:00 - 16:20	Coffee break	
16:20 - 18:05	Oral Session-8(<i>Diamond</i>), Oral Session-9(<i>Emerald</i>)	
18:05 - 21:00	Banquet	
27th Aug. 2014		
09:00 - 18:30	Excursion (Lake Soyang)	

Plenary Session

25th Aug. 2014 09:30 - 10:50 Plenary Lecture-1 (*Diamond*)

26th Aug. 2014 09:00 - 10:20 Plenary Lecture-2 (*Diamond*)



Plenary Session

25 August (09:30 - 10:50)

09:30 - 10:10 **Long term change of the trophic state in a deep reservoir (Lake Soyang, Korea):
the effects of aquaculture, monsoon, and agriculture**

KIM, Bomchul

(President of the Korean Society of Limnology)

10:10 - 10:50 **The future role of lakes and other inland aquatic systems in the carbon cycle at
local, regional and global scales**

PRAIRIE, Yves

(President of the International Association of Limnology, SIL)

26 August (09:00 - 10:20)

09:00 - 09:40 **Ecophysiological and toxicological-based understandings of cyanobacterial
bloom: necessary for integrated monitoring and control in freshwater lakes**

SONG, Li-rong

(Chinese Academy of Science)

09:40 - 10:20 **How can we overcome the coming water crises in East Asian Countries?**

KUMAGAI, Michio

(President of the Japanese Society of Limnology)

Long term change of the trophic state in a deep reservoir (Lake Soyang, Korea): the effects of aquaculture, monsoon, and agriculture

Bomchul Kim^{1*}, Myoungsun Shin¹, Sungmin JUNG¹, Eunjoo Lee², Jaeyong LEE¹, Youngsoon Choi¹,
Jaesung Eum¹

¹Department of Environmental Science, Kangwon National University, Chuncheon, Republic of Korea

²Institute of Korean Algaetech, Gangneung 210-793, Republic of Korea

Lake Soyang is the deepest (maximum depth 120m) and largest reservoir in South Korea. It is one of major water resources for capital area and the water quality is of great concern. Primary productivity, inorganic nutrients, and phytoplankton community have been monitored since 1981. Its trophic state has been changing during the last four decades since its construction. First ten years were a period of clear water with the dominance of a dinoflagellate plankton, *Peridiniumbipes f. occultatum*.

From 1987 net-cage type fish culture increased and the lake became eutrophic at very high rate for a short period. Aquaculture was the major source of phosphorus loading. Phytoplankton density had increased and dominant phytoplankton in summer was changed to cyanobacteria. Average primary productivity increased from 400 mgC/m²/day to 1,000mgC/m²/day which is at the eutrophy level.

All fish farms were removed in 1999 by governmental policy and the clear water returned with the disappearance of cyanobacterial blooms. But inorganic turbidity has emerged as a new threat to water quality. According to the change of agricultural practice toward more intense tillage, upland fields for vegetables became the major source of topsoil export. Turbid water runoff during summer monsoon filled the reservoir and discharged from the dam for a prolonged period of several months. With the increase of turbidity phosphorus loading into the lake also has increased, because topsoil is exported from the upland together with phosphorus adsorbed on the clay surface. After the removal of fish farms upland fertilizer emerged as the major source of phosphorus into Lake Soyang.

Since the year 2000 the reservoir showed gradual eutrophication due to the change of agricultural practice. Nutrients runoff from upland fields depended largely on rain intensity during summer monsoon. Most of annual phosphorus loading into the reservoir is concentrated in a few episodic heavy rain events, and the annual loading is determined by precipitation and rain intensity. In a year of higher precipitation we have larger phosphorus loading and higher phytoplankton density after monsoon. With the expectation of increased precipitation and rain intensity according to the climate change, it can be expected that more topsoil and nutrients in the watershed will be vulnerable to erosion and leaching. In conclusion agricultural activity is the main determinant of eutrophication in large reservoirs of Korea, however rain intensity of the monsoon is the major determinant of nutrient cycle in short term.

The future role of lakes and other inland aquatic systems in the carbon cycle at local, regional and global scales

Yves Prairie¹

¹UNESCO Chair in Global Environmental Change, Department of Biological sciences, Université du Québec à Montréal, Québec, Canada

The natural role of lakes and streams in the carbon economy of landscapes has been an area of active research over the past decade. Recent studies suggest that the amount of organic carbon altered by inland waters (either via gas evasion or permanent burial) is of the same order of magnitude as the net role of the oceans. Yet, from a global change perspective, the magnitude of the fluxes is less important than the changes in these fluxes that have already occurred or are expected to arise. I will use the results from recent research to illustrate how the role played by aquatic systems in the local, regional and global carbon balance is likely to change over the next century. In general, I contend that the changing role of inland waters will be much faster than that played by the oceans and should be considered in future modeling scenarios.

Ecophysiological and toxicological-based understandings of cyanobacterial bloom: necessary for integrated forecasting and control in freshwater lakes

Lirong Song¹, Wei Chen¹, Lin Li¹, Quan Zhou¹, Yunlun Jia¹, Kun Shan¹, Zhongxing Wu²

¹State Key laboratory of Freshwater Ecology and Biotechnology, The Institute of Hydrobiology, The Chinese Academy of Sciences, Wuhan, China

² School of Life Science, Southwest University, Chongqing China

Cyanobacterial bloom is recognized as one of major threats to sustainable freshwater utility and management in lakes and reservoirs worldwide. There are challenges facing to scientists how can we establish a relatively sound forecasting system and find an effective control measures for bloom. In viewing the current practices of the forecasting, it is evident that monitoring is mainly based on “external parameters” such as physicochemical and climate parameters, but less combined with “internal ones” such as ecophysiological parameters of the bloom. This shortage of integration between external and internal parameters, among others, leads to the forecast less applicable and useful in real situations. Together with the increasing concern on their harmful effect to the freshwater ecosystems and human health, there are growing requirements for integrated forecasting and control of blooms. For integrated forecasting, timing, accuracy, duration and consequence of bloom should be taken into account. So far knowledge of ecophysiology of cyanobacterial bloom are accumulating, the utility of this knowledge will surely facilitate forecasting of cyanobacterial bloom. We will examine the recent progresses and difficulties in the forecasting of bloom.

With regards to the control of cyanobacterial bloom, effectiveness, economical feasibility and environmental-friendly should be considered as priorities when selecting measures/techniques. However, it is often difficulty to assess whether a measure is environmental-friendly or not if toxicological studies is not sufficiently involved. A case study is illustrated here to investigate the efficiency and potential risk of so-called soil-based treatment that acted as degradation of the harvested cyanobacterial bloom biomass and its toxins from Taihu Lake. In summary, understanding of ecophysiology and toxicology is necessary for integrated forecasting and control of cyanobacterial bloom in freshwater lakes.

How can we overcome the coming water crises in East Asian countries?

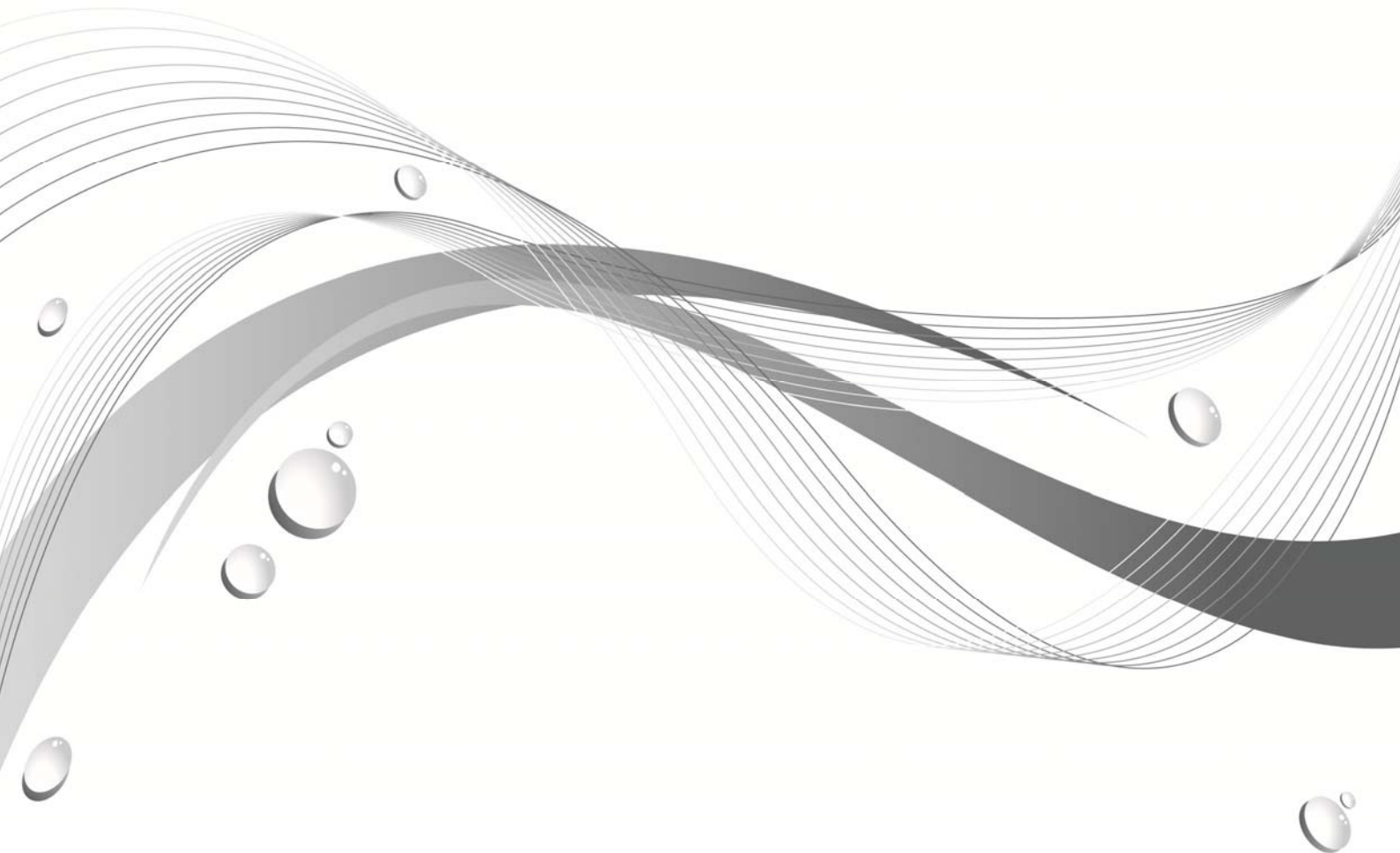
Michio Kumagai

President of Japanese Society of limnology
Ritsumeikan University, Japan

Earth's ecosystem are now quickly changing due to climate change, economic development and population expansion. Air temperature continues to rise and so many freshwater problems are occurring everywhere. This is particularly true in East Asian countries, including China, Korea, Mongolia and Japan, which are facing increased occurrence of floods, drought and pollution of air and water. Most of these are happening almost simultaneously across multiple countries and now we are urged to work together to prevent them and mitigate their impacts. This is a survival situation for human beings and effective co-ordinated action is needed immediately. Recently some major impacts on, and mitigation for, ecosystems and societies by climate change and global warming of inland waters were documented by Goldman et al. (2013). In this presentation, I introduce the freshwater problems identified in the book and discuss possible actions which we need to urgently implement.

Young Scientist Forum

26th Aug. 2014 14:00 - 16:00 (*Diamond*)



Young Scientist Forum

Time: 2014. 08. 26. Tuesday. 14:00 -16:00

Room: Diamond

Convener: CHANG, Kwang-Hyeon (*Kyung Hee University, Korea*)

- 14:00 - 14:20 Y1-1 Impacts of long-term increase in silicon concentration on diatom blooms in Lake Kasumigaura, Japan
ARAI, Hiroyuki
Tsukuba Univ.
- 14:20 - 14:40 Y1-2 Rapid gene diversification and impact of *Microcystis* cyanophages in a natural pond
SAKAI-KIMURA, Shigeko
Kyoto University
- 14:40 - 15:00 Y1-3 Estimating contributions of diets for top predators, *Misgurnus* spp. and predator-piercers in aquatic paddy fields in Korea based on a stable isotope mixing model with fatty acid profiles
YANG, Dongwoo
Ajou University
- 15:00 - 15:20 Y1-4 Evaluation of impacts of environmental changes on fish communities in streams through ecological informatics approaches
KWON, Yong-Su
Kyung Hee University
- 15:20 - 15:40 Y1-5 Biodegradability of algal derived organic matter in a large artificial lake
LEE, Yeonjung
Hanyang University

Y1-1

Impacts of long-term increase in silicon concentration on diatom blooms in Lake Kasumigaura, Japan

Hiroyuki Arai¹*, Takehiko Fukushima¹

¹Graduate School of Life and Environmental Sciences, University of Tsukuba, Tsukuba, Japan

Increasing trends of dissolved Si (DSi) and total Si concentration were detected based on the monthly datasets over the last three decades in the shallow eutrophic Lake Kasumigaura, Japan (mean DSi concentrations during the 1980s and the 2000s were 1.3 and 4.0 mg l⁻¹, respectively). For the same period, significant changes of diatom blooms were confirmed, such as an increase in annual mean abundance and a shift of blooming season from spring and autumn to the winter–spring period. The observation of such trends is rare; therefore, the elucidation of the causes could be useful to understanding Si dynamics and those impacts on diatom blooms in inland waters. Our laboratory experiments suggested that the DSi increase was caused by the DSi release from resuspended sediments, which increased for the late 1990s to the mid-2000s (Arai et al., *Limnol.*, 13, 81–95, 2012). The present study assessed the influencing factors for the trends of diatom blooms during 1981–2010 by the numerical simulation of DSi concentration and diatom abundance. The box model was developed based on the lake budgets investigated by Arai and Fukushima (*J. Soils Sediments*, 12, 1501–1507, 2012), such as inflow, outflow, release, and sedimentation. Si could be regarded as a main nutrient factor limiting diatom growth by analyzing N:P:Si ratios in the field; therefore, the simple diatom growth model depending on DSi, temperature, and light condition was developed. Our model simulation relatively well-reproduced the increasing trend and the shift of seasonality of DSi and diatoms, even though peaks of diatom blooms were underestimated in some years. The model simulation with the input variables or parameters changed suggested as follows: (1) the recent DSi release from resuspended sediments enhanced diatom abundance and (2) the degradation of light condition caused by resuspension affected the shift of blooming season. These findings implicate the significance of sediment-water interactions to Si dynamics and developments of diatom blooms in a shallow eutrophic lake.

Rapid gene diversification and impact of *Microcystis* cyanophages in a natural pond

Shigeko Sakai-Kimura^{1,2*}, Yoshihiko Sako¹ Takashi Yoshida¹

¹Graduate School of Agriculture, Kyoto University, Kyoto, Japan

²School of Environmental Science, University of Shiga Prefecture, Shiga, Japan

Viruses influence the abundance of host populations through virus-mediated host cell lysis. Additionally, viruses contribute to the generation and maintenance of both host and virus diversity through their co-evolution and regulate the abundances and genetic composition of their host population. Here, to determine the manner of the diversification of *Microcystis* cyanophage, we investigated the genetic diversity and temporal changes in *Microcystis* cyanophage populations using a total of 810 sequences of the Ma-LMM01-type cyanophage tail sheath gene (*g91*) from 2006 to 2011 in a natural pond. The sequences obtained were highly diverse and assigned to 419 different genotypes (100 % nucleotide sequence similarity). A maximum parsimony network showed the genotypes were largely divided into three sequence groups I – III, which were constructed by 5 major (more than 24 sequences: GT2, GT53, and GT163 in group I; GT25 in group II; and GT1 in group III), 6 moderately-frequent (including 7 to 18 sequences: GT7, GT26, GT56, GT149, and GT182 in group I; GT152 in group II), and rare genotypes based on their frequencies. The five major cyanophage genotypes co-existed and oscillated in the population throughout the sampling periods. This suggests that *Microcystis*–cyanophage co-evolved based on a negative frequency-dependent selection. The variants of the major and moderately-frequent genotypes (1 or 2 nucleotide substitutions) almost always co-occurred with their origins. This manner of emergence of the variants suggests that increased contact frequency with a host-phage population promotes rapid co-evolution in an arms race.

In addition, to evaluate the impact of phage infection on their host population, we estimated phage-infected *Microcystis* abundances by monitoring *Microcystis* cyanophage abundances using real-time PCR with a primer set designed based on the sequences of three sequence groups I – III described above. The frequency of Ma-LMM01-type phage-infected cells to Ma-LMM01-type phage-susceptible host cells were between 0.05 and 36 %, suggesting the phages occasionally may affect not only the shifts of genetic compositions but also the dynamics of Ma-LMM01-type phage-susceptible host populations.

Y1-3

Estimating contributions of diets for top predators, *Misgurnus* spp. and predator-piercers in aquatic paddy fields in Korea based on a stable isotope mixing model with fatty acid profiles

Dongwoo Yang, Sangkyu Park

Department of Biological Science, Ajou University, Suwon, Korea

To estimate contributions of diets of top predators such as *Misgurnus mizolepis* and *M. anguillicaudatus* and predator-piercers, *Muljarus japonicus*, *Laccotrephes japonensis*, *Ranatra chinensis* and *Gerris laticaudatus*, we collected samples for stable isotope and fatty acid analyses from 11 rice paddy fields under various farming practices in Korea from April, 2010 to April, 2012. Stable isotope mixing model (SIMM) estimated relative contributions of dietary sources to indicate that *Misgurnus* spp. consumed on Chironomidae, Ostracoda, daphnia and tubifex. When SIMM used fatty acid profiles as prior data, the diet proportions of daphnia and Ostracoda increased, while proportion of tubifex decreased regardless of discrimination factors. Gut content analysis for *Misgurnus* spp. supported the latter results. We also attempted to estimate the contributions of diets for predator-piercers, which are difficult to identify the content of guts. Our results suggest that prior data such as distance of fatty acid profiles would increase accuracy in estimation of diet proportions in SIMM.

Evaluation of impacts of environmental changes on fish communities in streams through ecological informatics approaches

Yong-Su Kwon , Young-Seuk Park

Department of Biology, Kyung Hee University, Seoul 130-701, Korea

Distribution and abundance of organisms are influenced by their environmental variables including climate, habitat, landscape, physicochemical factors, etc. In the aquatic ecosystem, distribution of fish is also strongly affected by environmental factors that include geological, hydro-morphological, physicochemical, meteorological and biological factors. Among these factors, climate is fundamental because fish do not have the physiological ability to regulate their body temperatures. In addition, fish populations to climate change are of considerable importance for determining future species distributions, abundances, and viabilities. In this study, we evaluated the impacts of changes of environmental factors such as physicochemical factors and climate on aquatic ecosystem through ecological informatics approaches. At first, we analyzed the relationships between fish communities and environmental variables at multiple spatial scales. Self-organizing map explored differences among fish communities, reflecting environmental gradients, such as a longitudinal gradient from upstream to downstream, and differences in land cover types and water quality. The random forest model for predicting fish community patterns was more powerful than a model using any single variable or other combination of environmental variables. The theoretical path model described the responses of different species to their environment at multiple spatial scales, showing the importance of altitude, forest, and water quality factors to fish assemblages. Then, we projected the impacts of climate change on the distribution of 22 endemic fish species with climatic and geographical variables using species distribution models (SDMs). Six different SDMs, including linear discriminant analysis, random forest, classification and regression tree, generalized linear model, support vector machine, and multivariate adaptive regression splines, were implemented for the prediction and compared for their predictive capacity. The results showed that random forest displayed the highest power to predict the current distribution of species. Random forest was therefore used to assess the potential effects of climate change on the distribution of 22 endemic fish species. The decline of endemic fish species richness and occurrence probability due to climate change lead to poleward and upward shifts as well as extinctions of species. We believe that our projections are useful for understanding how climate change will affect the distribution of endemic species in Korea, as well as provide information needed for preservation and conservation strategies for maintaining endemic fish.

Y1-5

Biodegradability of algal-derived organic matter in a large artificial lake

Yeonjung Lee, Kyung-Hoon Shin*

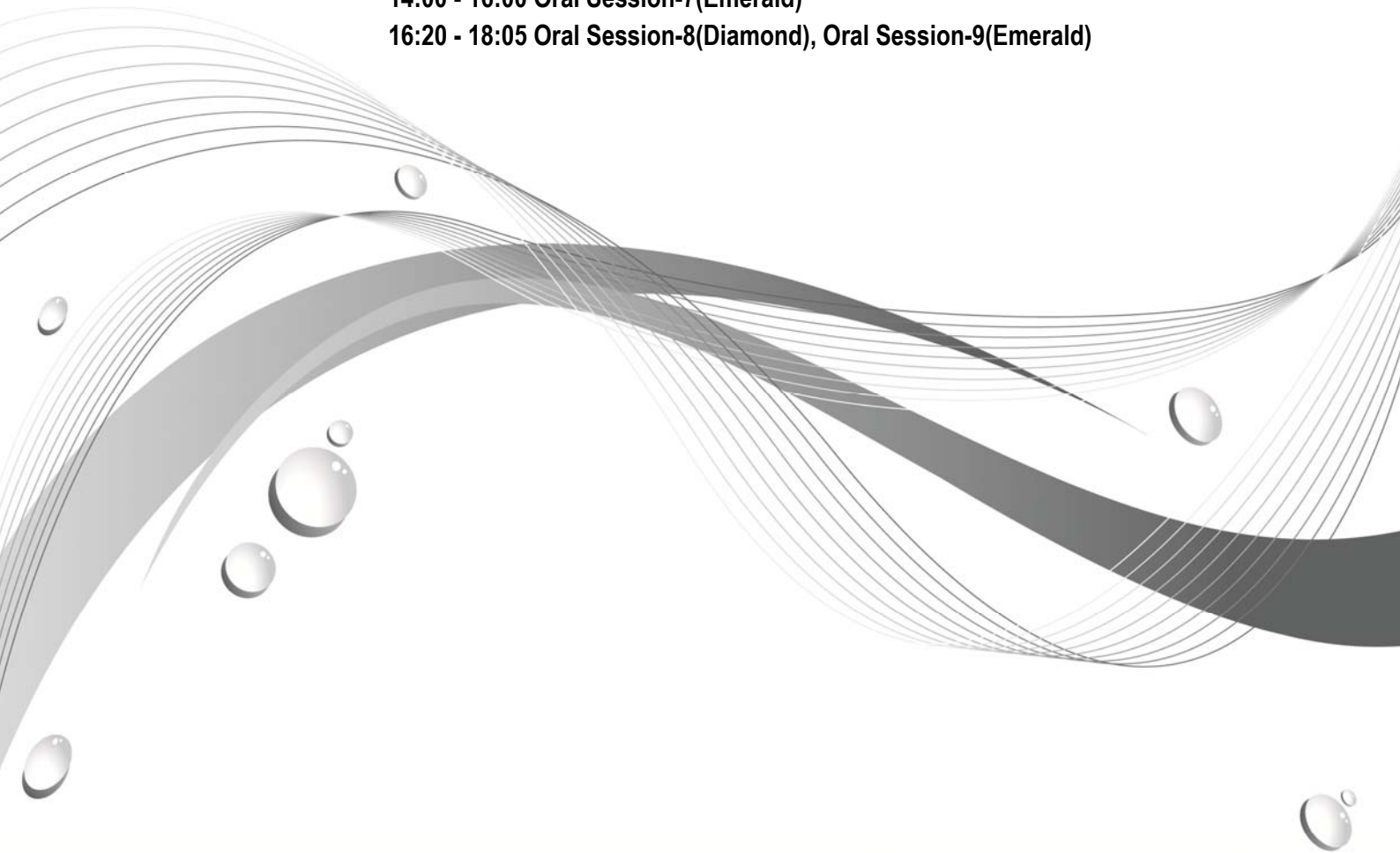
Department of Marine Sciences and Convergent Technology, Hanyang University, Ansan, Korea

The algal-derived organic matter is regarded as a major energy source for the consumers, as well as, as a source of organic pollution. The accumulation of organic matter in the lacustrine water leads to increase in water treatment costs. It also causes changes in the fate and transport of pollutants such as heavy metals in water bodies. In order to determine the contribution of algal derived organic matter to non-biodegradable fraction, the biodegradation of newly produced organic matter by phytoplankton and periphytic algae were carried out during 60 days in experimental incubations contained ^{13}C and ^{15}N enriched algal populations. The newly produced total organic carbon and particulate nitrogen by phytoplankton remained 16 and 22% of initial concentrations, respectively. On the other hand, those remained 44 and 41% of initial values, respectively, in periphytic algae derived organic matter. During the degradation experiment, concentration of algal-derived dissolved organic matter increased corresponding to decrease of algal-derived POC concentration. However, the property of total dissolved organic matter changed to more refractory based on fluorescence spectroscopy measurement. The present results indicate that non-biodegradable organic matter can be derived from photosynthetic organic matter produced by phytoplankton and periphytic algae through microbial transformations. Therefore, primary production of phytoplankton and periphytic algae should be monitored and controlled to manage water quality in a large artificial lake.

Oral Session

25th Aug. 2014 11:10 - 12:25 Oral Session-1(Diamond), Oral Session-2(Emerald)
13:30 - 15:30 Oral Session-3(Diamond). Oral Session-4(Emerald)

26th Aug. 2014 10:40 - 12:40 Oral Session-5(Diamond), Oral Session-6(Emerald)
14:00 - 16:00 Oral Session-7(Emerald)
16:20 - 18:05 Oral Session-8(Diamond), Oral Session-9(Emerald)



Oral Session

Oral Session-1. Biogeochemical cycling in freshwater systems under monsoon climates

Time: 2014. 08. 25. Monday. 11:10 - 12:25

Room: Diamond

Convener: IIZUMI, Yoshiko (*International Research Center for Agricultural Sciences, Japan*)

YOH, Muneoki (*Tokyo University of Agriculture and Technology, Japan*)

MARUO, Masahiro (*The University of Shiga Prefecture, Japan*)

- 11:10 - 11:25 O1-1 Water quality and feeding management in fishponds on the Mekong Delta, Vietnam
IIZUMI, Yoshiko (invited)
Japan International Research Center for Agricultural Sciences
- 11:25 - 11:40 O1-2 Freshwater ecosystems of the south of the Russian Far East in conditions of a changing
climate
BOGATOV, Victor
Institute of Biology and Soil Sciences, FEBRAS
- 11:40 - 11:55 O1-3 Dissolved iron concentration in rivers throughout Japan and GIS analysis of geographical
factorsa
YOH, Muneoki
Tokyo University of Agriculture and Technology
- 11:55 - 12:10 O1-4 Sediment in Lake Soyang as Integrating Archive of Catchment Process and Potential
Effect on Lake Water Quality
*KIM, Kiyong
University of Bayreuth
- 12:10 - 12:25 O1-5 How do weather extremes affect subtropical lake metabolism in a changing climate? An
answer to episodic lack of monsoons in Taiwan
TSAI, Jeng-Wei (David) (invited)
China Medical University (Taiwan)

Oral Session-2. Modeling physical and ecological processes in rivers and lakes

Time: 2014. 08. 25. Monday. 11:10 - 12:25

Room: Emerald

Convener: HAMILTON, David (*University of Waikato, New Zealand*)

CHUNG, Sewoong (*Chungbuk National University, Korea*)

- 11:10 - 11:25 O2-1 Modelling physical and chemical processes in lakes: Opportunities enabled by GLEON
HAMILTON, David (invited)
University of Waikato, New Zealand
- 11:25 - 11:40 O2-2 Modelling effects of temperature changes on the behavior of golden apple snails
PARK, Young-Seuk
Kyung Hee University
- 11:40 - 11:55 O2-3 Three-dimensional modeling of basin-scale motions in a deep and stratified lake
CHUNG, Sewoong (invited)
Chungbuk National University
- 11:55 - 12:10 O2-4 Modeling buoyancy control and surface bloom of *Microcystis* in a stratified reservoir
CHUNG, Sewoong (invited)
Chungbuk National University
- 12:10 - 12:25 O2-5 The effect of flood frequency and edaphic condition on the nitrogen fixation at the flood
plain
ASAEDA, Takashi
Saitama University

Oral Session-3. Management of freshwater ecosystem

Time: 2014. 08. 25. Monday. 13:30 - 15:30

Room: Diamond

Convener: CHOUNG, Yeonsook (*Kangwon National University , Korea*)

KIM, Hyun Woo (*Sunchon National University , Korea*)

- 13:30 - 13:45 O3-1 Total phosphorus thresholds for regime shifts are nearly equal in subtropical and temperate shallow lakes with moderate depths and areas
WANG, Haijun (invited)
Institute of Hydrobiology, Chinese Academy of Sciences
- 13:45 - 14:00 O3-2 Status report on wetland plants occurring in Korean Peninsula
CHOUNG, Yeonsook (invited)
Kangwon National University
- 14:00 - 14:15 O3-3 Effect of hydrologic condition on phytoplankton succession in Lake Poyang, the biggest freshwater lake in China
CHEN, Yuwei
Chinese Academy of Sciences
- 14:15 - 14:30 O3-4 The influence of the weir on the community shift of zooplankton in the middle part of Yeongsan River, Korea
KIM, Hyun Woo (invited)
Sunchon National University
- 14:30 - 14:45 O3-5 Trends in a satellite-derived vegetation index and its relationship with environmental variables in the restored lagoon system: Chilika lagoon, India
KIM, Ji Yoon
Pusan National University
- 14:45 - 15:00 O3-6 Assessment of the lake biomanipulation mediated by piscivorous rainbow trout and herbivorous daphnids using self-organizing map: a case study in Lake Shirakaba, Japan
HA, Jin-Yong
Toyama Prefectural University
- 15:00 - 15:15 O3-7 Impact of large-scale weir construction on the fish community structure and diet of top-predator fish in a large river ecosystem (Nakdong River, S. Korea)
JO, Hyunbin
Pusan National University
- 15:15 - 15:30 O3-8 Effects of added nutrients on the early growth of *Pueraria lobata* in the floodplain of a regulated river
RASHID, Md Harun
Saitama University

Oral Session-4. Application of stable isotopes in aquatic ecology and environment

Time: 2014. 08. 25. Monday. 13:30 - 15:30

Room: Emerald

Convener: SHIN, Kyung-Hoon (*Hanyang University, Korea*)

SAKAI, Yoichiro (*Kyoto University, Japan*)

- 13:30 - 13:45 O4-1 Application of stable isotopes to examine life history of benthic aquatic organism: implication from research on ontogeny of marine benthic organism
WON, Nam-II
Korea Water Resources Corporation
- 13:45 - 14:00 O4-2 Tracing the environmental change in artificial lake Shihwa: the application of $\delta^{13}\text{C}$, $\delta^{15}\text{N}$, $\delta^{34}\text{S}$ isotope analysis
KIM, Min Seob
Environmental Measurement & Analysis Center
- 14:00 - 14:15 O4-3 Intraspecific differences in vertical habitat and food utilization by crustacean zooplankton: stable isotopic evidence
SAKAI, Yoichiro
Kyoto University
- 14:15 - 14:30 O4-4 Summer monsoon effects on trophic source shifts in diets of secondary producers in a shallow reservoir food webs, Korea: Evidence from stable C-N isotopes
OCK, Giyoung
Hanyang University
- 14:30 - 14:45 O4-5 Effect of the monsoon on the food web structure according to the size of reservoir; Application of C and N stable isotope ratio
GAL, Jong Ku
Hanyang University
- 14:45 - 15:00 O4-6 Feeding strategy of nutria (*Myocastor coypus*) as semi-aquatic herbivore on off-season using stable isotope analysis
HONG, Sungwon
Pusan National university
- 15:00 - 15:15 O4-7 Characteristics of multiple organic matter sources in the upstream waters of an artificial coastal lake (Shihwa), Korea
LEE, Yeonjung
Hanyang University
- 15:15 - 15:30 O4-8 Trophic position of aquatic organisms determined by nitrogen stable isotope of individual amino acids
SHIN, Kyung-Hoon (invited)
Hanyang University

**Oral Session-5. Microbial processes in limnetic systems with special reference to biodiversity,
food web dynamics and material cycling**

Time: 2014. 08. 26. Tuesday, 10:40 - 12:40

Room: Diamond

Convener: NAKANO, Shin-ichi (*Kyoto University, Japan*)

SHEN, Hong (*Chinese Academy of Sciences, China*)

- 10:40 - 10:55 O5-1 Microbial ecology in Lake Biwa with special reference to production and decomposition of dissolved organic matter
NAKANO, Shin-ichi (invited)
Kyoto University
- 10:55 - 11:10 O5-2 Response of *Daphnia magna* population growth to differential algal food provision
JEONG, Kwang-Seuk
Pusan National University
- 11:10 - 11:25 O5-3 Ecological importance of kinetoplastid flagellates in the hypolimnion of Lake Biwa with special reference to the limitation of molecular techniques
MUKHERJEE, Indranil
Kyoto University
- 11:25 - 11:40 O5-4 The role of heterotrophic bacteria in the formation of *Microcystis* colonies
SHEN, Hong
Chinese academy of Sciences
- 11:40 - 11:55 O5-5 Diversity of zooplankton with spatial and temporal dispersion in irrigation reservoir
JEONG, Hyungi
National Institute of Environmental Research
- 11:55 - 12:10 O5-6 Seasonal variation of coastal zooplankton community in a eutrophic-brackish reservoir, Saemangeum
NAKANO, Sho
Kyung Hee University
- 12:10 - 12:25 O5-7 Bacterial community composition and enzyme activities from Yasu River to Lake Biwa, Japan
FUJINAGA, Shohei
Kyoto University
- 12:25 - 12:40 O5-8 A study of the distribution and behavior pattern of pelagic- and epiphytic cladoceran associated with macrophyte types using field and microcosm approaches
*CHOI, Jong-Yun
Pusan National University

Oral Session-6. River ecosystem health assessment: the value in the management and restoration

Time: 2014. 08. 26. Tuesday. 10:40 - 12:40

Room: Emerald

Convener: HWANG, Soon-Jin (*Konkuk University, Korea*)

JANG, Min-Ho (*Kongju National University University, Korea*)

- 10:40 - 10:55 O6-1 Prospects of using aquatic ecosystem health assessment to support water environment management in Korea
HWANG, Soon-Jin (invited)
Konkuk University
- 10:55 - 11:10 O6-2 Biodiversity, assemblage structure and environmental relation of macroinvertebrates in Korean streams and rivers
JUN, Yung-Chul
Konkuk University
- 11:10 - 11:25 O6-3 Aquatic ecosystem health 'of the people, by the people and for the people'; application of citizen science in management and conservation of the rivers and streams
PARK, Jung-Hwan
Konkuk University
- 11:25 - 11:40 O6-4 Testing the non-linear relationship between water quality and urban land uses using Generalized Additive Model
HWANG, Sun-Ah
Konkuk University
- 11:40 - 11:55 O6-5 Characterizing spatial and temporal changes of biological indices in Korean streams
KWON, Yong-Su
Kyung Hee University
- 11:55 - 12:10 O6-6 Evaluation of Korean stream characteristics using Habitat and Riparian Index (HRI) : past accomplishment and future direction
JOO, Gea-Jae
Pusan National University
- 12:10 - 12:25 O6-7 Distribution patterns of Korean freshwater fish in relation to environmental gradients
LEE, Jin Woong
Kongju National University University
- 12:25 - 12:40 O6-8 Diagnostic evaluation of the rivers based on the riparian vegetation in Korea
LEE, Chang Seok
Seoul Women's University

Oral Session-7. Ecology and biology of freshwater biota

Time: 2014. 08. 26. Tuesday. 14:00 - 16:00

Room: Emerald

Convener: LEE, Eun Joo (*Institute of Korean Algaetech , Korea*)

KANG, Myounghee (*Gyeongsang National University , Korea*)

- 14:00 - 14:15 O7-1 Exploratory methodology for understanding fish length and their swimming pattern using an acoustic camera and echo sounder
KANG, Myounghee (invited)
Gyeongsang National University
- 14:15 - 14:30 O7-2 New sight on genesis of the Lake Biwa malacofauna
PROZOROVA, Larisa
Institute of Biology and Soil Science FEB RAS
- 14:30 - 14:45 O7-3 Changes of phytoplankton community in Kyoungpo lake
LEE, Eun Joo (invited)
Institute of Korean Algaetech
- 14:45 - 15:00 O7-4 Impact of a land-based fish farm effluent discharges on rotifer community in a shallow lake in the Yangtze River basin, China
WANG, Qidong
Chinese academy of sciences
- 15:00 - 15:15 O7-5 Environmental factors affecting germination of akinete of *Anabaena* and cellular regrowth of *Microcystis*
PARK, Chae-Hong
Konkuk University
- 15:15 - 15:30 O7-6 Evaluation of the oxidative stress in submersed macrophyte; *Myriophyllum spicatum* in response to oxygen redox potential in substrate sediments
*ATAPATHTHU, Keerthi
Saitama university
- 15:30 - 15:45 O7-7 Response of physico-chemical characteristics of pond water in fish production and algal growth in northern Bangladesh
ISLAM, Md. Jahidul (invited)
Hajee Mohammad Danesh Science and Technology University
- 15:45 - 16:00 O7-8 East Fork Owyhee River Salmon and Steelhead Recovery Project
SEO, Jinwon (invited)
Director of Fish, Wildlife, & Parks Dept. in Shoshone-Paiute Tribes

Oral Session-8. Eutrophication Processes in Lake and Reservoir

Time: 2014. 08. 26. Tuesday. 16:20 - 18:20

Room: Diamond

Convener: ZHU, Guangwei (*Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences, China*)

JOO, Gea-Jae (*Pusan National University, Korea*)

- 16:20 - 16:35 O8-1 Response of phytoplankton to nutrient reduction in Shahe Reservoir, China
*ZHU, Guangwei (invited)
Chinese Academy of Sciences
- 16:35 - 16:50 O8-2 Water usage and water quality of several types of artificial water storage ponds in the
urban and rural area of Khulna, Bangladesh
NAKAJIMA, Jun (invited)
Ritsumeikan University
- 16:50 - 17:05 O8-3 The physiological responses of *Vallisneria natans* to epiphytic algae with the increase of
N and P in water bodies
SONG, Yuzhi
Nanjing University of Information Science & Technology
- 17:05 - 17:20 O8-4 The effects of temperature and light conditions on the buoyancy of a harmful
cyanobacterium *Anabaena circinalis*
KWON, DaeRyul
Konkuk University
- 17:20 - 17:35 O8-5 Nutrients and chlorophyll a responses to water level fluctuations in Poyang Lake: the
largest Yangtze River-connected lake of China
LIU, Xia
Chinese Academy of Sciences
- 17:35 - 17:50 O8-6 Research on the recruitment of cyanobacteria from the sediments in the eutrophic Shanzi
Reservoir
SU, Yuping
Fujian Normal University
- 17:50 - 18:05 O8-7 Annual Variation of nutrient and Chlorophyll-a and their driving factors in Lake Taihu
(China) based on daily observation
ZHU, Mengyuan
Chinese Academy of Sciences
- 18:05 - 18:20 O8-8 A scientometric study of the ISRLE society: inference of research collaboration and
core topics based on publication network
JOO, Gea-Jae (invited)
Pusan National University

Oral Session-9. Convergence of Geoscience and Aquatic science

Time: 2014. 08. 26. Tuesday. 16:20 - 17:50

Room: Emerald

Convener: LIM, Jaesoo (*Korea Institute of Geoscience and Mineral Resources, Korea*)SEO, Jinwon (*Director of Fish, Wildlife, & Parks Dept. in Shoshone-Paiute Tribes, USA*)

- 16:20 - 16:35 O9-1 Variations of total, dissolved, and particulate Hg concentration affected by rain event at the Three Sites in Korea
CANCEL KIM, Pyungrae
Kangwon University
- 16:35 - 16:50 O9-2 Holocene environmental change at the southern coast of Korea and its link to monsoon and sea-level changes
LIM, Jaesoo
Korea Institute of Geoscience and Mineral Resources
- 16:50 - 17:05 O9-3 Distribution and source of uranium in Okinawan rivers, Japan
*MOCHIZUKI, Akihito
Kyoto University
- 17:05 - 17:20 O9-4 Comparison of the lipid content and fatty acid profiles of topmouth culter (*Culter alburnus* Basilewsky) populations in six lakes, China
FAN, Hourui
Chinese academy of sciences
- 17:20 - 17:35 O9-5 Efficiency of two different types of fishway, Ice-harbor and nature-like type, installed in the Geum River, South Korea
BAEK, Seung Ho
Kongju National University
- 17:35 - 17:50 O9-6 Detecting a potential for toxin and off-flavor material production of cyanobacteria using molecular genetic methods
KIM, Keonhee
Konkuk University

Water quality and feeding management in fishponds on the Mekong Delta, Vietnam

Yoshiko Iizumi^{1*}, Thuan Cong Nguyen², Taro Izumi³

¹Crop, Livestock and Environment Division, Japan International Research Center for Agricultural Sciences (JIRCAS), Ibaraki, Japan

²College of Environment and Natural Resources, Can Tho University (CTU), Can Tho, Vietnam

³Rural Development Division, Japan International Research Center for Agricultural Sciences (JIRCAS), Ibaraki, Japan

To make efficient use of limited natural resources including agricultural land, the mixed farming system known as VAC¹⁾ is popular in Can Tho City, Vietnam. Can Tho is the largest city on the Mekong Delta and its sewer penetration rate is low in outlying areas. Piggery waste and human sewage from each household are usually discharged into a pond and subsequently flow into a public canal. Recently, a biogas digester (BD) that treats piggery sewage by anaerobic fermentation has become popular among VAC farmers. Effluent from BDs also flows into public canals from private ponds. These ponds are one of the most important sources of nutrients in the public water body. The aim of this study is to determine the water quality of fishponds and to present options for fishpond management that will reduce the effects on the environment.

Field surveys were conducted in rural areas of Can Tho City from November 2012 to April 2013. Sixty pond-water samples were taken (30 samples from VAC farming and 30 from VACB [VACB: VAC+BD] farming systems) and the following parameters were measured: nitrate, nitrite, ammonium, chlorophyll, pH, electrical conductivity (EC), water temperature, and UV and visible light absorbance. Each household completed a questionnaire about agricultural activities. Fish and fish feed samples were taken from three fishponds and one river in a national park to measure stable isotope ratios of carbon and nitrogen to analyze feeding habit of farmed fish (snakeskin gourami).

The average concentration of dissolved ammonium in pond water was 14.9 mg L⁻¹; the nitrate and nitrite concentrations of more than two-thirds of pond-water samples were below the determination limits of the equipment (RQflex, Merck). (The determination limits of nitrate and nitrite are 3 mg L⁻¹ and 0.5 mg L⁻¹, respectively.) The use of a BD reduced the environmental load of piggery waste to waters, as the ammonium concentrations and UV absorption values of VAC farming ponds were higher than those of VACB farming ponds. Isotope analysis indicated that commercial pelleted feed contributed more to the growth of farmed fish than did rice bran. Rice bran has a relatively low coefficient of digestibility, in spite of its wide and long-term use in fish and pig farming.

To reduce the aquatic impacts of pig and fish farming, it is suggested that: (i) piggery waste is discharged into fishponds after treatment by BD; and (ii) fish feed with a high coefficient of digestibility is used to feed farmed fish.

¹⁾ VAC is an acronym formed from three Vietnamese words: *Vuon* – orchard or garden, *Ao* – fishpond, and *Chuong* – animal shed.

01-2

Freshwater ecosystems of the south of the Russian Far East in conditions of a changing climate

Victor V. Bogatov

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RUSSIA

The Russian Far East is mainly a mountainous region, where plains and lowlands make up less than 25% of its territory. South of the Russian Far East is located in a monsoon climate zone. Freshwater ecosystems of the region are under the influence of the extreme environmental phenomena (especially catastrophic floods, draughts and river-bed freezing) that define the characteristics of their structure-functional organization. The regular alternation of low and high water periods favorably influences the general ecological situation in the rivers and the bottomland lakes. Such alternation allows support for rather high biological diversity of freshwater communities. It is expected that in the 21st century global changes (deforestation due to logging and fires, global warming, etc.) will change the natural cycles of flooding, likely increasing the strength of floods, but decreasing the likelihood of heavy showers during the dry season. At the same time we know that major floods can lead to the rapid depletion of river phytoplankton and zoobenthos, and can cause long-term mean water hyper-eutrophication (mass development of algae) in water bodies. Higher water temperatures can cause thermal shock and massive loss of Pacific salmon spawning grounds. Drier summers will increase the likelihood of forest fires, lowering water regimes of rivers and increasing nutrient load in the water. The loss of forest cover due to logging and fires will change the water balance, which in turn will cause an imbalance of nutrients within ecosystems with rivers drying, fish spawning grounds drying in summer, and freezing in winter. With changing thermal regimes water turbidity will also increase. In the face of global environmental change, increasing anthropogenic pressures and in the absence of protective measures it is expected that there will be significant loss of biodiversity of freshwater biota of the south of the Russian Far East, with the reduced water quality and the loss of valuable fisheries, increasing contamination of commercially important species with helminthic parasites and increasing number of invasive species in aquatic ecosystems.

Dissolved iron concentration in rivers throughout Japan and GIS analysis of geographical factors

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¹Tokyo University of Agriculture and Technology, Tokyo, Japan

²Gifu University, Gifu, Japan

³Hokkaido University, Hokkaido, Japan

Iron is a limiting nutrient that controls primary production in a certain oceanic areas. The transport by river can be an important process to supply iron in the ocean. Forest is believed to act as a key function where iron is solubilized with humic substances. However, there have been few studies that discuss dissolved iron transport from forested watersheds. It remains clarified how different the dissolved iron concentration is among rivers and which properties of land are important to control the river transport. The present study investigates the distribution of dissolved iron concentration in rivers throughout Japan by exploiting an existing data and from a field survey of ourselves. The geographical factors in watershed that majorly controls river dissolved iron concentration are analyzed by using GIS (geographical information system). The results showed a large variation of dissolved iron concentration among rivers as much as two orders of magnitude and their regional distribution. Dissolved iron concentration had no relationship with forest coverage, but showed a significant increase with the increase in peat soil area and the increase in the area of gentle slope (0 - 1°). Different relationships were found between snowy and non-snowy areas. The results in the present work suggest that the important landscape site to produce dissolved iron is low flat land where reductive condition prevails.

01-4

Sediment in Lake Soyang as integrating archive of catchment processes and potential effect on lake water quality

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¹Department of Hydrology, University of Bayreuth, Bayreuth, Germany

²Department of Environmental Science, Kangwon National University, Chuncheon, Korea

³Institute for Landscape Ecology, University of Muenster, Muenster, Germany

This Lake Soyang is the largest dam in South Korea and has an important meaning for the supply of drinking water. Lake Soyang is a warm monomictic. The water body is stratified by density difference during summer. During stratification oxygen depletion occurs in the hypolimnion through decomposition of organic matter. In these conditions, phosphate, N₂O and CH₄ can be released from sediment. Korea has a monsoon climate. In monsoon season with high rainfall, a large amount of terrestrial materials, including nutrients and organic matter flows into the lake from watershed. We hypothesize that the processes controlling the water quality in the lake are strongly related to the climate. During the monsoon period lake water quality is controlled by external processes. On the other hand, during the non-monsoon period, the lake is controlled by internal processing. The purpose of this study is to understand the extent to what catchment processes affect the nutrient dynamics in the Lake.

We hypothesize that materials released from the sediment, which are formed under anoxic condition and become distributed to the entire water body during the mixing period and can impact the water quality during dry season. In contrast, external input during the monsoon season with high loads of nutrients and carbon which mainly depend on catchment process will control internal sediment process and composition during the monsoon season quality.

How do weather extremes affect subtropical lake metabolism in a changing climate? An answer to episodic lack of monsoons in Taiwan

Jeng-Wei Tsai¹ *; Chih-Yu Chiu² *

¹ Department of Biological Science and Technology, China Medical University (Taiwan)

² Research Center for Biodiversity, Academia Sinica, Taipei, Taiwan

We investigated how an episodic lack of winter and spring monsoons, as an extreme weather event, would affect the dynamics of ecosystem metabolism in a mesotrophic, seepage shallow lake in northeastern Taiwan. A permanent wireless sensor network provided high-frequency free-water dissolved oxygen, water temperature profiles and meteorological data, which we used to estimate daily values of gross primary production (GPP), ecosystem respiration (R), and net ecosystem production (NEP). Results revealed that the disappearance of monsoons *decreased* lake volume, condensed waterborne nutrients, stimulated the development of algal biomass, promoted stratification, and resulted in the regime shift in lake metabolism. Pelagic GPP and R both initially stimulated, followed by abrupt collapses due to the stronger stratification of water column. The lake was characterized by a rapid metabolic shift from heterotrophy to a highly autotrophic status when the water level ebbing to the lowest level. Autotrophy of the lake profited from a greater decline in R instead of stimulating the GPP. *The lost of priming effects in heterotrophic process by benthic photosynthetically produced DOC might describe stronger R declines of the lake in droughts.* This study implicated that *controlling waterborne nutrients could be important to make the lake ecosystems less susceptible to a predicted dryer and warmer climate or anthropogenic water withdraw in subtropical areas.*

Keywords: ecosystem metabolism, subtropical lake, trophic status, high-frequency measurement, autotrophication, drought

O2-1

Modelling physical and chemical processes in lakes: Opportunities enabled by GLEON

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Advances in modelling physical and biological processes in lakes are frequently hindered by sparse observations that compromise model forcing data inputs and decrease the rigor of comparisons with simulation output. The Global Lake Ecological Observatory Network (GLEON) collects, shares and interprets high-resolution lake sensor data. It could therefore play a key role in addressing these deficiencies and enabling a robust model testing process. The objective of this paper is to illustrate some of these opportunities and to show how interdisciplinary networks can greatly enhance model boundary-setting and validation processes far beyond typical grab sample methods. Without having made every effort to accurately prescribe these model boundary conditions, calibration becomes a largely theoretical exercise, and of limited value to support a good predictive model. Many aquatic ecological models require inflow, outflow and meteorological data input at daily frequency and sometimes more highly resolved in the case of meteorological data. This requirement may itself necessitate further independent modelling to optimize the specification of boundary conditions.

Data from sensors deployed *in vivo* or from satellites offer unprecedented opportunities to rigorously test the validity of model algorithms and calibrated parameters, and substantially improve the statistical significance of relationships between observed and simulated data. Remote sensing data, corrected for atmospheric effects and properly ground-truthed, can provide highly suitable validation data across the surface horizontal domain of lakes for a range of optically active constituents (e.g. temperature, clarity and chlorophyll) yet there are relatively few published examples of linking remote sensing with lake models.

A similar situation exists with application of high-frequency sensor data for calibration of aquatic ecological models. High-frequency sensor data are rarely used for comparative purposes but can greatly enhance the range of statistical approaches available to assess the validity of model fit. For example, spectral analysis can be used to ensure that the dominant frequencies observed in model output match those of the sensor data.

With so much acquisition of high-frequency sensor data taking place in lakes around the world, including rapidly evolving chemical and biological sensors, and with GLEON acting as a laboratory for synthesis and coordination of these data, there is an excellent opportunity to make major improvements in some of the underlying process algorithms in aquatic ecological models. Ultimately we should expect some major improvements in the predictive power of these models.

Modelling effects of temperature changes on the behavior of golden apple snails

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Temperature is one of main factors influencing biology and ecology of organisms including their behavior and spatial distribution. In particular, it is critical for invasive species to colonize in new habitats or areas. Invasive species, once successfully introduced and established in a new area, are hard to be eradicated. Thus, it is essential to understand the mechanism and processes of such biological invasions. Golden apple snail (*Pomacea canaliculata*) is an exotic species in Asian countries, which was introduced from the tropical and temperate South America and has become a serious agricultural pest, especially to young rice. In this study, we evaluated the effects of temperature changes on the behavior of golden apple snails at four different water temperatures based on Markov chain, Shannon entropy, and Random forest model. Markov chain revealed that golden apple snails maintained their previous behavior at the lowest water temperature, while behavior transition tended to be higher at the highest temperature. Shannon entropy was the lowest at 15°C, indicating that golden apple snails continued their previous behavior for a long time, regardless motion or motionless behavior, or their behaviors was less diverse. The results concluded that golden apple snails controlled their behaviors to minimize their thermal stress and optimize their metabolic rate. Further, computation methods such as Shannon entropy, Markov chain, and Random forest model could contribute to quantify the effects of temperature on the behaviors of golden apple snails.

O2-3

Three-dimensional modeling of basin-scale motions in a deep and stratified lake

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Physical mixing processes drive energy flow, mass transport, particle dynamics, and water quality in a lake. The energy conveyed by the wind to a stratified lake leads to basin-scale motions, which provide a major driving force for vertical and horizontal mixing in stratified lakes. Thus, physical processes need to be accurately modeled for the correct simulation of the dissolved and particulate contaminants, nutrients, and algae dynamics in the lakes. A three-dimensional (3D) hydrodynamic model is applied to model Lake Tahoe, USA, and is compared with field data under summer stratification and winter mixing conditions to identify and illustrate the spatial structure of the basin-scale motions including internal waves and gyres, and to validate the model. Lake Tahoe is located at the crest of the Sierra Nevada mountain range, between California and Nevada at an altitude of 1898 m. It has a maximum depth of 501 m, and an average depth of 313 m, making it the 11th deepest in the world. In summer, the lake is stable and shows strong density stratification, while it is characterized by the occurrence of a weak, evolving stratification and large vertical motions driven by storm events in winter. The model solves the unsteady Reynolds-averaged Navier-Stokes equations with hydrostatic pressure assumption using a semi-implicit method. The vertical Reynolds stress terms and combined turbulent fluxes in momentum and transport equations are modeled with a 3D mixed-layer approach derived from the mixing energy budgets. The model properly simulated the thermo-hydrodynamics and associated basin-scale motions in the lake. The results demonstrated that the model well represents the depth of the mixed-layer that allows the internal waves to be energized correctly at the basin scale. Both the model results and observed thermistor chain data identify the presence of Kelvin modes and Poincaré mode waves. The simulated wave periods were consistent with theoretical predictions and the previous studies. The lake was weakly stratified during the winter, and produced large amplitude (up to 60 m) internal oscillations with periods approaching 132 hours during the study period. The results revealed that, as indicated with the low (< 1) Lake Numbers, one-dimensional modeling approach may not be suitable for representing the full range of motions during the cooling period when basin-scale internal waves and gyres motions are significant. This suggests that the use of 3D model to guide field experimentation and to predict water quality should be considered .

Modeling buoyancy control and surface bloom of *Microcystis* in a stratified reservoir

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Development of cyanobacteria bloom in the surface waters of lakes and reservoirs causes a serious problem for drinking water supply system because some species releases toxins into the water in the form of hepatoxin and microcystin that are often fatal for many aquatic organisms. In Daecheong Reservoir located in Geum River basin of Korea, an excessive growth of cyanobacteria mainly overwhelmed by *Microcystis aeruginosa* (hereafter *Microcystis*) has been a nuisance problem for last two decades. Despite diverse efforts including physical, chemical, and biological countermeasures have been implemented to control the bloom, the issue is still pending. A coupled hydrodynamic and ecological modeling can be used to interpret field data, understand the underlined physical and biogeochemical processes of the bloom events, and lastly as a management decision support tool once the model has been validated. The three-dimensional coupled hydrodynamic and ecological model, ELCOM-CAEDYM, was extended to include buoyancy control dynamics for cyanobacteria, and applied to the reservoir and validated with field data. The model was used to explore the interplay of dynamic physical and biological processes in determining the temporal and spatial variability of *Microcystis* biomass during an intense mono-specific bloom event. The model reproduced the temporal and spatial variability of the water temperature, nutrient concentrations, and the spatial heterogeneity of algal biomass. Simulation results indicated that the physical processes, particularly inflow mixing, played a dominant role in determining the spatial heterogeneity of *Microcystis* biomass and that correlated with the vertical and horizontal variations of the nutrient concentrations. In addition, the shallow mixed layer depth relative to the euphotic depth under a stable thermal stratification provided a perfect physical habitat for the dominance of the cyanobacteria relative to other species, due to their buoyancy control capability. During periods of low wind velocity less than 4 m/s when the mixed layer was shallow, the bloom-forming *Microcystis* maintained a competitive advantage over non-buoyant algae groups. Inclusion of the buoyancy control function within the coupled physical-ecological model considerably improved the model predictability by capturing the surface bloom and the shift of dominant species from green algae to cyanobacteria. The coupled modeling approach markedly improved the prediction of not only the surface algal bloom, but also the total productivity of algal biomass in the reservoir. The results demonstrate that inclusion of the physiological feature of specific algal species can be critical to improve model performance and better reproduce the real bloom processes in stratified waterbodies.

02-5

The effect of flood frequency and edaphic condition on the nitrogen fixation at the floodplain

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River floodplains are disturbed and nitrogen (N) limited ecosystems. Symbiotic N fixation is an important source of N in floodplain soils, especially in the earlier stage of succession. Since the flooding disturbance affects the floodplain ecosystems, we assumed that symbiotic N fixation in a floodplain site would also be highly dependent on the elevation. To test this hypothesis, we collected samples of soil and plants, *Pueraria lobata*, *Robinia pseudoacacia*, and *Albizia julibrissin*, and non N-fixing species nearby, from several quadrats of the midstream flood plain of Tama river in Tokyo subject to different magnitude of flood disturbances. Nitrogen, phosphorus (P) and carbon (C) concentrations of soil and plants, soil pH, soil particle size, and nitrogen stable isotope ratio of soil, water and plant samples were measured. Fraction of fixed N in the plant tissues was obtained by the natural abundant method. Soil carbon and nitrogen contents had significant positive correlations with site elevation, i.e. negatively correlated with frequency of the flood inundation. Soil phosphorus content was nearly homogeneous. Soil pH values ranged between 6.0 and 7.23 at low elevation sites; whereas the values were lower and ranged between 5.16 and 6.81 at high elevation sites. There was a significant difference ($p < 0.001$) in N fixation among sampling points, which suggests that flooding disturbance affects the process. Low elevation sites which are inundated more than once a year, N fixation takes place extensively if total N (TN) is $\leq 0.3\%$ and $TN/TP < 2$, and, plants can derive more than 80% of their total N requirement from atmosphere. Sites which are inundated less than once in three years, the fraction substantially decreased to nearly zero if $N > 0.5$ and $TN/TP \sim 6$. Site elevation or frequency of floods directly affected soil characteristics, especially nitrogen and carbon content.

Therefore, it can be concluded that site elevation or flood pulses affect the symbiotic N fixation in a floodplain by modifying the edaphic factors.

Total phosphorus thresholds for regime shifts are nearly equal in subtropical and temperate shallow lakes with moderate depths and areas

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Published research suggests that the total phosphorus (TP) thresholds for the regime shifts between a clear-water state dominated by submersed macrophytes and a turbid-water state dominated by phytoplankton in shallow lakes vary with forms of lake basins and climates. However, such hypotheses remain untested by direct field evidence. We therefore tested the hypotheses with empirical data from subtropical lakes on the Yangtze floodplain and also from other lakes in temperate to tropical zones. TP thresholds were found to vary little at moderate depths, but to decrease notably when depth exceeds a level of probably 3-4 m, and increase sharply when depth is below a level of around 1-2 m. TP thresholds were found to be nearly equal in shallow lakes ($1-2 \text{ m} < \text{mean depth} < 3-4 \text{ m}$; $0.1 \text{ km}^2 < \text{area} < \text{at least } 350 \text{ km}^2$) from temperate to subtropical (probably to tropical) zones, being 80-120 mg m^{-3} for the forward shift from a clear-water state to a turbid-water state and 40-60 mg m^{-3} for the backward shift. The threshold of turbidity for the forward shift was found to be higher than that for the backward shift, amending the previous hypothesis of the equality of turbidity thresholds for both shifts. Our findings suggest that, according to the subequality of TP thresholds, similar target concentrations for in-lake TP can be set in most shallow lakes world-wide to mitigate eutrophication.

O3-2

Status report on wetland plants occurring in Korean Peninsula

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Plant species occur within a certain range of a wide spectrum of habitats associated with water. Obligate wetland plants, which inhabit water, are an extreme. Obligate upland plants, which inhabit forests or dry meadows, occupy the other extreme. Various plant species have been established between the two extremes. Therefore, although categorizing plants occurring over a continuum of water conditions is artificial, it is useful information for protecting, restoring and assessing wetlands. We classified all vascular plant species occurring in the Korean Peninsula into five categories, obligate wetland plants (OBW), facultative wetland plants (FACW), facultative plants (FAC), obligate upland plants (OBU) and facultative upland plants (FACU), based on their frequency of occurrence in wetlands, adopting the Ramsar definition. The decision for the category of each species was made from a group discussion among us with reference to the literature and field experience. Among five categories, OBW and FACW were further divided by degree of wetness into hygrophytes and aquatic macrophytes. Aquatic macrophytes were subdivided into four types by plant morphology. Among 4,055 taxa of vascular plants (3,744 native and 281 naturalized) occurring in Korean Peninsula, 441 wetland plant taxa inhabit, which comprises 11% of vascular taxa. Out of 441 taxa, OBW and FACW are 202 and 239 taxa, respectively. Upland plants are found to be 3,441 taxa (3,248 OBU and 193 FACU), which comprise 85%. It clearly shows the land characteristics of the Korean Peninsula. In relation to the habitat, 41% of all taxa (1,675) occurs in forests, and 46% (1,851 taxa) occurs in relatively open habitats such as mesic or dry grasslands, or shrublands. 10% (393 taxa) were mainly found to occur in wet meadows such as riparian zones, littoral zones, coastal zones, marsh or moors. The rest 142 taxa (4%) inhabit waters. Thus 63% and 32% of wetland plants are being distributed in wet meadows and aquatic environments, respectively. Out of 142 taxa inhabiting waters, 61 are emerged plants and comprises the highest percentage with 43%, followed by submerged plants (25%; 35 taxa), floating-leaved plants (22%; 31 taxa) and floating plants (11%; 15 taxa). Herbs comprise 93% of wetland plants. The percentage of woody plants reaches 7%. Wetland plants classified includes 6 out of 64 taxa classified as endangered taxa by The Ministry of Environment, such as *Drosera peltata* var. *nipponica* and *Menyanthes trifoliata* and 63 out of 586 taxa classified as rare taxa by Korea Forest Service. We classified all 4,055 plant taxa occur in Korean Peninsula based on qualitative study with reference to literature and field experience. The results of this study are expected to be useful to preserve and to restore wetland plant species and wetlands, to create artificial wetlands and to compare and to assess wetland ecosystems in Korea.

Effect of hydrologic condition on phytoplankton succession in Lake Poyang, the biggest freshwater lake in China

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Phytoplankton biomass, community composition in different hydrological stages in Lake Poyang were studied using the monitoring data from 2009 to 2014. The water physical and chemical characteristics were also measured. Our results showed that phytoplankton biomass increased gradually, especially after 2012, the phytoplankton biomass reached 94.91 mg l^{-1} in decreasing-water period. Bacillariophyta species are generally dominant in Lake Poyang, constituting more than 50% of the total phytoplankton biomass, except from July 2009 (26%) and January 2012 (35%). Mean values for phytoplankton biomass had higher values in increasing water period (32.75 mg l^{-1}) and decreasing water period (26.26 mg l^{-1}) than in low-water period (21.95 mg l^{-1}) and high-water period (19.40 mg l^{-1}). Chlorophyta / Bacillariophyta ratio has a seasonal pattern in 2009-2011. But after 2012, the distribution of Chlorophyta / Bacillariophyta ratios was different from the former years, with mass developments of Cyanophyta. In low-water phases, Chlorophyta / Bacillariophyta ratio was lower, while it was higher in increasing water phases and high-water phases. Phytoplankton biomass was positively correlated to transparency, pH, ORP and concentration of orthophosphates, and negatively correlated to concentrations of suspended solids. Chlorophyta / Bacillariophyta ratio was positively correlated to transparency, temperature, ORP of water, and negatively correlated to electrical conductivity, dissolved oxygen, turbidity, salinity, suspended solids of water and concentration of TN and TP. These results indicated that hydrological condition clearly played an overall impact on phytoplankton community composition in Lake Poyang, through affecting the lake water physical and chemical characteristics.

03-4

The influence of the weir on the community shift of zooplankton in the middle part of Yeongsan River, Korea

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We evaluated the effect of weir construction on the changes of zooplankton community during the study periods (2004~2013). Zooplankton biomass differed significantly at sampling sites after construction of two weirs in the middle part of the river. The proliferation timing of the species (e.g., *Polyarthra vulgaris*, *Brachionus calyciflorus*) and community level (e.g., cladocerans) was slightly different before and after weir construction. Maximal zooplankton community abundance generally occurred in spring and autumn, although there were inter-annual variation in it was density peak timing. There was considerable longitudinal variation in total zooplankton biomass since 2010. In addition, patterns in growth rates of the major zooplankton community were different in both weirs systems. Among major zooplankton community, high densities of cladocerans (e.g., *Moina macrocopa*) were found in upper river stretch of weir, while those of copepods were found in lower river stretch of weir. The present study propose that weir construction controlling the extent of inshore retention may be of major significance in regulated river with environmental factors regulating substantial zooplankton growth in the middle part of the river. Additionally, the results of the present study generally conform to the hypothesis of similar structure of zooplankton communities in river-reservoir hybrid system.

Trends in a satellite-derived vegetation index and its relationship with environmental variables in the restored lagoon system: Chilika lagoon, India

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In 1990s, Chilika Lagoon, the largest brackish lake ecosystem in the East-Asia, had severe problems with excessive dominance of freshwater exotic plants and rapid debasement of biodiversity, associated with decreased hydraulic connectivity between the lagoon and the ocean. To halt the degradation of the lake ecosystem, Chilika Development Authority implemented a restoration project that created a new channel penetrating the barrier beach of the lagoon in 2000, while evaluation for the restoration results did not consider continuous trend of biological components and its relationship with changing lagoon environments. Using satellite-derived Normalized Difference Vegetation Index (NDVI) dataset, we investigated the state of vegetation changes after the restoration of the lagoon from April 1998 to July 2013. SPOT Vegetation 10 day Synthesis (VGT-S10) products from April 1998 to July 2013 were used in the study. Time-series of NDVI data were decomposed into trend, seasonal, and random component using a local regression method. Their results were visualized to understand traits of spatial distribution in the lagoon. NDVI trend, indicative of primary productivity, was rapidly decreased at the restoration period and gradually increased (slope coefficient: 0.0024, $p < 0.05$) after two years of restoration. Seasonal peaks of NDVI were mainly observed at the beginning and end point of summer monsoon every year. Monthly changes of NDVI were influenced by water temperature, precipitation, salinity and nutrient concentration. We found sequential connections among NDVI, lagoon salinity, sea level pressure, and El Niño/Southern Oscillation. Higher El Niño/Southern Oscillation increased sea level pressure, and caused intrusion of sea water into the lagoon, and subsequently elevated salinity decreased annual mean NDVI. Our findings suggested that lagoon restoration plan for enhancing interconnectivity with ocean should further consider oceanographic effects due to meteorological forcing and long-term NDVI can be used for evaluation index for the adaptive management of restoration site.

O3-6

Assessment of the lake biomanipulation mediated by piscivorous rainbow trout and herbivorous daphnids using self-organizing map: a case study in Lake Shirakaba, Japan

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This paper focuses on assessing a lake biomanipulation and introduces self-organizing maps (SOM) as an analytical tool. In 2000, the biomanipulation using herbivorous plankters (*Daphnia galeata*) and piscivorous fish (*Oncorhynchus mykiss*) was implemented to improve water quality in Lake Shirakaba, Japan. We aimed to identify the relationships among dominant zooplankton and environmental conditions during the study period (pre-: 1997-1999, intermediate-: 2000-2002, and post-biomanipulation: 2003-2006, sampled between May and October on the biweekly basis, N=122). From the SOM, the limnological characteristics of the lake were categorized into five features. The results accommodated that the newly introduced non-native grazers, *D. galeata*, were well stabilized by introducing *O. mykiss* which helped *D. galeata* survive away from predation pressure of *Hypomesus transpacificus nipponensis*. The interplay and relationship between variables projected by the SOM was also supported by the previous research and evidences in compliance with competitions and predations. Hence the results manifest that a regime shift of zooplankton communities in this lake has occurred since the biomanipulation. Furthermore, the present study highlights the applicability of contemporaneous introduction of both top-down cascade regulators (i.e. *D. galeata* and *O. mykiss*) as an alternative choice for the successful biomanipulation

Impact of large-scale weir construction on the fish community structure and diet of top-predator fish in a large river ecosystem (Nakdong River, S. Korea)

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Habitat alteration (i.e. weir construction) affects aquatic community structure in the riverine ecosystems. Recently, large-scale weirs have been built in the main channels of the four large rivers in South Korea. Especially 8 large weirs (50% of total constructed weirs) implemented along the main channel of Nakdong River (300km of total 514km) during the late 2009 to 2011. Depth of the river changed from 1-2m to 6-7m while width of the river changed from 240-300m to 350-530m. To assess disturbance effects, we conducted an intensive seasonal fish survey and a molecular approach to determine diet composition of a top-predator fish (largemouth bass, *Micropterus salmoides*) in the Nakdong River main channel through the period of the 4-large river enhancement project (2005-2014). Obtained seasonal survey data from 3 sites were divided into three groups based on construction period (before 2005-2009, n=17; during 2010-2011, n=8; and after 2012-2014, n=10). The results indicated that overall state of fish condition (i.e. length-weight relationship and condition factor K) were good in before, poor in during, and average after construction periods. Species diversity declined steeply during the construction period and did not experience a reasonable recovery following the construction period. Total biomass of fish showed a pattern similar to species diversity; however, after construction period there was a slight increase. Specifically, exotic species increased steeply after construction but native species showed a different pattern when compared to exotic species. Interestingly, introduced species (i.e. *Opsariichthys uncirostris amurensis*) showed no construction impact on total biomass and fish condition. Comparison of top-predator diet (operational taxonomic units: OTUs) composition and number to construction period showed that the construction period impacted a number of OTUs found in the gut contents. There was a significant difference in number of OTUs in gut contents among the construction periods (ANOVA: $F=6.335$, $P=0.005$). Large-scale weir construction; therefore, not only influences the fish community but also has an effect on diet composition of top-predator fish in a large river ecosystem. These fish community and diet changes could be due to a qualitative and/or quantitative modification in benthic or planktonic production caused by habitat alteration in the large river ecosystem.

O3-8

Effects of added nutrients on the early growth of *Pueraria lobata* in the floodplain of a regulated river

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Pueraria lobata (kudzu), a fast growing invasive liana has out-colonized many pioneering species in riparian habitat of Japan in recent years. Being a symbiotic plant, it can grow in N-limited soil. We conducted a nutrient addition experiment in the floodplain of Tama River, Japan to observe its growth response to changed nutrient conditions. A fertilization study was conducted in Fuchu and Ohguri in a view to explore the limiting nutrient(s) for *Pueraria* in two distinct soil conditions. The soil of Fuchu is very poor in term of soil organic matter and moisture content, and available plant nutrients particularly nitrogen and phosphorus. We observed the early growth of *Pueraria* in response to nutrient addition. We also examined physiological parameter viz. total chlorophyll content in leaves since chlorophyll synthesis in plant is directly related to N availability of plants. It was found that in N-limited soil, though growth of the plant, in terms of stem length and diameter, leaf area and leaf chlorophyll content, was correlated with soil N availability, was not significantly restricted due to N-limitation. In N-rich soil, on the other hand, phosphorus was limiting nutrient for it. Since anthropogenic nutrient addition in riparian ecosystem is inevitable due to urbanization, this knowledge is important particularly for management of *P. lobata*.

Application of stable isotopes to examine life history of benthic aquatic organism: implication from research on ontogeny of marine benthic organism

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The ontogeny of an organism is very important ecological topic essential to understanding the population dynamics of the target organism and further the biological community where the species inhabit. However this topic is difficult to be demonstrated in the field and to need a lot of resources as a time-consuming work. Stable isotopes have been widely used to figure out a lot of ecological subjects. Especially, transition phases in aquatic organism and community have been successfully detected by stable isotope studies. Life history of an organism is composed of many different life stages possibly experiencing various ecological niches. Subsequently, the ontogenetic niche shifts of an target organism could be well examined by stable isotopes revealing its ecological traits such as potential primary food sources and species interactions at each life stage. This study reviewed recent studies on the ontogeny of marine benthic organisms to suggest the applicability of stable isotopes to examine life histories of benthic aquatic organisms. Abalone (*Haliotis* spp.) has two different life periods which are larval and benthic. During benthic period, abalone experience remarkably different benthic habitats which are crustose coralline algae (CCA) bed for early benthic life stages, red algae (mainly *Gelidium* sp.) bed for juvenile stage, and finally kelp bed for adult stage. Stable isotope studies have revealed that primary food sources have been shifted from egg yolk, benthic microalgae, red algae or small brown algae, and brown algae for larval, early juvenile, juvenile, and adult stages, respectively. The present results were well consistent with many previous experimental studies on the ontogeny of abalone. This study indicates that stable isotope ratios could be very promising tools to elucidate the ontogeny of benthic aquatic organisms in the field.

O4-2

**Tracing the environmental change in artificial Lake Shihwa :
the application of $\delta^{13}\text{C}$, $\delta^{15}\text{N}$, $\delta^{34}\text{S}$ isotope analysis**

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Stable isotopes has proved to be an extremely useful tool in elucidating many ecological problems. Stable isotopes can be used as environmental tracers in the following ways: (i) to identify sources, (ii) to distinguish sources, (iii) to quantify relative inputs in a system. When utilized carefully, stable isotopes provides an additional device for environmental forensics. The following research provides application of stable isotope techniques to identify source in semi-closing ecosystem. The $\delta^{13}\text{C}$, $\delta^{15}\text{N}$ and $\delta^{34}\text{S}$ signatures of sediments were measured across physical gradients in a Sihwa lake to evaluate whether stable isotopes were useful indicators of environmental change. Surface and core samples were collected in 2009 and 2012 for the study. The results show that these components contents are variable with sampling period and station. $\delta^{15}\text{N}$ of sediment was not strongly correlated to any gradient, but patterns for $\delta^{13}\text{C}$ was more strongly related to physical gradients. Sulfide adjusted for these differences and may be a useful alternative, when $\delta^{34}\text{S}$ of the sulfur sources varies between study sites. A nearly linear relation between $\delta^{34}\text{S}$ and station was observed for sites in Sihwa lake, which indicates that sulfate in the sediment was derived from two isotopically distinct source regions. This indicates that $\delta^{13}\text{C}$, $\delta^{15}\text{N}$ and $\delta^{34}\text{S}$ signatures of sediments are influenced by diffuse non-point sources from industrial, municipal and agricultural areas in Lake Shihwa and by point sources from the effluence of municipal and industrial wastewater throughout wastewater treatment plants in outer sea.

Intraspecific differences in vertical habitat and food utilization by crustacean zooplankton: stable isotopic evidence

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Diel vertical migration (DVM) is a common behavior of crustacean zooplankton. While ecological causes and functions of the zooplankton DVM have been well studied, little is known about where they forage during their vertical migration. Here we investigated vertical habitat utilization by daphnia in the offshore zone of Lake Biwa, using stable isotope analysis. During stratification period, there was marked vertical variation in $\delta^{15}\text{N}$ value of POM as potential food sources for these zooplankton. Such an isotopic variation was also observed for daphnia collected from epi- and hypolimnion. Two-source mixing model revealed that epilimnion individuals relied on epilimnion POM entirely, whereas hypolimnion ones showed about 40% reliance on hypolimnion POM and 60% on epilimnion POM, suggesting that the latter fed in both layers while performing vertical migration. For these species, vertical isotopic variation disappeared during winter mixing period probably because individuals were vertically mixed well. In conclusion, there is intraspecific variation in vertical habitat utilization by crustacean zooplankton.

O4-4

Summer monsoon effects on trophic source shifts in diets of secondary producers in a shallow reservoir food webs, Korea: Evidence from stable C-N isotopes.

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In monsoon climate regions, man-made reservoirs regulated by dam have been found to disturbed the balance of allochthonous and autochthonous carbon sources. Although previous studies suggested commonly that after heavy rains in a summer monsoon period, autochthonous phytoplankton production dropped and instead, large amount of allochthonous terrestrial materials is temporarily imported to reservoirs, the understanding on how the temporarily disturbed POM source composition and concentration influence structure and functions of food webs in a pelagic and littoral zone remains still unclear. This study conducted in the Lake Paldang, the biggest water supply reservoir on Han River, Korea aims to assess the reservoir food webs structure in response to the summer monsoon derived-disturbances in primary energy resources. We analyzed carbon and nitrogen stable isotope ratios for particulate organic matter (POM), zooplankton, benthic macroinvertebrates and predatory fish before and after summer monsoon periods to trace energy flows through food webs. Our stable carbon-nitrogen results reveal that in the pre-monsoon period when phytoplankton density was abundant in the lake, cladoceran Daphnia and Copepod feed mainly on bulk phytoplankton, whereas they would change diets sources from the bulk POM when the lake trophic condition became poorly unproductive after summer monsoon. Cladoceran Daphnia filtering whole suspended materials appeared to be more ^{13}C depleted than the large copepods which can take selectively chlorophytes and rotifers indicating the filter feeding cladoceran zooplankters feed flexibly on allochthonous sources relative to the cyclopoid copepods if labile food diets like phytoplankton would be limited after summer monsoon period. On the other hand, herbivores invertebrates, the secondary producers in a littoral zone, were isotopically stable in response to the summer monsoon disturbance in POM source composition and amount. The findings collectively indicates that after rainy season the augmented allochthonity can subsidize zooplankton production in a pelagic zone, but may influence benthic macroinvertebrate communities to little degree in a littoral zone, and overall the effects could be integrated to the top predators. Also, the stepwise effects from POM to top predators through secondary producers can be spatially different between a lacustrine and transitional zone.

Effect of the monsoon on the food web structure according to the size of reservoir: ; Application of C and N stable isotope ratio

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To understand the effect of the monsoon on the ecosystem according to the size of reservoir, we compared the variation of food web structure after monsoon using C and N stable isotope ratios in three lakes which have different size (Lake Chungju, Lake Heongsung, and Lake Doam). We collected higher consumer (fish) and potential food sources (benthic invertebrate, zooplankton, particulate organic matters, settling particles). Particle organic matters showed the enriched carbon isotope ratios and depleted nitrogen isotope ratios during monsoon period (July-September). It seems to be affected by the growth of blue-green algae during summer. It also means that the base of pelagic food web (phytoplankton) should be influenced by monsoon in all study areas. However, stable isotope ratios of fish in the two lakes, except the Lake Chungju, did not clearly show the impact of the monsoon. On the other hand, it tended to enhance carbon isotope ratios of fish after summer in Chungju Lake. In terms of flushing the organisms in water column occurred by the discharge of the dam during rainy season in the smaller lake, variation of the pelagic food sources could not affect to consumers in these lakes. It means that response of ecosystem against the monsoon effect could be different with the size of lakes. In addition, compound specific isotopic ratios of individual amino acids are discussed to understand more accurate trophic position of major fish species in this study.

O4-6

Feeding strategy of nutria (*Myocastor coypus*) as semi-aquatic herbivore on off-season using stable isotope analysis

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Globally, Nutria (*Myocastor coypus*) has been spread due to their fur and meat. In South Korea, nutria has occurred only in Nakdong River basin. In terms with management of invasive species, the foraging pattern or endurance during winter is needed to know. Especially, during winter season, the foraging behavior tends to show their maximizing surviving strategy. Semi-aquatic mammals show the own territorial feeding property, to escape from terrestrial predator. In the study presented here we used stable isotope ratios of carbon and nitrogen in nutria tissues (liver, and hind-leg muscle) reflecting on the isotope value of terrestrial and aquatic herbaceous vegetation in order to verify the seasonal feeding habitat use. Specifically, we sought to: (1) verify the region between terrestrial and aquatic vegetation, (2) determine the annual food habits of nutria, and (3) determine if a seasonal relationship exists between isotope values of nutria, mean temperature and body weight. In the results, the $\delta^{15}\text{N}$ values divided into terrestrial and aquatic groups, however the $\delta^{13}\text{C}$ values were not discriminated ($\delta^{13}\text{C}$: $p > 0.41$, $t = -0.832$, $df = 34$, $\delta^{15}\text{N}$: $p < 0.001$, $t = -8.09$, $df = 34$). Parts of plants (root, stem) did not show the difference of the values (aquatic plants: $\delta^{13}\text{C}$: $p = 0.42$, $df = 14$, $t = -0.056$, $\delta^{15}\text{N}$: $p > 0.38$, $t = 0.90$, $df = 14$, terrestrial plants: $\delta^{13}\text{C}$: $p = 0.65$, $t = 0.46$, $df = 18$, $\delta^{15}\text{N}$: $p > 0.26$, $t = -1.16$, $df = 18$). However, the relationship between food and predator on isotopic values, nutria feeding was leaned with the roots of aquatic plants. All relationship with aquatic plants and nutria did not show the seasonality. And also, $\delta^{15}\text{N}$ of liver tissues did not show the pattern with weight of nutria ($R^2 = 0.138$, $F = 2.073$, $P = 0.174$), but $\delta^{15}\text{N}$ of hind-leg muscle correlated with that of nutria ($R^2 = 0.406$, $F = 11.618$, $P < 0.05$). Adversely, that of liver tissues showed the relationship with mean temperature ($R^2 = 0.530$, $F = 14.684$, $P < 0.01$), but that of hind-leg muscle did not present the relationship ($R^2 = 0.002$, $F = 0.028$, $P = 0.869$). The results showed that nutria feeding diet could be resulted in the speciation apart from the terrestrial region, and winter temperature affected nutria diet and the coincidence with the difficulty of food source lead to weight loss. In terms with regulation of nutria population, we proposed that the best way to trap nutria is that the baited food source should be put aside with water-terrestrial surface zone due to food feasibility during winter season.

Characteristics of multiple organic matter sources in the upstream waters of an artificial coastal lake (Shihwa), Korea

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In order to understand the characteristics and contributions of potential organic source in the upstream waters of the artificial Lake Shihwa, the biodegradability, fluorescence properties, and isotopic composition were determined four times during November 2012 to October 2013. The organic matters derived from rural area, urban area, and industrial area were collected as the potential organic sources. The organic matter in the rural area showed low concentration and poor biodegradability; the humification index also indicated a high humification degree. On the other hand, the high organic matter content and biodegradability were observed in the industrial area; the humification index showed low values. The moderate contents of bulk organic matter and biodegradable fraction were observed in urban area. The rural area were different from the other sites, with respect to the depleted stable carbon isotope ratio values; the industrial areas were distinct from the other site, as they had depleted nitrogen isotope values. The contributions of these sources proved to be distinctly increased after summer monsoonal precipitation. Our results suggest that determination of carbon and nitrogen isotope ratios, combined with measurements of biodegradability and fluorescence properties, is useful to estimate the quantitative contribution of multiple organic sources to coastal lake.

O4-8

Trophic position of aquatic organisms determined by nitrogen stable isotope of individual amino acids

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Recently, compound-specific isotope analysis (CSIA) has been used as a tool for ecology, environmental science, and climate change study. In particular, the carbon and nitrogen isotopic signatures of individual organic compounds determined by gas chromatography/combustion/isotope ratio mass spectrometer (GC/C/IRMS) have been applied for food web dynamics and biogeochemical cycles of organic matter. In the current presentation, analytical methods and recent applications of CSIA are introduced with the exemplary research results. Also, trophic positions of fishes are compared using conventional bulk method and individual amino acids method in three lakes located at North Han River as well as the estuary of Seomjin River. The comparative results strongly suggest $\delta^{15}\text{N}$ of individual amino acids should provide more reliable trophic position information rather than $\delta^{15}\text{N}$ of bulk nitrogen in organisms in both study sites.

Microbial Ecology in Lake Biwa with special reference to production and decomposition of dissolved organic matter

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In 1970's, Japanese Government and Shiga Prefectural Government had started some measures to reduce high phosphorus loading to Lake Biwa. Due to the efforts, the water quality of Lake Biwa has been improved during the last 40 years. Mysteriously, a portion of organic matter expressed by chemical oxygen demand (COD) in the lake during the period have been gradually increasing every year, though chlorophyll *a* concentration whose high values indicate high production of dissolved organic matter (DOM) have been decreased, and some researchers have reported that the increase in COD might be due to the accumulation of refractory and/or semi-labile DOM, and that those DOM might be autochthonously produced. We have clarified the microbial processes with special reference to production of those DOM. Our findings are summarized as below: In the epilimnion of Lake Biwa during the stratified period, phytoplankton produce protein-like DOM, and the DOM is converted into humic-like DOM through decomposition by planktonic bacteria. The humic-like DOM is transported to the hypolimnion through winter vertical mixing. In the hypolimnion during the stratified period, only one bacterial species, CL500-11 (phylum *Chloroflexi*), predominates, and bacterivorous Kinetoplastid flagellates also dominate. So, in the hypolimnion of Lake Biwa during the stratified period, there may be the unique microbial food webs where humic-like DOM is consumed by bacterial assemblages predominated by CL500-11, and where those bacteria are grazed by bacterivorous protists such as Kinetoplastids.

O5-2

Response of *Daphnia magna* population growth to differential algal food provision

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In this study, contribution of two different food algal species, *Chlorella vulgaris* and *Stephanodiscus hantzschii*, to population growth of *Daphnia magna* was examined by means of grazing experiment and stable isotope analysis. Size of maternal and offspring *D. magna* and offspring number was compared in accordance with food algal supply conditions (*C. vulgaris* only, *S. hantzschii* only, and mixture). Despite provision of equal amounts of food algal species (in terms of carbon content), the size of individuals as well as offspring number were differentially increased as ratio of the diatom provision increased. Stable isotope analysis revealed significant assimilation of diatom-derived materials that is believed to be important for the growth of *D. magna* populations. Our results confirm the followings: (1) differential food algal provision affects population growth of *D. magna*, and (2) the applicability of stable isotope approaches for clarifying the contribution of different food algae, and (3) elucidation of the importance of food quality for growth of *D. magna* individuals and populations. Furthermore, we expect that stable isotope analysis will help to further precisely examine the contribution of prey to predators or grazers in controlled experiments.

Key words: *Daphnia magna* / Food source / *Stephanodiscus hantzschii* / *Chlorella vulgaris* / population growth / stable isotope analysis

Ecological importance of kinetoplastid flagellates in the hypolimnion of Lake Biwa with special reference to the limitation of molecular techniques

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Kinetoplastid flagellates are rarely reported from diversity studies by molecular techniques using universal eukaryote DNA primers. However, they were often detected from various aquatic environments by microscopic analysis. To investigate this paradox, we examined the nanoflagellate diversity by constructing 18S ribosomal RNA gene clone libraries using universal eukaryote DNA primers, kinetoplastid diversity by kinetoplastid specific DNA primers and abundance of kinetoplastid nanoflagellates by Catalyzed Reporter Deposition–Fluorescence *In Situ* Hybridization (CARD-FISH) in Lake Biwa, Japan. Samples were collected from January 2012 to January 2013 on a monthly basis from various depths covering the epilimnion, metalimnion and hypolimnion. None of the clone library by universal eukaryote primers detected sequence affiliated to kinetoplastid flagellates. However, kinetoplastid sequences were obtained using kinetoplastid specific primers and they were also detected with CARD-FISH from all the seasons, contributing up to 11.9% and 36.0% of total eukaryotes in the epilimnion and hypolimnion respectively. Kinetoplastids were the dominant members of planktonic nanoflagellates in the hypolimnion during summer stratification contributing up to 45% of total flagellates. Thus we attribute this paradox to the evolution of small subunit ribosomal RNA of Kinetoplastids leading to their un-detection by universal eukaryote primers thus resulting in underestimation in the clone library. This may also be true in other studies using universal eukaryote DNA primers. The present study revealed that kinetoplastids are an important group of flagellates in Lake Biwa and may have significant ecological importance in the hypolimnion water. This study highlights the unique ecosystem of oxygenated hypolimnion harboring interesting group of microorganisms playing an important role in the matter cycling in deep lakes.

O5-4

The role of heterotrophic bacteria in the formation of *Microcystis* colonies

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Recent studies have suggested that bacteria-*Microcystis* interactions significantly influence the morphology of *Microcystis*. However, little is known about the specific genus or species of heterotrophic bacteria that can influence *Microcystis* colony formation. In addition, the mechanisms of colony formation behind heterotrophic bacteria-*Microcystis* interactions remain unclear. A total of 48 strains of heterotrophic bacteria were purified from the mucilage of *Microcystis*, from which five *Microcystis* colony-inducing bacteria (MCIB), *Aeromonas veronii* (Bac-AV), *Enterobacter aerogenes* (Bac-EN), *Exiguobacterium acetylicum* (Bac-EA), *Bacillus cereus* (Bac-BC) and *Shewanella putrefaciens* (Bac-SP), were found that they had capable of inducing the aggregation of unicellular *Microcystis* into colonies. Species-specific associations between *Microcystis* and five MCIB species resulted in *Microcystis* colony formation but not in the aggregation of other unicellular alga, such as *Chlorella vulgaris*. Bac-AV, Bac-EN, Bac-EA and Bac-BC were associated with *Microcystis aeruginosa* colod with *M. wesenbergii* colony formation but not with *M. aeruginosa* colony formation but not with the aggregation of unicellular *Microcystis wesenbergii*. Bac-SP was associate formation. The presence of MCIB enhanced both EPS production and cellular viscosity, which consequently promoted *Microcystis* colony formation. Furthermore, MCIB showed species-specific relationships with *Microcystis* colony formation and might have an important role in the development of *Microcystis* blooms.

Diversity of zooplankton with spatial and temporal dispersion in irrigation reservoir

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Temporal and spatial distribution patterns of zooplankton communities of irrigation reservoir (Chodae Reservoir, South Korea) were studied in fine scale to find principal factors influencing spatial and temporal dispersion of their abundance and species diversity. The samples were collected from 12 different stations inside water-body, and one littoral site during May to October, 2013 with one- to two-week interval. Among the zooplankton, Rotifera diversity showed remarkably high portion compared with that of Cladocera and Copepoda. On the other hand, major dominant species of mesozooplankton continuously emerged throughout the study period. Moreover, Total zooplankton densities in the reservoir at the stations were significantly different particularly not only between littoral and pelagic zones, but also among pelagic stations. The results confirmed that temporal and spatial patterns of zooplankton abundance, species composition, and consequent diversity are dynamically changed by the regulation of hydrological variations and biotic factors such as phytoplankton abundance and fish presence. For the determination of zooplankton community distribution, habitats selection is important indicator to be classified as zooplankton dynamics and diversity with spatial and temporal dispersion.

O5-6

Seasonal variation of coastal zooplankton community in a eutrophic-brackish reservoir, Saemangeum

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Coastal plankton community often shows dramatic seasonal and spatial dynamics since it receives various effects both from ocean and freshwater. The Saemangeum dyke construction created huge brackish reservoir with unique ecosystem having strong eutrophication impacts from the catchment area as well as dilution impacts from open ocean water input through the sluice gates of the dyke simultaneously. The Saemangeum plankton community consists of freshwater, brackish and oceanic species, and their composition and overall community structure respond to seasonal variation of environmental factors such as salinity, and nutrients input from rivers, sensitively. In this study, to investigate the spatial and temporal distribution pattern of zooplankton community particularly in relation with eutrophication impact and sea water input, the field survey was carried out in the Saemangeum reservoir from 2013 to 2014. The sample collection and water quality monitorings were conducted in each season (July, October 2013, February and April 2014) at 17 sites in the reservoir including two river water input points (Mangyeong River and Dongjin River). The zooplankton species compositions were analyzed, and their carbon and nitrogen stable isotope ratios were also measured to estimate their biological interactions particularly with available organic carbon sources both from sea and rivers. The zooplankton's community showed a distinctive trend of seasonal and temporal variation with changes of seawater distribution in the reservoir. Especially, the brackish copepods genus *Acartia*, which inhabited in the whole reservoir area except freshwater region, showed seasonally different dominant species. The dynamics of zooplankton community with special emphasis on copepods community, and the relationship with biotic and abiotic environmental factors were analyzed and the results are discussed.

Bacterial community composition and enzyme activities from Yasu River to Lake Biwa, Japan

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We investigated the horizontal distribution patterns of bacterial community compositions (BCC) and extracellular enzyme activities (EEAs) from the mouth of Yasu River to the pelagic region of Lake Biwa at six stations along a 9.6-km horizontal transect. Surface water samples were collected along the set transect from November 2012 to September 2013. The concentrations of dissolved nitrogen and phosphorus in the near-shore region were higher than those in the lake. Betaproteobacteria and Bacteroidetes dominated in the river mouth, whereas Alphaproteobacteria and Actinobacteria dominated in the lake. β -glucosidase and cellobiohydrolase activities in the near-shore region were higher than those those in the lake, and the alkaline phosphatase activity did not differ from the river mouth to the pelagic region. In contrast to a clear difference in BCC and EEAs between river mouth and lake, the differences in BCCs and EEAs among stations in the lake were insignificant. The less heterogeneity of BCC and EEAs in the lake indicated that the effects of river to the BCC and EEAs in the surface layer of lake is limited to the near-shore region.

O5-8

A study of the distribution and behavior pattern of pelagic- and epiphytic cladoceran associated with macrophyte types using field and microcosm approaches

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In empirical studies, aquatic macrophytes have a fundamental structuring role in freshwater environments. Several authors have suggested that trophic interactions are particularly mediated by aquatic macrophytes. In the current article, we investigated three shallow wetlands in South Korea to understand spatial distribution and behavior pattern of pelagic- and epiphytic cladoceran species (*Daphnia obtusa* and *Simocephalus vetulus*) associated with different macrophyte types, through field sampling, stable isotope analysis, and an experimental approach. The surface and bottom layer of the water was occupied by surface-dwelling and submerged macrophytes, respectively, and the two cladoceran species were distributed correspondingly to the macrophyte distribution pattern. *D. obtusa* was distributed in bottom layer, and *S. vetulus* was concentrated at water surface. The results of a stable isotope analysis showed that two cladoceran species largely depended on the particulate organic matter (POM) collected in water surface and bottom layer, respectively. The microcosm experimental approach revealed that the types of macrophytes determined the vertical distribution of cladoceran species. A greater number of *S. vetulus* were found on the surface-dwelling macrophytes on the surface, whereas *D. obtusa* was more abundant in the bottom layer (only in submerged macrophytes) in all treatments. This spatial distribution pattern was largely extended by predation. Moreover, we discovered that *S. vetulus* have very little movement than *D. obtusa* in fish predation treatment. We hypothesized that the varying distribution pattern would be due to the characteristic habitat utilization of each cladoceran species. In particular, epiphytic species can effectively avoid fish predation through its behavioral pattern (i.e. little movement and attached inhabitation). From this result, we suggested that their different habitat use on macrophyte facilitated the coexistence of the two species. Significantly, the macrophytes were supporting the coexistence of the cladocera species, and may play an important role in enhancing the biodiversity of the wetlands and sustaining its complex food web. The results of this study support the current understanding of epiphytic / pelagic cladoceran coexistence.

Prospects on using aquatic ecosystem health assessment to support water environment management in Korea

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“Restoration of ecological integrity of the Nation’s waters” is the objective of the Water Quality and Aquatic Ecosystem Conservation Act, and water environment management programs in Korea. With implementation of national investment in water infrastructure and regulation, much work has been done to restore rivers, lakes, streams, and wetlands. Although there have been major water quality improvements over past three decades, many environmental challenges remain, such as loss and destruction of habitat, altered hydrology, invasive species, stormwater, eutrophication, and nonpoint source pollution. In the face of such challenges, it is very crucial to deploy water environment management program to meet the vision of the Water Quality and Aquatic Ecosystem Conservation Act for protection of aquatic life. Measuring the condition of aquatic biota residing in the waters using biological assessment and incorporating that information into management decisions can be an important tool to support national and local water environment management programs. Biological assessments provide information on the cumulative effects on aquatic communities from multiple stressors. Thus, the nation can use it to set environmental goals, detect degradation, prioritize management actions and trace improvement.

Korea recently adopted biological criteria and the concept of ecosystem health with the recognition of an indelible limitation of applying chemical parameters to sound management of aquatic ecosystem integrity. Such work became important for surface water management policy, and the National Aquatic Ecological Monitoring Program (NAEMP) has been established in 2007. The monitoring program includes an evaluation of the biological and habitat characteristics of river and stream ecosystems across the country, including 960 sites. The four-class assessment system designates ecosystem health as excellent (Class A), good (Class B), fair (Class C), and poor (Class D). The recent nationwide monitoring result indicates that many rivers and streams are severely degraded. Five year’s (2008-2012) monitoring results show that the proportion of 51%, 44%, and 28% of total measured sites by benthic diatoms, fishes, and benthic macroinvertebrates, respectively, belongs to the fair-poor classification. The average of these

proportions measured by the three biological assemblages was about 2.7-fold higher than that measured and classified by BOD standard.

The NAEMP has produced promising results that became an integral part of related policies to preserve and restore rivers and streams, riparian buffer areas and watersheds, and has supported scientific research relevant to lotic environments and watershed management. The important aims of the NAEMP also include incorporating the monitoring results into management decisions as well as using the information for public outreach. NAEMP is currently under process of refining to provide a more effective tool for assessing ecosystem health of nation's lotic waters and better utilizing accumulated data to achieve abovementioned aims.

This study was supported by the project 'Aquatic Ecosystem Health Survey and Assessment' funded by the Ministry of Environment and National Institute of Environmental Research, Korea.

Biodiversity, assemblage structure and environmental relation of macroinvertebrates in Korean streams and rivers

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Conserving and reviving freshwater biodiversity are becoming a global issue for improving the stream ecosystem integrity and implementing sustainable freshwater ecosystem management. To meet this goal it is critical to identify how the assemblage compositions of aquatic biota are determined by environmental gradients at several spatial scales. Nevertheless, studies on their large-scale environmental relationships remained scarce, especially in Asian regions. This study aimed to understand spatial distribution patterns of benthic macroinvertebrates in 388 streams from five major river systems in Korea. A total of 340 taxa, belonging to 113 families in 23 orders of 5 phyla, were identified. Assemblage composition in most Korean streams consisted of few predominant colonizers (e.g., *Limnodrilus gotoi*, Chironomidae spp., *Uracanthella punctisetae*, *Cheumatopsyche brevilineata*, *Hydropsyche valvata* and *H. kozhantschikovi*) and a majority of rare taxa. Macroinvertebrate-based cluster analysis classified 720 sampling sites into five clusters, displaying large differences in watershed and physicochemical characteristics. Canonical correspondence analysis revealed that altitude, water velocity and streambed composition were the most important determinants, rather than watershed and water chemistry variables, for explaining the variation of macroinvertebrate assemblage patterns. The results of the current study are expected to provide scientific bases for establishing the conservation and restoration strategies of macroinvertebrate biodiversity against anthropogenic disturbance and developing more confident bioassessment tool for the diagnosis of stream ecosystem integrity.

This study was supported by the project 'Aquatic Ecosystem Health Survey and Assessment' funded by the Ministry of Environment and National Institute of Environmental Research, Korea.

O6-3

**Aquatic ecosystem health 'of the people, by the people and for the people';
application of citizen science in management and conservation of the rivers and streams**

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In the effort of restoration and conservation of the nation's freshwater environment, substantial manpower and resources are required, particularly to monitor the extensive area of streams, rivers and watershed. In the current system of the government-centralized management program where the ecosystem monitoring is done by limited resource of the experts, the shortage of human resource is inevitable. So-called 'citizen science' program can be a feasible solution to overcome the problem of manpower shortage in the nationwide monitoring of aquatic ecosystem health and to support local monitoring programs. Citizen science mainly pursuing the engagement of general public in monitoring data collection has often been conceived to be the only possible way to gather such a large data set as covering a huge spatial and long temporal scale. Successful gathering of massive data through carefully designed citizen science programs has been reported in the various scientific disciplines such as astronomy, molecular biology, ornithology, forestry and other areas of ecological science. In this study, the examples of successful citizen science program in various fields are presented with the emphasis on the factors brought into the success, which shed the implication of possible implementation of citizen science program in the monitoring of many streams and rivers in Korea. Moreover, suggested are the possible application of currently available and widely used information and communication technologies in citizen science program for monitoring the streams and rivers, with other cases of modern citizen science which successfully adopted the technologies. The educational aspect of citizen science in relation to the aquatic ecosystem management is also briefly discussed. Since the public awareness and participation are an integral part of long standing national environmental policy, especially for the restoration of integrity of natural ecosystem, a well-designed citizen science program in the field of aquatic ecology must include educational as well as research aspect. With above arguments, this study underlines that citizen science is an effective tool for gathering extensive monitoring data of aquatic ecosystem and for educating the general public to achieve consensus in effort of aquatic ecosystem restoration and conservation practices in Korea.

Testing the non-linear relationship between water quality and urban land uses using Generalized Additive Model

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The water quality characteristics of rivers are closely related to the land use types prevalent within a watershed. Particularly, numerous studies have suggested that there are significant negative linear relationships between water quality and urban land uses. In this study, we investigated non-linear relationships between water quality and the proportion of urban land use in watersheds. As the study areas, we selected the five major rivers in Korea, including the Han, Geum, Nakdong, Younsan, and Seomjin Rivers monitored under the National Aquatic Ecological Monitoring Program (NAEMP). BOD, T-N, and T-P collected from 527 sampling sites along the rivers were used to delineate the water quality characteristics. For computing the urbanization rate within watershed, we used LULC GIS data released by the Korean Ministry of Environment. A linear model and a non-linear model were estimated using LM and generalized additive models (GAM) modules in R-package. To compare the two models, the coefficient of determination (R^2) and Akaike's information criterion (AICc) were used. The higher R^2 and lower AICc value for a model, the more probable it is. In all water quality parameters, the GAMs showed higher R^2 and lower AICc values compared to those of the LMs. Specifically, the explanatory powers (R^2) of LM models for BOD, TN, and TP were 0.18, 0.2, and 0.2, respectively. Whereas, GAM models represented the higher explanatory power for BOD ($R^2=0.21$), TN ($R^2=0.25$), and TP ($R^2=0.24$). The AICc values of estimated the GAM models were 273.86 (BOD), 44.02 (TN), and 537.99 (TP) while those of the LMs represented lower values for BOD (288.32), TN (69.98) and TP (561.72). The results of model comparison strongly suggested that the GAMs had better goodness-of-fit than LM models, indicating the relationships between water quality and urban land uses are non-linear. The results of this study strongly suggested that there should be different management practices and policies for different watersheds with considering the proportion of land uses in watersheds.

O6-5

Characterizing spatial and temporal changes of biological indices in Korean streams

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Community structure or species composition of fish has frequently been used in environmental monitoring and assessment of aquatic ecosystems health. In order to evaluate the change of stream ecosystem health, we analyzed the spatiotemporal trends in stream ecosystem health based on biological indices using fish community on the Korean nationwide scale. Temporal trend analysis was conducted on 615 sampling sites in Korea using biological indices for six years from 2008 to 2013 using the Mann-Kendall test with Kendall's tau, a nonparametric statistical method, and the relationship between biological indices and environmental variables were analyzed. The distribution of trend values by Kendall's tau in each site was highly related to the sites' geographic locations. In addition, 615 sampling sites were classified into five clusters through the range of Kendall's tau, with difference in environmental variables and biological indices between clusters. Trend value of biological index exhibits strong relationships with the altitude, distance from source and urban area in the watersheds.

Evaluation of Korean stream characteristics using Habitat and Riparian Index (HRI) : past accomplishment and future direction

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In this study, a variety of riparian factors and in-stream habitat conditions were evaluated. In order to determine the current status of Korean streams, stream restoration is an important process affecting the ecological health of stream ecosystems. In recent years the improvement of ecological characteristics has been subject to an increasing focus for restoration projects. We utilized data collected from 960 stream sites between 2008 ~ 2013 to discover general patterns of anthropogenic modification in Korean streams (2008: 640, 2009: 720 2010: 800, 2011: 880, 2012 ~ 2013: 960). We scored 10 variables including presence of sandbars, weirs, and channelization. The final Habitat and Riparian Index (HRI) scores were calculated by summing 10 individual items scores (range between 0 and 100). The HRI scores were used to classify the study sites into 4 groups (best, good, normal, and poor; all classification levels have 25 points interval). The survey results (low scores indicate more disturbed) provided a general distribution of disturbed/undisturbed streams or rivers in the watershed. We then compared the HRI scores with the socio-geographical patterns (population, land coverage, elevation, and slope) of the watershed. The results showed that the streams in highly populated areas suffered more from human modification compared to other well-preserved stream sites. In metropolitan cities, urbanized areas had negative relationship with HRI scores. In general, mountainous streams possessed a better status of stream habitat and riparian characteristics due to different land-cover patterns (i.e., mainly forested area). We could distinguish the forcing variables (i.e., land use pattern) for the disturbed streams through a comparison between the HRI and geographical information; the HRI application was able to identify areas of high necessity for restoration. The HRI also provide qualitative habitat status for semi-aquatic mammals (nutria, Eurasian otter, etc.) and their relationship with HRI for the optimal management decision.

O6-7

Distribution patterns of Korean freshwater fish in relation to environmental gradients

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The development of stream can bring about environmental changes that impact freshwater fish communities. In temperate streams, the distribution of freshwater fish species is associated with environmental gradients. To analyze the relevant factors, large-scale exploration is required. Thus, to evaluate the distribution patterns of Korean freshwater fish. Fish communities were surveyed at 720 sites over a 6-week period in 2009. A total of 124 fish species in 27 families were identified; *Zacco platypus* and *Zacco koreanus* of the Cyprinidae were the dominant and subdominant species, respectively. Of the species found, 46 (37.1%) were endemic and 4 (3.2%) exotic. Upon canonical correspondence analysis (CCA), both altitude and biological oxygen demand (BOD) were highly correlated with CCA axes 1 and 2, respectively. This explained 62.5% of the species–environment relationship. Altitude and stream order were longitudinally related to species distribution. The numbers of both total and endemic species gradually increased as streams grew in size to the fourth–fifth-order, and decreased in sixth-order, streams. Overall, the fish communities of each watershed were very similar, whereas some species showed site-specific occurrence patterns due to the paleogeomorphological characteristics of Korean peninsula. However, various anthropogenic activities may negatively affect fish communities. Therefore, long-term sustainable management strategies for conservation of freshwater fish fauna are required.

Diagnostic evaluation of the rivers based on the riparian vegetation in Korea

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Riparian vegetation, an important mediator of land–water interactions, provides habitat for animals and other organisms; however, riparian vegetation zones have been altered by agricultural and urban development in Korea. This riparian vegetation survey was conducted to diagnose the integrity of the rivers and streams in Korea. The integrity of the riparian vegetation was assessed based on vegetation diversity, stand profile, exotic plant area (%), annual plant area (%), and species richness. Exotic and annual plants were more common than endemic perennial and woody plants. Rivers and streams more than 80% earned grades below moderate and thereby reflected the overall poor health of the ecosystems. The vegetation elements showed a significant correlation with each other and the synthetic index. Among the correlations between vegetation elements, the relationship between vegetation diversity and species richness was closest. Based on the correlation coefficients with the synthetic index, the degree of naturalness in rivers showed the closest relationship with the vegetation profile. The vegetation revealed a significant correlation with the biochemical oxygen demand (BOD), benthic invertebrates, fish, and environmental conditions in the channel and around the waterside.

Key words: Diagnosis, Exotic plant, Health, Integrity, Riparian vegetation

07-1

Exploratory methodology for understanding fish length and their swimming pattern using an acoustic camera and echo sounder

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Throughout the last decade, the development and enhancement of scientific acoustic hardware and software now enables researchers to estimate the abundance of aquatic organisms, in order to understand distributional pattern and to monitor fish migration or behavior in ways that are both efficient and non-intrusive. An acoustic camera, which is a type of imaging sonar, is a relatively new instrument compared to echo sounders. The acoustic camera produces high resolution data samples, even though the detection range is relatively short. For example, it is approximately 30 m at 1.8 MHz and 90 m at 1.1 MHz. This system has video-like data quality, so that it has been increasingly employed to elucidate the ecology and population of aquatic organisms, especially in fresh water environments. It is expected that the more the system is used, the more information could be obtained. In this study, the acoustic camera (Dual-frequency Identification Sonar, DIDSON, Sound Metrics, USA) and the echo sounder (EY 60, Simrad, Norway) were both used to collect acoustic data in Mituo of Yangtze River on April 19, 2011. The Mituo area was decided as the core zone of the National Nature Reserve for the Rare and Endemic Fishes in the Upper Reaches of the Yangtze River. It is a river channel with the largest turning angle (approximately 124 degrees), and is an extremely important area since many juveniles of endangered and endemic fish species were found around the area. Any information related to these species is highly necessary for more suitable river management and natural conservation. This demands a tool for obtaining that information. Therefore, the aim of the study is to devise a method for understanding fish length and swimming pattern using acoustic data from two systems. The precise steps of this method are demonstrated using Echoview ver 5.4 (Myriax, Australia). As a result, not only fish length but also, their distribution depth, change in depth, speed and time are exported for further analysis. This method can be applied to understand the ecological characteristics of fish in various environments.

New sight on genesis of the Lake Biwa malacofauna

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Faunogenesis of ancient Lake Biwa, which predecessor water bodies are known from Pliocene is remains obscure in spite of more than a century long study. Primary used southern Chinese origin of the lake fauna is not supported by data on extinct and the relict pectinibranch gastropods in Valvatidae and Viviparidae, as well as small bivalves "*Pisidium*". Extinct *Igapaludina* is similar to recent *Amuropaludina*, which nowadays endemic for the Amur basin. Not sculptured adult shell, subglobose embryonic shell with rounded periphery and fine spiral microsculpture are apomorphic Amuropaludinidae characters. DNA demonstrated the sister taxa of the Biwan endemic *Heterogen* is Japanese in origin *Cipangopaludina japonica*. Shell and soft body morphology of "*Pisidium*" *kawamurai* is closely related to *Lacustrina etorohuense* from southern Kuril Iturup Island.

Basing on morphological, molecular, paleontological and geological data a new theory on the origin and time of colonization of the Lake Biwa by these mollusc groups is suggested similar to that substantiated for Cyprinidae (Nakajima, 2012). We hypothesize that discussed mollusc groups have spread in Paleo-Biwa from the ancient lake system covering north-eastern Asia eastward Altai and Transbaikalia during Late Cretaceous and Paleocene (Martinson, 1961, 1998 and others). These big mesotrophic lakes at times connected with Paleo-Amur network, which the most ancient middle fragment was connected with Yellow Sea during the same period (Artemenko, Sorokin, 2009). Extinct genera of Bellamyidae and Amuropaludinidae, lower *Cipangopaludina*, *Semisulcospira*, *Megalovalvata*, small bivalves *Lacustrina* and various large bivalves dwelled the lakes. Relicts of Miocene malacofauna are recorded in Pliocene Kobiwa-ko (*Tulotomoides*, *Igapaludina*, "*Bellamyia*" *suzuki*), Pliocene Lake Chuyskoye in Altai (amuropaludinids), Lake Biwa (*Biwakoalvata*, *Lacustrina*), Lake Baikal (*Megalovalvata*), lakes in Iturup Island (*Lacustrina*).

To develop the theory future investigations will focus molecular studies of these and related taxa as well as re-examination of fossil material. The work was supported by the Center for Northeast Asian Studies of Tohoku University and Far East Branch of the Russian Academy of Sciences, grant No 12-1-П30-01.

07-3

Changes of phytoplankton community in Kyoungpo lake

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This study examined the weekly changes of water environments and phytoplankton community with the salinity gradients at Gyoungpo lake from April to November in 1998, 2012 and 2014. Gyoungpo lake was removed Gyoungpo crossbeam for water quality at 2004. So average salinity value of Gyoungpo lake was increased from 7.5 ppt to 20ppt. A total 99 species of phytoplankton in 1998, 80 species in 2012. 40 species was appeared in 1998 and 2012, commonly. Transparency, SS, NO₃-N and N/P ratio of 2012 was lower than 1998. A period of water shortage (April, May) of 2012 was decreased transparency according to decreased salinity and increased SS and Chl. a. The result of Correlation coefficients between species and community scores of DCA ordination based on data matrix of the phytoplankton was appeared large variation with sampling season at 1998 than 2012. The reason was thought that increase of seawater input quantity and velocity of conversion. So that the stability of water environment was increased. *Gymnodium* sp., *Peridinium* sp., *Prorocentrum* sp., *Nitzschia longissima*, *Schroederia setigera*, *Lyngbya* sp., *Asterococcus limneticus*, *Asterococcus superbus* and *Cyclotella meneghiniana* were well adapted at high salinity in 2012. Comparatively, *Asterionella formosa*, *Nitzschia freustulum*, *Chlorella ellipsoidea*, *Scenedesmus bijuga* and *Scenedesmus ellipsoideus* were well appeared in 1998. Community of phytoplankton can divided two season, one is spring the other is flood season in summer.

Key words : phytoplankton, salinity gradient, environmental factors

Impact of a land-based fish farm effluent discharges on rotifer community in a shallow lake in the Yangtze River basin, China

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This study investigated the impact of a land-based fish farm effluent discharges on rotifer community in a shallow lake in the Yangtze River basin, China. The traditional fish farm named “Luhu fish farm” with an area of 660ha and about 180 ponds is located adjacently to the surveyed lake named Lake Luhu which received the effluent from the fish farm. Based on the aquafarm effluent discharge stages, four sampling expeditions were carried out in March 20, June 14, September 22 and December 26, 2012. Three sampling directions from the outfall of the fish farm to the open water of the lake were assessed and the sampling sites were located at 0, 50, 100, 200, 500, 1000, 1500m along each sampling direction, and the largest distance was considered as a control site representative of natural, unpolluted condition from the fish farm discharges. The nutrient contents including total nitrogen, ammonia, nitrate, nitrite and total phosphorous at different distances showed a significant decrease from the outfall of the fish farm towards the open water. Meanwhile the primary production which was measured as chlorophyll *a* also represented a decreasing trend from the outfall of fish farm towards the open water. The results of Nonmetric multidimensional scaling ordinations suggest that the rotifer communities of all the sites are distinct separated, and there is a gradual transition in community composition along the gradient. The community composition of rotifer in four seasons also displayed differences. Most species showed similar patterns of occurrence in different sites while having differences in abundance. Several rotifer species were more abundant in sites near the outfall of the fish farm. Especially for the species like *Polyarthra dolichoptera*, *Filinia longiseta*, *Brachionus angularis*, *Trichocerca pusilla*, *Asplanchna priodonta* and *Trichocerca similis*, the abundance of these species showed significant decreasing trend from the outfall of the fish farm to the open water. The results suggest that the increased nutrient input from land-based fish farm effluent have a negative impact on rotifer community and also confirm that the abundance of certain rotifer species are indicators of higher trophic conditions.

07-5

Environmental factors affecting germination of akinete of *Anabaena* and cellular regrowth of *Microcystis*

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Bloom-forming harmful cyanobacterial genera *Anabaena* and *Microcystis* produce akinetes and resting cells, respectively, to survive from adverse growth conditions. When the environment becomes favorable for their growth, akinetes and the resting cells in the sediment go through germination and awakening process to reintroduce their planktonic cells to the water column for reproduction. The key environmental factors that regulate the germination and awakening process are known to be among temperature, light condition, pH, and nutrient, but the optimum conditions of which may differ from species to species. This study was conducted to identify the optimum key environmental condition for germination and awakening of *Anabaena* akinetes and *Microcystis* resting cells. Using the akinetes and resting cells isolated from the sediment of Han River and Nakdong River, respectively, experiments have been conducted with different temperature (5, 10, 15, 20, 25, 30 °C), light conditions (0, 5, 15, 30, 50, 100 $\mu\text{mol}/\text{m}^2/\text{s}$), pH (5, 6, 7, 8, 9, 10), and nutrient conditions (nitrogen defected, phosphorus defected, nitrogen and phosphorus defected and nutrient enriched). Higher germination rate of *Anabaena* akinete was observed in higher temperatures (55% at 25 °C, 30 °C.) than in lower temperatures (15% at 15 °C and 10 °C and 10% at 5 °C.). Similarly, high growth (>500%) and buoyancy was shown with *Microcystis* resting cells in high temperature (30 °C) whereas the growth was reduced in low temperatures 5 °C (-67%), 10 °C (-70%) with no sign of buoyancy. Low light intensity was favorable for the *Anabaena* akinete germination (>45% of germination at 5, 15 and 30 $\mu\text{mol}/\text{m}^2/\text{s}$, <10% of germination at 50 and 100 $\mu\text{mol}/\text{m}^2/\text{s}$) while growth rate of *Microcystis* resting cell was increased with the increase of the light intensity (>500% at 100 $\mu\text{mol}/\text{m}^2/\text{s}$, >300% at 50, 30, 15 $\mu\text{mol}/\text{m}^2/\text{s}$, all showing buoyancy). Both *Anabaena* akinete and *Microcystis* resting cell required nitrogen and phosphorus sufficient condition and pH range of 7 to 9 for germination and cell awakening with buoyancy. These results indicate that light condition is likely the factor that regulates the difference in timing for the reintroduction of the *Anabaena* and *Microcystis* into the water column from the sediment. While bloom formation in the water column can not be fully elucidated by germination and awakening with buoyance, this result implies that there might be a brief temporal competitive exclusion occurring at the initial phase of bloom formation among phytoplankton species.

This study was supported by "The Project of Basic Investigation of Environment in Han River Watershed (2013)".

Evaluation of the oxidative stress in submersed macrophyte; *Myriophyllum spicatum* in response to oxygen redox potential in substrate sediments

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This study was carried out to evaluate the oxidative stress in submersed macrophyte; *Myriophyllum spicatum* in response to sediment redox condition. The study site was Moto Arakawa, which is a tributary of the Arakawa River flowing in central Saitama, Japan. Eight sampling points were selected along a stretch (~1 km) of the tributary and the oxygen redox potential (ORP) of the substrate sediments inside macrophyte strands was measured using an ORP meter. *M. spicatum* plants were also sampled from the same locations to prepare plant extracts to be used in the subsequent stress response assays. Stress responses in plant roots and shoots (leaves and stem) were assayed by measuring the activities of antioxidant enzyme; catalase (CAT), peroxidase (POD) and ascorbic peroxidases (APX) as well as concentration of indole acetic acid (IAA) and total chlorophyll.

Elevated levels of antioxidant enzyme (POD, APX and CAT) activities were found when plants exposed to high anoxic environments while the IAA content in plant tissues decreased with parallel to increased anoxic condition. Significantly low concentrations of chlorophyll were also observed when plants exposed to high anoxic stress. Findings of this study suggested that sediment anoxic conditions make oxidative stress in aquatic macrophytes and the severity of the stress increased with increasing anoxic stress.

07-7

Response of Physico-chemical characteristics of Pond water in Fish Production and algal growth in northern Bangladesh

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The physico-chemical properties of waters from 28 ponds of northern Bangladesh were analyzed to assess their quality for fish production as well as algal growth and development. The variation in the physico-chemical parameters of the aquaculture ponds above or below standard values has potential effects on the health and productivity of aquaculture. Overall, we found that the pond water were acidic to neutral (pH varied from 6.0 to 7.2) in nature that is suitable for aquaculture. The dissolved oxygen (DO) concentration was suitable for fish production but more DO level should be present for all aquatic life especially for the growth and development of fish. The COD (chemical oxygen demand) of all pond waters were within the permissible limits for fish production. The temperature values were remained within the standard values in all the aquaculture ponds. Pond water samples contained Ca^{2+} , Mg^{2+} and Na^{+} as the dominant cations, and HCO_3^{-} and Cl^{-} were the dominant anions. All samples were within 'soft' class regarding hardness. Based on Cu^{2+} , Zn^{2+} , Mn^{2+} and Fe^{3+} , all pond water samples were within the 'safe' limit for algae production.

East Fork Owyhee River Salmon and Steelhead Recovery Project

Jinwon Seo

Director of the Fish, Wildlife, and Parks Dept. in Shoshone-Paiute Tribes

The East Fork Owyhee River, located in northeastern Nevada, is a tributary of the Snake River, and it is southernmost drainage to Columbia River. The river runs through the Duck Valley Indian Reservation, and native population of anadromous fish including Chinook salmon and steelhead historically migrated hundreds of miles from the Pacific Ocean so these fishes were a significant part of tribal resources and culture. However, the Northwest Power and Conservation Council (NPCC) identified it as "Blocked area" in 1995 due to many dams and diversion structures which had been constructed along the Columbia, Snake, and Owyhee Rivers. Therefore, the tribes have been appealing to federal and state agencies that there is still potential capability for their spawning and rearing areas in the river and it is very important to restore them for the tribes' fishery resources and culture. Cramer Fish Sciences and our department assessed habitat conditions of mainstem reaches and major tributaries of the river with literature reviews and field surveys in 2013, and then estimated carrying capacity with collected data. Our analysis revealed that the annual summer rearing capacity for the entire study area could be ranged between 3,300 and 43,000 juvenile steelhead trout and from 3,600 to 41,000 Chinook salmon. Therefore, it would be beneficial for the tribes to develop a trap-and-haul program to transport adult fish from dams on the Lower Snake River.

O8-1

Response of phytoplankton to nutrient reduction in Shahe Reservoir, China

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*Reservoirs are the very important water bodies in China for sustainable water resource supply. However, most of the reservoirs locate at southeast region of China face the challenge of eutrophication. Nutrient reduction is one of the most popular strategies to control the eutrophication in these reservoirs. Understand the reaction of phytoplankton to nutrient reduction is very useful for the reservoir managers for their decision making. Based on the 6-year monitoring data of nutrient and phytoplankton community in Shahe Reservoir, Taihu catchment, China, the drivers of predominant phytoplankton in the reservoir have been analyzed. With the reduction of nitrogen and phosphorus, the biomass of phytoplankton in the reservoir decreased drastically. The predominant species include *Phormidium* and *Raphidiopsis* of cyanophyta, *Cryptomonas* of cryptophyta, *Synedra*, *Cyclotella*, and *Achnanthes* of bacillariophyta, and *Chlamydomonas* of chlorophyta. Based on correlation analysis and multiple regression analysis, it was found that none of the species significantly response to the nitrogen reduction, and only biomass of *Raphidiopsis* and *Chlamydomonas* significantly correlated with dissolve total phosphorus. However, most of the species significantly response to the climate factors, such as air temperature, water temperature, rainfall, water volume or water level. The result suggested that climate condition still play a key role on the phytoplankton biomass and community in Shahe reservoir under the current nutrient condition. More nutrient reduction is needed to make sure the reservoir meet the water supply function demand.*

Water usage and water quality of several types of artificial water storage ponds in the urban and rural area of Khulna, Bangladesh

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A lot of artificial water storage ponds are used for various water utilizations in Asian developing countries. Water is stored in the ponds and usually used directly on-site. One hundred and twelve ponds were surveyed in the urban and rural area near Khulna City, Bangladesh. People use pond water and well water for their domestic use in the rural area, while tap water and bottled water are also used in the urban area where poor families use pond water and well water like rural families. The survey was carried out for estimation of pond size (water amount), water usage and water quality. Their difference between wet and dry seasons was also considered. The surveyed ponds were categorized into domestic use (dish washing, cloth washing and bathing), wastewater storage use, agriculture use (paddy in dry season), fisheries use (fish and shrimp) in the rural area and urban domestic use. The average size of the pond was in order of fisheries use > urban domestic use > agriculture use > domestic use > wastewater storage in the wet season and drastically decreased in domestic and agriculture use ponds in the dry season. From the results and discussion of the water quality measured by simple on-site tests (Temperature, pH, DO, ORP, EC and Transparency) and laboratory analysis (SS, TOC, DOC, TN, DN, TP, DP, PO4-P and Alkalinity), the water quality in the rural domestic ponds in the dry season should be improved to reduce unhygienic risks. The principle component analysis (PCA) of the water quality data showed that the algal growth by nutrients load largely effected to the water quality of the ponds.

O8-3

The physiological responses of *Vallisneria natans* to epiphytic algae with the increase of N and P in water bodies

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To reveal the mechanism of submerged plants decline in progressively eutrophicated freshwaters, physiological responses of *Vallisneria natans* were studied by measuring physiological indexes of chlorophyll content, Malondialdehyde (MDA) content and superoxide dismutase (SOD) activity based on simulation experiment under different N and P levels in water (TN, TP [mg.L⁻¹]: 0.5, 0.05; 2.5, 0.25; 4.5, 0.45; 12.5, 1.25). Compared with controls (treatments of non-epiphytic algae), chlorophyll contents of *V. natans* were significantly decreased ($p < 0.01$) for the presence of epiphytic algae under any concentrations of N and P in water bodies. The presence of epiphytic algae induced peroxidation of membrane lipids, so compared with controls, MDA contents of *V. natans* had significantly increased ($p < 0.01$). Compared with controls, SOD activity significantly enhanced ($p < 0.05$) with the presence of periphytic algae in the treatments of T2 and T3 in the whole culture process, sometimes reach an extremely significant level ($p < 0.01$). However, in the treatments of T1 and T4, SOD activity had no obvious change rules with the presence of epiphytic algae ($p < 0.05$) by comparing with controls. Two-factor repeated measurement data testing showed that the effects of epiphytic algae on the chlorophyll content and MDA content and SOD activity were significant respectively ($p < 0.001$), The effects of epiphytic algae were combining with effects of concentrations of N and P ($p < 0.001$) and the culturing time ($p < 0.001$) respectively and they interact each other ($p < 0.001$). The results of this study could not only help to understand the mechanisms of the loss of submerged plants with eutrophication, but also provide a scientific basis for the management of lake.

The effects of temperature and light conditions on the buoyancy of a harmful cyanobacterium *Anabaena circinalis*

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It is known that the colonies of cyanobacteria species vertically migrate using their buoyancy to overwinter in the sediment and reintroduce itself to the epilimnion during summer for cell growth. This life-cycle seems to be closely related to the temperature and light intensity changes of the environment. To understand the buoyancy behavior of the *Anabaena circinalis*, a series of laboratory tests was conducted under various temperature and light conditions. Direct cell counting and measurement of chlorophyll-*a* at the bottom and top water layer of the incubation cylinder were used to determine the buoyancy behavior at 1, 3, 5, 10, 15, 20, 30 and 60 minutes time intervals. Vertical migration with temperature conditions showed negative buoyancy (i.e. sinking) at 10 °C and 15 °C with the velocity of 0.24 m/h and 0.35 m/h, respectively. However, positive buoyancy (i.e. floating) was shown at relatively high temperatures of 20, 25 and 30 °C with the velocity of 0.14 m/h, 0.27 m/h and 0.14 m/h, respectively. Relatively strong light conditions of 120 and 240 $\mu\text{mol}/\text{m}^2/\text{s}$ affected negatively to the buoyancy behavior showing the sinking velocity of 0.36 m/h and 0.42 m/h whereas positive buoyancy was shown at 30 and 60 $\mu\text{mol}/\text{m}^2/\text{s}$, with the velocity of 0.48 m/h and 0.6 m/h, respectively. Algal growth under different temperature and light conditions was identical with the changes in buoyancy. The lowest growth was shown at 10 °C and 120 and 240 $\mu\text{mol}/\text{m}^2/\text{s}$ light conditions while the highest growth rate was measured at 30 °C and 30 $\mu\text{mol}/\text{m}^2/\text{s}$ light condition. These results indicate that the buoyancy and cell growth of *A. circinalis* respond identically to the changes of temperature and light intensity showing negative buoyancy and lower growth rate at low temperature (<15 °C) and relatively high light intensity (>120 $\mu\text{mol}/\text{m}^2/\text{s}$) and positive buoyancy and cell growth at high temperature (>20 °C) and low light (<60 $\mu\text{mol}/\text{m}^2/\text{s}$). *A. circinalis* seems to concurrently achieve buoyancy and cell growth when the temperature is high and light intensity is low.

This study was supported by "The Project of Basic Investigation of Environment in Han River Watershed (2013)".

O8-5

Nutrients and chlorophylla responses to waterlevel fluctuations in Poyang Lake: the largest Yangtze River-connected lake of China

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As one of the few remaining lakes that is still freely connected with the Yangtze River, Poyang Lake exhibits a unique aquatic ecology which is different from the disconnected lakes. Due to the lack of long-term data on the environmental changes of Poyang Lake, the mechanism of limnological responses to waterlevel fluctuations (WLFs) is still unknown. Samples were collected weekly over 10 months from September 2011 to December 2012, and the effect of fluctuations in water level on nutrients and phytoplankton chlorophylla (chl_a) concentrations was investigated in Poyang Lake. Chl_a concentrations were strongly related to WLFs, with higher chl_a concentrations in the higher water phase (average = $8.88 \pm 5.74 \mu\text{g L}^{-1}$). The regression analysis indicated that chl_a concentrations were significantly positively correlated with water temperature ($p < 0.0001$) and Secchi depth ($p < 0.0001$) but negatively correlated with total and inorganic nitrogen nutrient concentrations (TN: $p < 0.01$; NO_x-N: $p < 0.01$; NH₄-N: $p < 0.05$). Secchi depth and total and inorganic nitrogen nutrient concentrations were all significantly correlated with WLFs of Poyang Lake (Secchi depth: $p < 0.01$; TN: $p < 0.0001$; NO_x-N: $p < 0.01$; NH₄-N: $p < 0.0001$). Three periods with two different water levels were identified in the lake by principal components analysis: the low water level with high nutrient values and the high water level with high water temperature, Secchi depth, and chl_a values. These results support the hypothesis that WLFs clearly exert an overall impact on the growth of phytoplankton in Poyang Lake of the Yangtze River floodplain. WLFs affect the water transparency (expressed by Secchi depth), nutrients, and chl_a concentrations of Poyang Lake, likely due to flush flood pulse, resuspension of suspended matter, dilution effects, and human activities.

Research on the recruitment of cyanobacteria from the sediments in the eutrophic Shanzi Reservoir

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Abstract

The effects of four environmental factors, including temperature, light, nutrients and physical disturbance, were investigated in this study on the recruitment of cyanobacteria from the winter sediment in the eutrophic Shanzi Reservoir using an orthogonal experiment. The results revealed that temperature and light were the determinants for *Microcystis* and *Oscillatoria*. Cyanobacteria become dominant at higher temperature (20°C) and light intensity (2000 lx), and *Microcystis* and *Oscillatoria* contributed to the majority proportion. Detailed recruitment simulation undertaken with respective gradient of temperature and light suggested that both *Microcystis* and *Oscillatoria* are temperature sensitive, the critical point of which is 10°C. However, distinct light impacts were observed on the two species. The recruitment of *Oscillatoria* was light independent, whereas *Microcystis* had positive relationship with light intensity. To identify the toxic *Microcystis* and the water-sediment interaction, further study on quantitative polymerase chain reaction (qPCR) and phylogenetic analysis has shown that the structure of microbial community was highly associated with intermediate distance and disturbance, though the physical agitation has limited impacts on the cyanobacteria recruitment.

Keywords

eutrophic, *Microcystis*, *Oscillatoria*, sediment, recruitment, temperature, light, quantitative PCR

O8-7

Annual Variation of nutrient and Chlorophyll-a and their driving factors in Lake Taihu (China) based on daily observation

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Excessive anthropogenic nutrient loading, especially nitrogen and phosphorus, is considered as the main reason for the break out of harmful algal blooms in lakes. At the same time, the growth and decay of algae inversely also play an important role in nutrient cycling in lake water. While in large and shallow Lake Taihu, the seasonal and spatial changes of algal bloom and nutrient are quite rapid and complicated, thus monthly observations were not enough to reveal the important ecological processes. In this study, annual high-frequency observations of chlorophyll-a and nutrient concentration, physical chemical indicators in lake water, meteorological indicators and phytoplankton identification were conducted in Lake Taihu, where had serious algal bloom problem. Daily changes of chlorophyll-a, nutrient concentrations and forms showed that nutrient responded to algal blooms when they formed. The dominant species in spring was *Anabaena* spp. (Cyanophyta), while in summer and autumn was *Microcystis* spp. (Cyanophyta). Chlorophyll-a concentration increased in spring when the nitrogen concentration reached the peak value, and chlorophyll-a even increased more in summer when phosphorus concentration reached the peak value. Significant correlations were found between chlorophyll-a and particle nutrient concentration through the whole year. Dissolved nutrients were absorbed and supported the growth of algal blooms, and thus transformed into particle nutrients, while they were released again from the decomposition of algae, and supplied the new generation of algal blooms. Chlorophyll-a and nutrient concentration in lake water changed quite fast according to the high-frequency observation, as the spring peak of phytoplankton biomass appeared only for a few weeks. The effect of algal blooms on nutrients steadily maintains the high level of phytoplankton biomass and the eutrophic ecosystem.

A scientometric study of the ISRLE society: inference of research collaboration and core topics based on publication network

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ISRLE (International Symposium on River and Lake Environment) was first initiated by Korean and Japanese limnologists in 1980s. During 1990s, China also participated as conference host and now the meeting had developed to international meeting representing limnological societies in the East Asia. During its 30 years history, diverse researches on river and lake environments were presented in the conference and there were also in-depth discussion among the international participants. Enthusiastic communication during ISRLE conference have strengthened inter-disciplinary research collaboration and expanded research network. Before we go further, it is meaningful to review historical development of issued research topics and to confine how research collaborations were made in diverse limnological field. This step will further can suggest how ISRLE members collaborate and focus guide research topics. This talk will review development of research topics, key word, and author network in the ISRLE society by using scientometric methods. Presentations in the ISRLE conference (1,000 abstracts) and major limnological journals (4,500 scientific papers) in the participation country were considered for the analysis (Korea: Korean Journal of Ecology and Environment, Japan: Japanese Journal of Limnology and Limnology, China: Chinese Journal of Oceanology and Limnology, and Inland Waters). Considering ecology is society related science, we also analyzed relative interest of publics on limnological components and issues. This retrospective analysis will provide meaning information to further develop and enhance ISRLE collaboration.

CANCEL

09-1

Variations of total, dissolved, and particulate Hg concentration affected by rain event at the three sites in Korea

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Mercury differs from other heavy metals because it continuously goes through the deposition and re-emission cycle in the environment because of its high vapor pressure. Atmospheric Hg is often emitted as inorganic forms; however once inorganic Hg is deposited into aquatic ecosystems it can be transformed into MeHg, the most toxic form through mostly microbial processes, and bio-accumulates in food chain. Therefore, it presents the greatest health risk to human and wildlife.

In this study, water samples were collected at the three sites in Haean-Myen, Yangu-gun, Korea. The first site is connected to the watershed surrounded by forest (Site A). The second site is located in Manda-stream in Younggu-gun (Site B), and the third site is located under the Salgumi-bridge in Soyoung-river (Site C). Water samples were collected during June and July in 2012 and during July in 2013 when heavy rain occurred. Water Samples were taken separately for total Hg (THg), dissolved Hg (DHg) and particulate Hg (PHg). THg was analyzed by cold vapor atomic fluorescence spectrophotometry (CVAFS, BrooksRand Model III) after all Hg in the sample was reduced by SnCl₂. DHg was analyzed also by CVAFS after being filtrated by 0.45 μm syringe filter, and PHg was calculated by subtracting DHg from THg concentrations.

The average concentrations of THg and PHg were 0.45 and 0.22 ng/L at the Site A, 3.12 and 2.84 ng/L at the Site B, and 0.37 and 0.17 ng/L at the Site C, showing that THg and PHg concentrations were statistically higher in Manda stream than those measured at the other two sites. THg concentration at the Site B was also higher than that in Soyang Lake, Yangsu-ri Reservoir, and Juam Reservoir in Korea, which were measured in previous researches. The fraction of PHg to THg was significantly higher, contributing about 90% of THg while, at the other two sites, PHg accounted less than 50% of THg. On the other hand, DHg concentrations were not statistically different spatially (the average DHg concentrations were 0.22 ng/L, 0.17 ng/L and 0.28 ng/L, at the site A, site B, and site C, respectively); therefore, possible Hg flux volatilized from water to air might be lower at the Site B although both THg and PHg concentrations were higher at the Site B than at the other two sites. Concentrations of all Hg species were observed to be higher during June than during July in 2012 possibly because of the effect of run-off due to the heavy rain occurred in June, 2012.

Holocene environmental change at the southern coast of Korea and its link to monsoon and sea level changes

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To trace environmental change in a coastal area related to Holocene monsoon and sea-level changes, we performed AMS radiocarbon dating and geochemical analyses using sedimentary cores recovered from the Beolgyo tidal flats at the southern coast of Korea. The $\delta^{13}\text{C}$ values of total organic carbon, which represent relative inputs of terrestrial and marine organic sources, displayed a long-term increasing trend from -27 to -21‰ during the period between 10,000 and 3,000 cal yr BP, suggesting an evolutionary series of fluvial-dominant to marine-dominant environments. From 3,000 cal yr BP to present, $\delta^{13}\text{C}_{\text{TOC}}$ decreased gradually from -22 to -24‰ , indicating enhancement of freshwater input during this time. Based on averages of total sulfur content and total organic carbon/total sulfur ratios, a proxy for paleosalinity in coastal areas, the observed long-term change was divided into six stages. Especially, on multi-centennial to millennial timescales, higher C/S ratios and lower TS% were linked to higher $\delta^{13}\text{C}_{\text{TOC}}$ values, showing strong freshwater input excursions at Stage 2 (8,200~7,400 cal yr BP), Stage 4 (4,200~3,350 cal yr BP), and Stage 6 (1,140 cal yr BP to ~present). Furthermore, a rapid sea-level jump (>2 m) between 8,300 and 7,900 cal yr BP was observed in the study area based on dating of coastal sediments and C/S ratios and $\delta^{13}\text{C}$ values. This study suggests that sedimentary $\delta^{13}\text{C}_{\text{TOC}}$ values and C/S ratios can be used in the Asian coastal region to trace past freshwater input events and summer monsoon intensity during relatively stable sea-level periods (e.g., middle to late Holocene).

09-3

Distribution and source of uranium in Okinawan Rivers, Japan

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We measured natural background concentrations of dissolved U in 194 Japanese rivers and the highest concentrations were observed in Hija and Kokuba Rivers (Mochizuki and Sugiyama, 2012), located in the limestone region of Okinawa (an island far southwest of Japan). However, the U concentrations in the earth's surface of their drainage areas are relatively low and therefore the mechanisms of U supply to these rivers are of interest. In this study, we determined U concentrations as well as major chemical compositions in 17 Okinawan rivers and estimated the sources of U supplied to these rivers.

Field survey was carried out in April 2013, April 2014, and June 2014. We measured water temperature, pH, electric conductivity, and dissolved oxygen concentration onsite and collected water samples. In the laboratory, we determined the Na, K, Ca, Mg, Cl, SO₄, and U concentrations and alkalinity ($[\text{HCO}_3^-] + 2[\text{CO}_3^{2-}] + [\text{OH}^-] - [\text{H}^+]$) of the samples.

The major chemical compositions of the rivers in the northeastern region of the island were the Na-Cl or Na-HCO₃ types, while those in the southwestern region were the Ca-HCO₃ type. The Ca-HCO₃-type composition is derived from the dissolution of limestone, which is widely distributed in the southwestern region. The U concentrations in rivers were much higher in the southwestern region (32 – 3500 ng/L) than in the northeastern region (5.6 – 18 ng/L). The highest concentration was observed in Mukue River (3500 ng/L), which exceeded the drinking water quality standard in Japan (2000 ng/L).

In the 11 rivers with Ca-HCO₃-type compositions, the limestone-derived fraction of U ([U]^{*}) was estimated using the following equation:

$$[\text{U}]^* = \{\text{U/Sr}\}_{\text{lime}} \times [\text{Sr}]^* \quad (1)$$

where $\{\text{U/Sr}\}_{\text{lime}}$ represents the concentration ratio of U/Sr in the limestone and $[\text{Sr}]^*$ the Sr concentration in rivers derived from limestone. We used Sr instead of Ca because water was saturated with respect to CaCO₃ in some rivers. The values of [U]^{*} was comparable to the U concentrations in river water, and therefore the U concentration in rivers can be almost explained by a dissolution of limestone. We also conducted laboratory experiments in order to elucidate the behavior of elements including U, Ca, Sr during limestone dissolution, and the results will be shown in the presentation.

Reference: Mochizuki, A. and M. Sugiyama (2012), Japanese Journal of Limnology, 73 (2), 89-107 [in Japanese].

Comparison of the lipid content and fatty acid profiles of topmouth culter (*Culter alburnus* Basilewsky) populations in six lakes, China

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Fatty acids, believed to be affected by many factors such as temperature, habitats, diets, food resources and so on. However, there is a paucity of information on fatty acid profiles of wild freshwater piscivorous fish, especially associated to variations in fatty acids in relation to catch location and food availabilities. In China, topmouth culter *Culter alburnus* Basilewsky, a typical freshwater carnivore, with high nutritional value and its markedly increasing aquaculture business, is one of the commercially important fish species. In view of the wide natural distribution of *C. alburnus*, and its cultured facilities in different places, it was worthwhile to evaluate the fatty acid profile in relation to its natural distribution and to different rearing conditions.

Accordingly, in this study, we compared the fatty acid profile of *C. alburnus* samples derived from six geographically different lakes and three different culture facilities to test the hypothesis whether differences of the fatty acid profiles of fish are related to habitat characteristic and/ or are associated with food availability. Cultured topmouth culter contained significantly ($P < 0.05$) higher lipids than its wild counterpart. The fatty acids that predominated in wild *C. alburnus* muscle were 16:0, 20:5n-3, 22:5n-3 and 22:6n-3. In cultured ones, 18:1n-9, 18:2n-6 and 20:4n-6 were predominant. The percentages of total saturated and polyunsaturated fatty acids as well as the n-3/n-6 ratio were higher in the wild than in cultured topmouth culter, whereas the corresponding total monounsaturated content was lower. The ratio of n-3 to n-6 PUFA ranged from 0.33 (Lake Xingkai Fishery) to 3.65 (Lake Hongze), and the later differed significantly from all the other populations. Principle components analysis of the data set highlighted good discrimination between wild and farmed fish. Factor 1 and 2 accounted for >80% of the variation in the data. The variables contributing to this discrimination were: the fatty acids 15:0, 18:0, 18:1n-9, 18:2n-6, 20:2n-6, 20:4n-6 and 22:5n-3. Classification and regression tree (CART) analysis was achieved using fatty acid compositions, with 18:2n-6, 20:4n-6, 18:0, 18:1n-7 and 22:5n-3 providing the highest contributions for discrimination. Our results suggested that there be significant differences of fatty acid profiles in relation to the different habits and origins of fish. And it is also expected the findings will contribute to establish a fundamental fish fatty acid system which may be applied in traceability of fish product origins.

09-5

Efficiency of two different types of fishway, Ice-harbor and nature-like type, installed in the Geum River, South Korea

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Recently, three large weirs with fishways were constructed in the Geum River which is one of the major rivers in South Korea for efficient use of water. As weirs block the longitudinal connectivity of stream, fishway is normally installed to overcome blockage of migration and movement of aquatic organisms. In this study, we monitored two types of fishway, Ice-harbor and nature-like type, installed in the Gongju and the Sejong weir, respectively in the Geum River using PIT telemetry. The results showed that each species used fishway at different time, and it was related with ecological characteristics of each species. Fishes spent more time passing nature-like type (mean : $221.6h \pm 177.6h$) than Ice-harbor (mean : $68.2h \pm 218.2h$). Also, fishes that have relatively poor swimming ability utilized nature-like type fishway. These results suggest that nature-like type has probability of another role as habitat of fishes

Detecting a potential for toxin and off-flavor material production of cyanobacteria using molecular genetic methods

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Some cyanobacteria produce toxins and off-flavor material which cause water quality deterioration and raise public health concerns. Therefore, an accurate identification of harmful cyanobacteria of concern and understanding of their potential to produce unfavorable materials are important in the management perspective. This study was conducted to detect the toxin and odor material producing potential among the cyanobacteria strains isolated from North Han River and/or Nakdong River. Genomic DNA was extracted from the *Microcystis*, *Aphanizomenon* and two morphological types (coil and linear) of *Anabaena* strains after one month incubation under 28°C temperature, 200 $\mu\text{molE}/\text{cm}^2/\text{sec}$ (14:10=L:D) light condition. Phylogenetic clusters were analyzed using PCR amplified cyanobacterial 16S rDNA gene. Primer for the amplification of harmful material synthesis genes were either designed or employed after reference search of existing primers. After amplification of the harmful material synthesis genes, their potential was checked with band appearance after agarose gel electrophoresis. Phylogenetic clustering analysis revealed that the isolated strains belonged to the *Microcystis aeruginosa*, *Aphanizomenon flos-aquae* and *Anabaena circinalis* in species level. Morphologically different *Anabaena circinalis* were shown to be monophyletic taxon with over the 90% probability. Among four kinds of cyanobacterial toxins screened, only the microcystin production potential was evident in all the tested isolates except for the coil type *Anabaena circinalis*. On the contrary, odor synthesis potential was shown only in *A. circinalis*. This study indicates that the production of harmful substances among cyanobacteria cannot be determined in species. The findings using the molecular method revealed that *Anabaena circinalis* occurring in North Han River is most harmful among tested species for they are capable of producing both toxic and odor materials. Further development of primers targeting on each type of microcystin is necessary for more specific detection of toxin production potential by cyanobacteria.

This study was supported by National Institute of Environmental Research in the project, "Research on the occurrence of cyanobacteria toxins and management strategy".

Poster Session



Poster Session

Poster Session 1

Biogeochemical cycling in freshwater systems under monsoon climates

- P1-1 Woody Debris export from forested watershed during rain storms in Korea
CHOI, YoungSoon
Kangwon National University
- P1-2 Development of a frequency analysis tool of environmental extreme events
LEE, Sanguk
K-water Institute
- P1-3 Potential effect of water temperature rise on cyanobacterial harmful algal blooms in freshwater lakes and rivers, Korea
YOU, Kyung-A
National Institute of Environmental Research
- P1-4 Long-term variation of water quality and effect of climate change in Lake Soyang
JUNG, Sungmin
Kangwon National University
- P1-5 Projection of the effects of climate change on the thermal stability of Juam reservoir, Korea
YOON, Sung Wan
Chungbuk National University
- P1-6 Monitoring cyanobacteria in lake using remote sensing
LYU, Heng
Nanjing Normal University
- P1-7 Characterization of highly strong metal binding ligands in waters of natural lakes in Japan and Korea by electroanalysis
MASAHIRO, Maruo
The University of Shiga Prefecture

- P1-8 Dynamics of dissolved oxygen and physical properties over an annual cycle in the Youngsan Lake, Korea
LEE, Dahye
Mokpo National Maritime Univ.
- P1-9 Using Solution-State ¹H NMR to Characterize Particulate Organic Matter in Floodplain and Lake Bottom Sediments in North Han River Watershed, South Korea
KIM, Sun-Hye
Ewha Womans University
- P1-10 Using fluorescence EEMs and PARAFAC to compare optical characteristics and biodegradability of dissolved and particular organic matter in a multiple land-use watershed, Korea
YANG, Boram
Ewha Womans University
- P1-11 Distribution and chemical characteristics of dissolved organic matter in Lake Biwa extracted by hydrophobic adsorbents
RIKA, Utsumi
University of Hyogo
- P1-12 Distribution and chemical characteristics of dissolved organic matter in Lake Biwa extracted by activated alumina
RIKA, Utsumi
University of Hyogo

Poster Session 2

Modeling physical and ecological processes in rivers and lakes

- P2-1 The effects of sampling frequency on the results of water quality modeling during the rainy season in Lake Soyang, Korea
JUNG, Sungmin
Kangwon national university
- P2-2 Assessment of Water Quality Changes of the Gunwi Reservoir after Dam Impoundment
LEE, Sanguk
K-water Institute
- P2-3 Water Quality Simulation of Trial Dam Impoundment of the Boohang Reservoir
LEE, Sanguk
K-water Institute
- P2-4 Comparison of spatial characteristics of algae occurrence in Daecheong reservoir and Chungju reservoir during the summer season using ELCOM-CAEDYM
CHONG, Suna
K-water
- P2-5 A study on development of prediction system for algal-derived taste and odor compounds using two dimensional model
CHONG, Suna
K-water

Poster Session 3

Application of stable isotopes in aquatic ecology and environment

- P3-1 Distribution and sources of organic matter in the surface sediments of the three rivers (Han River, Guem River and Younsan River) estuaries, western coast of Korea
YOON, Suk Hee
Environmental Measurement & Analysis Center
- P3-2 Effects of removal efficiency with an atyid shrimp (*Caridina denticulata*) and a bagrid catfish (*Pseudobagrus fulvidraco*) on cyanobacteria *Microcystis aeruginosa* bloom : in situ mesocosm experiment
KIM, Min Seob
Environmental Measurement & Analysis Center
- P3-3 Microcystin (LR and RR) accumulation of three freshwater bivalves in *Microcystis aeruginosa* bloom through dual isotope tracer experiment
KIM, Min Seob
Environmental Measurement & Analysis Center
- P3-4 Spatial and temporal variation in zooplankton $\delta^{13}\text{C}$ depending on autochthonous organic matters
JANG, Changwon
Kangwon National University
- P3-5 Vertical distribution and sources of dissolved organic matter stable isotope composition in Lake Soyang
JANG, Changwon
Kangwon National University
- P3-6 The seasonal dynamics of Saemangeum food web in relation with desalination and eutrophication
NAKANO, Sho
Kyung Hee University
- P3-7 Inorganic nitrogen uptake by heterotrophic bacteria and phytoplankton in the Yeongsan River, Korea
LEE, Yeonjung
Hanyang University

Poster Session 4

Microbial processes in limnetic systems with special reference to biodiversity, food web dynamics and material cycling

- P4-1 Studies on nitrification in the riparian zone of Longmenkou reservoir in Tai'an, China
TIAN, Weijun
Ocean University of China
- P4-2 Development of a new cultivation technology, I-tip, for studying microbial diversity and its application to freshwater sponges of Lake Baikal, Russia
AHN, Tae Seok
Kangwon National University
- P4-3 Feeding efficiency of cladoceran (*Daphnia* and *Simocephalus*) and ostracod species on blue-green algal bloom
CHANG, Kwang-Hyeon
Kyung Hee University
- P4-4 Spatial and temporal distribution of plankton community and its relation with water quality and fish community in recently created reservoir by multi-purpose dam
Go, Sunmi
Kyung Hee University

Poster Session 5

Ecosystem health, management and conservation

- P5-1 The impact of land uses on benthic macroinvertebrate diversity in the coastal ecosystem of Lake Biwa
SAKAI, Yoichiro
Kyoto University
- P5-2 Fish resources change trend in the Hanjiang River and the Danjiangkou Reservoir, China
YUAN, Jing
Institute of hydrobiology, Chinese academy of sciences
- P5-3 Distributional Characteristics of Alien plants in Riparian Zone of the North Han River, Korea
KONG, Hak-Yang
National Institute of Environmental Research
- P5-4 Relationship between epilithic diatom and environmental variables using four different gradient analysis : A case study in Han River, South Korea
SHIN, Yuna
National Institute of Environmental Research
- P5-5 Influence of land use of riverside area on the species structure of epilithic diatom assemblage : A case study in Han River, South Korea
SHIN, Yuna
National Institute of Environmental Research
- P5-6 Classification of Lake Ecosystems Based on Vegetation Communities and Physico-chemical Factors in South Korea
LEE, Yonghak
Kangwon National University
- P5-7 Analysis of non-point source pollution reduction project effect in Lake Doam and improvement ways
CHOI, Jonghwan
Kangwon National University

Poster Session 6

Ecology and biology of freshwater biota

- P6-1 Random Forest Simulation of the Epilithic Diatom Communities in Geum River Large Influencing Area of South Korea
KIM, Baik-Ho
Hanyang University
- P6-2 Spatial and Temporal Distribution of Epilithic Diatom Communities in Major River Mouth of Korean Peninsula
KIM, Baik-Ho
Hanyang University
- P6-3 Changes of fish fauna after weir construction in the South Han River, Korea
BYEON, MyeongSeop
National Institute of Environmental Research
- P6-4 Variation in fungal activity due to changes in habitat characteristics along a river continuum
CHUNG, Namil
Kyung Hee University
- P6-5 Study on Zooplankton dynamics in different lakes of Southern portion of South Korea
JEONG, Hyungi
National Institute of Environmental Research
- P6-6 Species diversity of the cladocera (Crustacea: Branchiopoda) on the Korean Peninsula and Jeju Island
JEONG, Hyungi
National Institute of Environmental Research
- P6-7 Ecological Characteristics on the Habitat of Manchurian Trout (*Brachymystax lenok tsinlingensis*) Populations in Gyebang Stream and Naerin Stream, Korea
CHOI, Jun kil
Sangji Univ. Wonju, Kangwondo
- P6-8 An Evaluation of Habitats for Freshwater Bivalve Unionid Mussels in terms of Water Qualities in Brooklets Running through Rice Paddy Fields in Himi City, Japan
TANAKA, Hitoshi
Center for Environmental Science in Saitama

- P6-9 Chironomid fauna of Fuji Five Lakes
HIRABAYASHI, Kimio
Shinshu University
- P6-10 Community Structure and Fluctuation of Benthic Macroinvertebrate in 8 Weir Constructions of Nakdong River
KWON, Hyeokyeong
Andong National University
- P6-11 Community Structure of Benthic Macroinvertebrates in 9 Artificial Lakes of Nakdong River System
KIM, Jaehun
Andong National University
- P6-12 Community Fluctuation of Benthic Macroinvertebrates in Upper Nakdong River
LEE, Mijin
Andong National University
- P6-13 Maternal transfer and multi-generational toxicity of waterborne of copper to apple snail
ZHUANG, Hui Lin
China Medical University, Taiwan
- P6-14 Altitudinal distribution of macroinvertebrates in Seom River in Korea
SIM, Youn-Bo
Konkuk University, Seoul, Korea
- P6-15 Diet composition of predatory fish species in relation with predator size class in a lentic freshwater ecosystem, South Korea
LEE, Eunkyung
Pusan National University
- P6-16 A Molecular phylogeny of Japanese Planorbidae (Gastropoda, Pulmonata): Investigation of Japanese Planorbid fauna
SAITO, Takumi
Tohoku University
- P6-17 Appearance of filamentous green algal *Mougeotia* due to water quality restoration in Lake Suwa, Japan
FUTATSUGI, Noriko
Shinshu university

- P6-18 Benthic macroinvertebrates in the small and shallow Lake Nakatsuna, Nishina Three Lakes, Japan
ICHIKAWA, Makoto
Shinshu University
- P6-19 Occurrence pattern and classification of phytoplankton community during cold seasons in the Yeongsan Lake, Korea
LEE, Dahye
Mokpo National Maritime University
- P6-20 Inhibition of *Myriophyllum spicatum* on Bloom-causing Cyanobacteria and Other Phytoplankton Species in a Coexistence Experiment
JEONG, Seon Ah
Ajou University
- P6-21 Aquatic molluscan fauna of the Upper Yenisei River basin (The Republic of Tuva, Russia)
SHARYI-OOL, Mariana
Institute of Biology and Soil Science Far East Branch of the Russian Academy of Sciences

Poster Session 7

Eutrophication Processes in Lake and Reservoir

- P7-1 Relationship between a Dense Population of Cyanobacterium *Anabaena* spp. and Rainfalls in the North Han River System in 2012 and 2013
KIM, Baik-Ho
Hanyang University
- P7-2 Development of a water quality index model for lakes and reservoirs
LEE, Yunkyung
Kangwon National University
- P7-3 Export characteristics of non-point pollutants from agricultural watershed with dammed streams
CHOI, Kwangsoon
Korea Water Resources Corporation
- P7-4 Algae-derived particulate organic matter in the upper regions of a brackish Lake Sihwa
CHOI, Kwangsoon
Korea Water Resources Corporation
- P7-5 A study on the cause of algal bloom and water quality improvement method in Tongyeong Yokji Island, Korea
KIM, Youngsung
K-water
- P7-6 The absorption character of inland entrophic water based on optical classification
LI, Yunmei
Nanjing Normal University
- P7-7 Response of phytoplankton to the cessation of aquaculture in a subtropical lake: a case study
JI, Gaohua
Shanghai Ocean University
- P7-8 Carbon contents of suspended particulate matter in stream and reservoirs
EUM, Jaesung
Kangwon National University

- P7-9 Assessment of Water Quality Variations Under Non-rainy and Rainy Conditions by Principal Component Analysis Techniques in Lake Doam Watershed, Republic of Korea
BHATTRAI, Bal Dev
Kangwon National University
- P7-10 Water quality variation of Gyeongpo Lake before and after submerged weir removal
KWAK, Sungjin
Kangwon National University
- P7-11 Changes of trace elements vertical distribution associated with the appearance of all anoxic layer in Lake Fukami-ike
NOBORI, Megumi
Aichi Institute of Technology

Poster Session 8

Plankton Dynamics in the Asian River Ecosystem

- P8-1 Dynamics of Phytoplankton from major Lakes in the Yeongsan River system
NA, Jeongeun
Yeongsan River Environment Research Center
- P8-2 Effect of long-term water quality improvements on zooplankton community in at urban river (Geum-ho River, South Korea)
KIM, Seong-Ki
Pusan National University
- P8-3 Seasonal distribution of phytoplankton community in estuarial lakes in the Yeongsan river, Korea.
CHO, Hyeon Jin
Chonnam national university

Poster Session 9

Ecotoxicology and environmental chemistry

- P9-1 Phytotoxicity of Engineered nanoparticles nano-titanium dioxide and silver nanoparticle on submerged aquatic plants
SONG, Uhram
Jeju National University
- P9-2 Impacts of low-level pollution by pesticides on freshwater ecosystem structure
HA, Jin-Yong
Toyama Prefectural University
- P9-3 Ecological risk assessment of waterborne copper to freshwater zooplankton community by mesocosms experiment using DGT (gel sampler)
HA, Jin-Yong
Toyama Prefectural University
- P9-4 Hydrogen sulfide in water and interstitial water in Lake Youngrang and Lake Hwajinpo
SUGAHARA, Shogo
Shimane university
- P9-5 Microcystin accumulation in marine Mollusca, *Crassostrea gigas*
MABUCHI, Rie
Shinshu University
- P9-6 Inhibitory effects of the plant secondary metabolites growth of *Microcystis aeruginosa*
FUNAYAMA, Kei
Shinshu University
- P9-7 Determination of the intra- and extracellular cylindrospermopsin produced by the filamentous blue-green algae
ODA, Shoko
Shinshu University
- P9-8 The influence of N:P ratio on toxin and off-flavor production of different cyanobacteria isolated from Han River: Comparison of *Anabaena*, *Microcystis* and *Aphanizomenon*
SEO, Wan Bum
Konkuk University
- P9-9 Effects of the temperature and light intensity on the growth and production of geosmin and microcystin-LR of cyanobacteria
KWON, DaeRyul
Konkuk University

Poster Session 10

Restoration of lakes (reservoirs) and rivers

- P10-1 Habitat restoration for the promotion of biological diversity in artificial lake
HEO, Woomyung
Kangwon National University
- P10-2 Changes in nutrients before and after building a breakhead maintenance construction in Lake Fukami-ike,
Japan
YAGI, Akihiko
Aichi Institute of Technology
- P10-3 Long-Term Runoff Simulation in Gamcheon Watershed using SWAT and K-DRUM Models
NOH, Joonwoo
K-water
- P10-4 Habitat restoration plan and applied technology for the river ecology
KIM, Dong-sup
K-water
- P10-5 Development and application of fish habitat block and methods applied to reservoirs and streams
KIM, Dong-sup
K-water
- P10-6 Establishment of biological habitat data base (DB) for aquatic ecosystem restoration
KIM, Dong-sup
K-water
- P10-7 Fluorescence characteristics of dissolved organic matter(DOM) at inflow streams with different land uses
KIM, Sea Won
Korea Water Resources Corporation
- P10-8 Environmental improvement plans of the Moshui River in Qindao City, China, to reduce pollutants into the
Yellow Sea
CHOI, KwangSoon
Korea Water Resources Corporation

- P10-9 Engineering technologies for high efficiency green-tide harvesting system at the water-bloom of river
KIM, Sea Won
Korea Water Resources Corporation
- P10-10 Water Quality Projection in the Geum River Basin in Korea to Support integrated Basin Wide Water Resources Management
NOH, Joonwoo
K-water Institute
- P10-11 Application of HEC-RAS for the purpose of flood routing in the Ara Waterway
NOH, Joonwoo
K-water Institute
- P10-12 Measurements of Velocity Distribution at the Entrance of Hydro Power Plant at Sejong Weir
KIM, Youngsung
K-water
- P10-13 Fields Measurements on Conversion Factor between Surface Velocity and Average Velocity of Discharge Measurement Using Microwave Water Surface Current Meter
KIM, Youngsung
K-water
- P10-14 Initial effects of large artificial structure construction on South Han River ecosystem, Korea
YOU, Kyung-A
National Institute of Environmental Research
- P10-15 Evaluation of Sediment Oxygen Demand on river
LEE, Yosang
K-water
- P10-16 Water quality impact assessment of river sediment
LEE, Yosang
K-water
- P10-17 Improvement of Microwave Water Surface Current Meter for Efficiency on Discharge Measurements
KIM, Youngsung
K-water

- P10-18 The removal efficiency for unicellular and colonial *Microcystis* sp. and the effect of electrode materials by electrochemical oxidation
Jeon, Bongseok
Shinshu University
- P10-19 Cyanobacterial cell damage and cyanotoxin release by alum treatment
HAN, Jisun
Shinshu University
- P10-20 Habitat preference in epilithic diatom using CART analysis : A case study in Han River, South Korea
SHIN, Yuna
National Institute of Environmental Research

Poster Session 11

Biotechnology and environmental application

- P11-1 A study on the optimum installation plan of algae fence at yeoncho dam water intake tower in Geoje, Korea
KIM, Sea Won
Korea Water Resources Corporation
- P11-2 A comparison and intercalibration of phytoplankton chlorophyll a concentrations determined by two spectrophotometric methods: the trichromatic method and the acidification method
JANG, Changwon
Kangwon National University
- P11-3 Algal growth characteristic in anaerobic digestion effluent of aquatic weed
HIROYO, Takee
The University of Shiga Prefecture

Poster Session 12

Alternative stable states and management of macrophytes in shallow lakes

- P12-1 Long Term Changes in the Dominant Species in Lake Biwa, Japan
HAMABATA, Etsuji
University of Shiga Prefecture
- P12-2 Macrophyte reaping affects macrophyte community at south Lake Biwa
MARUNO, Shinya
University of Shiga Prefecture

Poster Session 13

Other aspects of aquatic sciences

- P13-1 Characterizing geophysicochemical features of lakes and reservoirs associated with plankton composition and carbon biomass
KIM, Hyun Woo
Sunchon National University
- P13-2 Bioaccumulation of mercury from seston to fish through the food web in Lake Biwa
BAN, Syuhei
University of Shiga Prefecture
- P13-3 Species composition and primary production of benthic algae in two shallow blackish lakes located in the northern area along the eastern coast of Korea
ISHIDA, Noriko
Nagoya Women's University
- P13-4 Primary production and litter decomposition of macrophytes in the Sihwa Constructed Wetlands
CHOI, KwangSoon
Korea Water Resources Corporation
- P13-5 Impact on water quality from submerged soil by impoundment of dam reservoirs
LEE, Seungyoon
Korea Water Resources Corporation(K-water)
- P13-6 Early Holocene sea level rise and geomorphological development of the Yeongsan River, Korea
NAHM, Wook-Hyun
Korea institute of geoscience and mineral resources
- P13-7 Acoustic simulation for CAT deployment and now-casting system implementation in Lake Biwa (Jp)
AUGER, Guillaume
Ritsumeikan University
- P13-8 3-Dimensional Hydrodynamic Simulation of Reservoir Sedimentation and Flushing Operation
Noh, Joonwoo
K-water Institute
- P13-9 Is nutritional quality of faeces of freshwater fish, *Danio rerio* upgraded by protozoa?
FUJIBAYASHI, Megumu
Tohoku University

- P13-10 Re-assessment of dissolved organic matter in Lake Biwa using UV absorbance and fluorescence spectra
HAYAKAWA, Kazuhide
Lake Biwa Environmental Research Institute
- P13-11 Construction of environmental friendly algal harvesting system (AHS) to mitigate blue-green algae bloom in reservoir, Korea
CHONG, Suna
K-water
- P13-12 Understanding the historical degradation of floodplain wetlands in the lower Nakdong River, South Korea
IM, Ran-Young
Pusan National University
- P13-13 Village ponds as important landscape components in Eastern India (1) Chilika Lagoon Basin : Patterns of distribution
JOO, Hogyeum
State University of New York at Stony Brook
- P13-14 Comparison and assessment of the fish community impacted by Newtown development in the Jwa-gwang stream, Busan Metropolitan City, South Korea
GIM, JeongSoo
Pusan National University
- P13-15 Fish utilization of Ice harbor-type fishway installed in the Gongju weir by time periods using a trap sampling method
LEE, Jin woong
Kongju National University
- P13-16 Fish utilization of fishway installed in the Sejong weir by time periods using a trap sampling method
PARK, Sang hyeon
Kongju National University
- P13-17 Optically stimulated luminescence dating of Nakdong River deltaic sediments and their accumulation rate, southeastern Korean Peninsula
KIM, Jin Cheul
Korea Institute of Geoscience and Mineral Resources

P1-1

Woody Debris export from forested watershed during rain storms in Korea

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In Korea, many lakes or reservoirs have a significant portion of forested land in their watershed. Woody Debris (WD) or litterfall, particulate organic matter originating from the forest, includes leaves, twigs, barks, flowers, fruits, etc. including organic matter from the riparian zone. Bulk WD enters a lake with varied particle sizes, especially during the monsoon rainy season in Korea. Few studies have quantified how much WD enters aquatic ecosystems and runoff characteristics until now. In this study, I investigated the WD runoff volume and characteristics from the forested watershed. WD was classified to 4 groups as DOC (under 0.45 μm), FPOC (0.45 μm ~ 1 mm), CPOC (1 ~ 2 mm), CPOC (over 2 mm) for quantifying runoff during rain events. This study was conducted in the headwater subwatershed in the upper area of Lake Soyang watershed. The field sampling campaign included 13 rain events and 23 non-rainy days. WD runoff varied with precipitation amount and rainfall intensity during rain events. Variation in discharge and WD runoff were not found for rain events with 20 mm precipitation. DOC concentration simultaneously varied with the increase of discharge, but FPOC and CPOC showed a slight increase or a similar magnitude of DOC in the rain events with 20 to 60 mm precipitation. During rain events with 90 mm precipitation, DOC concentration showed a limited increase with the maximum concentration less than approximately 6 mg/L, while FPOC and CPOC were more than 2 to 15 times. POM and POC were highly correlated and the relationships were coefficient as $\text{CPOM} = \text{CPOC} \cdot 0.53$ ($R^2 = 0.99$), and $\text{VSS} = \text{FPOC} \cdot 0.38$ ($R^2 = 0.89$) which was higher than those for lakes and streams. CPOC: CPON ratio in the CPOM showed 14.9, and FPOC: FPON ratio in the FPOM showed 5.1, indicating that ratio in the CPOM was 3 times larger than FPOM. The runoff ratio of DOC loading tended to increase for rain events of small and intermediate rainfall intensity. But at higher intensity, the runoff ratio of POC was dramatically increased with more than 85% of total loading. The runoff loading ratio of CPOC was similar to FPOC in the rain events over 90 mm. Stream discharge and POC were highly correlated, while DOC showed low correlation owing to the limited concentration indicated under 6 mg/L and irregular runoff concentration depending on the runoff of the soil water in the watershed. FPOC and CPOC also indicated the critical point which was approximately 40 mm precipitation and 0.2 m³/s discharges to generate the runoff. Bulk WD composed of organic matter with more than 90% of dried WD flowed into the lake or river system during the monsoon season annually. WD should be regarded as a pollutant from the non-point source, considering climate change now and in the future, and the proportion of forested watershed in Korea.

Development of a Frequency Analysis Tool of Environmental Extreme Events

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In many cases pollution data sets are skewed so that the symmetric normal distribution is not a suitable model for estimating quantiles, proportions, or means. The lognormal distribution is frequently used for a frequency analysis of skewed data in environmental engineering. The Weibull, gamma, and beta distributions are sometimes used to model environmental pollution data. The K-Water Frequency Analysis Tool (K-FAT) was developed to provide a frequency analysis of environmental pollution, rainfall, and streamflow performance. The K-FAT operates through the inclusion of 14 probability distribution functions. Cunnane (1989) investigated the mostly utilized probability distribution functions in the world. The parameter estimation of the probability distribution functions were conducted in three ways: Method of Moments, Maximum Likelihood Method and L-Moments Method. The goodness-of-fit tests include Chi-Squared, Kolmogorov-Smirnov, Cramér von Mises, Probability Plot Correlation Coefficient (PPCC), and modified Anderson-Darling tests. To determine the best fitting probability distribution type, the methods Akaike Information Criterion (AIC) (Akaike, 1973), and Bayesian Information Criterion (BIC) (Schwarz, 1978) were utilized. These methods were included in the system to help users in deciding on which probability distribution function is best for the environmental and hydrologic data time series. The main program and the sub-program utilizes the Compaq Visual Fortran version 6.6 with 18,530 lines of codes. The GUI of the K-FAT consists of 3 modules: a pre-processing module, which analyzes and generates data from the Databases; a main module, which performs the frequency analysis system; and a post-processing module, which displays the results of the analyses in the form of figures, tables, graphs, plots and texts. This system can contribute to further researches regarding the continuous advancement of environmental and hydrologic statistics.

P1-3

Potential effect of water temperature rise on cyanobacterial harmful algal blooms in freshwater lakes and rivers, Korea

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This study was conducted to analysis the relationship between climate change and cyanobacterial harmful algal blooms in the Daechung Reservoir and the Nakdong River. we specifically examine the relationships between eutrophication, climate change and representative cyanobacterial genera from freshwater (*Microcystis*, *Anabaena*, etc). Cyanobacteria form worldwide harmful algal blooms in freshwater ecosystems. Resent research suggests that eutrophication and climate change are two processes that may promote the proliferation and expansion of cyanobacterial harmful algal blooms. Temperature rise can serve as favorable conditions for cyanobacterial blooms, because water quality was already eutrophic state in the Daechung Reservoir and the Nakdong River. *Microcystis* during the study period was a dominance genus and was composed with potentially toxic and non-toxic *Microcystis* In the Daechung Reservoir. The rate of potentially toxic *Microcystis* is an important in *Microcystis* blooming, because the microcystin concentration can be act as the potentially microcystin in water. In the Nakdong River, the advent of cyanobacterial genera (*Microcystis*, *Anabaena*, *Aphanizomenon*, *Oscillatoria*) has been observed a broad range of water temperatures. To conclude, The increasing temperature by global warming could lead to more frequent cyanobacterial harmful algal blooms.

Long-term variation of water quality and effect of climate change in Lake Soyang

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Lake Soyang is one of the largest reservoir in Korea and located in the upstream region of the Han River that is severing as the main water supply resources to densely populated capital area. In this study, we monitored long-term variation of water quality in Lake Soyang during 20 years.

The concentrations of phosphorus and suspended sediment increased dramatically during rainfall events. The concentrations of total phosphorus(TP) increased from 0.01 to 2.0 g P m⁻³ with a concomitant increase in flow rate and turbidity and phosphorus content in the Soyang River showed an increasing trend since 1996. From middle-1990s to 2006, SS and phosphorus loading of the Soyang River increased dramatically. Phosphorus loading increased from <200 tP .yr⁻¹ before 1996 to a maximum of 300 tP .yr⁻¹ in 2006 and annual average TP, SS and TN loading were 201 kg · km² · y⁻¹, 198,907 kg · km² · y⁻¹, 2,461 kg · km² · y⁻¹. respectively. Water quality problem in Lake Soyang was DO depletion, high phosphorus concentration in the hyperlimnion before 2000, because of fish farm. After closing fish farm, SS and TP were increasing in the metalmnion, So turbidity inflow became major problem. The increasing turbidity due to serious agricultural nonpoint runoff in the watershed and seem to be the impact of climate change with increased total rainfall, rainfall intensity. Because total amount of rainfall was gradually increased compared to past years and rainfall intensity was highly varied in the study area, and chlorophyll a concentration in surface water was maximum after rain periods on July to August, it means phytoplankton growth was affected to turbidity inflow

P1-5

Projection of the effects of climate change on the thermal stability of Juam reservoir, Korea

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As meteorology is the driving force for lake thermodynamics and mixing processes, the effects of climate change on the physical limnology and associated ecosystem are emerging issues. The potential impacts of climate change on the physical features of a lakes or reservoir include the heat budget and thermodynamic balance across the air-water interface, formation and stability of the thermal stratification, and the timing of turn over mixing. In addition, the changed physical processes may result in alteration of materials and energy flow because the biogeochemical processes of a stratified waterbody is strongly associated with the thermal stability and resistance to mixing.

In this study, a novel coordinated modeling framework is developed for projecting the potential effects of climate change on the reservoir water temperature and thermal stability. The framework consists of an artificial neural network(ANN) algorithm for down-scaling GCM(Global Climate Model) output, the Soil and Water Assessment Tool(SWAT) for projecting hydrological and hydro-environmental processes in watershed, a reservoir operation model(Hec-ResSim) for simulating future discharges of reservoir, and a two-dimensional coupled hydrodynamic and water quality model(CE-QUAL-W2) for the assessment of reservoir water temperature, mixing and lakes stability responding to the climate change. The modeling frame work was applied to a warm monomictic Juam reservoir in Korea for exploring the impact of climate change on the reservoir water temperature and thermal regime. The downscaled climatic data from ECHO-G Global Circulation Model using the ANN module were used as meteorological forcing for SWAT based on IPCC's A1B emissions scenario. SWAT simulated the stream flows for the future projection from 2011 to 2100. The outputs of ANN module and SWAT were converted to the boundary conditions of the reservoir model for the projection of reservoir water temperature and thermal stability responding the climate change scenario.

The projection results showed that increasing air temperature will cause higher epilimnion temperatures, earlier and more persistent thermal stratification, and increased thermal stability in the future. The Schmidt stability index used to evaluate the stratification strength of the reservoir showed tendency to increase, implying that the climate change may have considerable impacts on the water quality and ecosystem through changing the vertical mixing characteristics of the reservoir. The increased stability may modify the biogeochemical cycling of nutrients and dominant algal species in the reservoir.

Monitoring cyanobacteria in lake using remote sensing

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This study was conducted to build the retrieval algorithm of the concentration of cyanobacterial pigment - phycocyanin (PC) based on MERIS image, an accessory pigment unique to freshwater blue-green algae. Based on the semi-empirical PC retrieval algorithm proposed by Simis et al., an improved PC algorithm was developed for eutrophic lakes, like Taihu Lake, China. In here, through the extensive field cruises in Taihu Lake, China, the correction coefficients of γ, δ for calculating absorptions of chlorophyll-a at 665nm and absorptions of phycocyanin at 620nm are obtained through a linear least-squares fit in terms of in-situ measurement and found that their values are differ from the values used by Simis et al. (2005) and Randolph et al.(2008). The two parameters should be lake dependent due to different bio-optics of lakes. In this research, we found that, $a_{pc}^*(620)$ decreases exponentially with increase in PC concentrations. Therefore, a non-linear power-function of $a_{pc}^*(620)$ with PC, instead of a constant value of $a_{pc}^*(620)$ as used by Simis et al. (2005) and others (Simis et al, 2007, Randolph et al., 2008), was proposed for retrieving PC concentrations in Taihu Lake, yielding a better result. Then, this algorithm was applied to the MERIS image. At last, a ratio of cyanobacteria accessory pigment, phycocyanin (PC), to the primary photosynthetic pigment, chlorophyll-a, was built to indicate the abundance of cyanobacteria. The result showed that the ratio of PC and Chla has significant relationship with the algae bloom. Although there are no higher chlorophyll-a concentration and phycocyanin concentration in some region in lake, the ratio of PC:Chla was very large in the waters, which indicated this areas has higher possibility of algal bloom than other areas.

P1-7

Characterization of highly strong metal binding ligands in waters of natural lakes in Japan and Korea by electroanalysis

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This study was conducted to understand the existence of highly strong metal complexing ligands in lake waters that determine the fate of heavy metals in water. Sample waters were obtained in Lake Biwa (Shiga, Japan: mesotrophic, freshwater lake), Lake Teganuma (Chiba, Japan: eutrophic, freshwater lake), Lake Yeongrang-ho (Sokcho-si, Gangwon-do, Korea: eutrophic, brackish lake), and Lake Hwajim-po (Goseong-gun, Gangwon-do, Korea: eutrophic, brackish lake). There is high potential of existence of very stable copper complexes in eutrophic brackish and freshwater, as it sometimes includes high concentration of sulfur containing compounds and concentration of competing metals such as calcium and magnesium are very low compared with those in seawater. Pseudopolarography was applied to detect copper complexing ligands that form more stable complexes compared with those detected by other methods such as AdCSV. By analysis of waters sampled at north basin of Lake Biwa, existence of the ligand that has stability close to EDTA was always detected. These types of ligands were also detected by AdCSV using salicylaldehyde as competing ligands. But more stable ligand that forms more stable complex compared with that with EDTA was also detected in some samples, suggesting significance of very stable complexes in water of Lake Biwa. In case of Lake Teganuma, almost all ligand showed stronger complexation than that of EDTA, and it might show the contribution of ligands containing thiol groups or sulfide. In Yeongrang-ho, it also contained highly strong complexing ligand probably because of anoxic condition.

Dynamics of dissolved oxygen and physical properties over an annual cycle in the Youngsan Lake, Korea

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Spatial and temporal dynamics of dissolved oxygen (DO) were investigated over an annual cycle from September 2008 to August 2009 in the Youngsan Lake. Water samples were collected at 5 stations along the channel of the lake and vertical profiles of DO, salinity and water temperature were also measured. Water depth of sampling stations was relatively low compared with other lakes, ranging from 3.6 to 15.3 m. Previous studies have documented that thermocline is not developed due to shallow water depth in the Youngsan Lake. However, thermoclines were observed at lower regions including St. 3, 4, 5 during dry season from April, May and June 2009 in this study. DO levels especially in the bottom water decreased during warm seasons such as fall, spring and summer. Development of thermocline appears to affect depletion of DO in the bottom during warm seasons and at the lower regions with deep water depth (>13 m). Salinity in the bottom water increased to 17.5 psu in January 2009 at St. 5. This suggests that physical properties including water temperature and salinity may also contribute to depletion of DO in bottom water by affecting water stability in the lake although the water depth is shallow.

P1-9

Using Solution-State ^1H NMR to Characterize Particulate Organic Matter in Floodplain and Lake Bottom Sediments in North Han River Watershed, South Korea

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More frequent occurrence of intense rainfall events in monsoon Asia as a potential consequence of climate change has been linked to increases in terrestrial export of particulate organic matter (POM), altering the storage of organic carbon in floodplains and lake sediments in dammed watersheds. Although the fate of POM stored in sediment deposits has important implications for the carbon cycle feedback between inland water systems and the climate, little is known about the biodegradation and chemical transformation of organic carbon stored in sediment deposits on the floodplain and lake bottom sediment. Solution-state ^1H Nuclear Magnetic Resonance (NMR) spectroscopy was used to compare chemical characteristics of organic matter components of the floodplain and lake bottom sediments in the Lake Soyang Watershed and two downstream reservoirs, South Korea. Specifically, we examined the potentials of ^1H NMR spectroscopy to assess the degree of biodegradation and subsequent changes in chemical properties of sediment POM based on functional groups on ^1H NMR spectra. Peaks of the ^1H NMR signals related to aliphatics and carbohydrates/lignin were the dominant fractions across all floodplain sediments. The relative abundance of carbohydrates/lignin peaks decreased from upstream to downstream floodplain sediments to the bottom sediments of the Lake Soyang. By contrast, the relative abundance of CH_2 peaks in the aliphatic region, which is indicative of recalcitrant cuticular lipid components, tended to increase toward the most downstream floodplain and lake bottom sediments. The CH_3 functional group indicative of microbially processed POM fractions occurred in higher abundance in the sediments with high inputs of labile OM. Further analysis is in progress to compare the stability of POM at different sediment depths of the Lake Soyang and two downstream reservoirs. These preliminary results suggest that different fractions identified by solution-state ^1H NMR can allow us to compare stability and microbial processing of sediment POM under different depositional settings.

Using fluorescence EEMs and PARAFAC to compare optical characteristics and biodegradability of dissolved and particular organic matter in a multiple land-use watershed, Korea

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There is a growing interest in transport and biodegradation of dissolved organic matter (DOM) and particular organic matter (POM) in inland waters. However, little is known about downstream changes in characteristics and biodegradability of DOM and POM in watersheds under increasing human influences such as agricultural runoff and increased water retention time through dams. To compare optical characteristics and biodegradability of DOM and POM as influenced by land use patterns in the Lake Soyang Watershed, a dammed, mountainous watershed, a 14-day laboratory incubations were performed with water samples collected during the peak flow period of a monsoon rainfall event at three locations: a headwater forest stream, an agricultural stream, and a downstream river. Along with biodegradable dissolved organic carbon (BDOC), changes in fluorescence excitation emission matrices (EEMs) during the incubation were compared for DOM, suspended sediment-derived DOM (SS-DOM), and reference materials (humic acid, fulvic acid, and algal extract), using a parallel factor analysis (PARAFAC). BDOC concentrations were relatively low in both DOM (7-15% of the initial DOC concentrations) and SS-DOM (3-17%) across the three sites, compared to the labile algal extract (57%). For both DOM and SS-DOM, BDOC concentrations were highest at the agricultural stream, followed by the downstream river and the forest stream. Three fluorescence components were identified by the PARAFAC modeling, including humic-like (Component 1), fulvic-like (Component 2), and protein-like fluorescence (Component 3). Three PARAFAC components exhibited noticeable changes in fluorescence intensity during the incubation, with overall increases for Components 1 and 2 and decrease for Component 3. Components 1 and 2 of both DOM and SS-DOM had the strongest specific fluorescence per unit mass of DOC at the agricultural stream, whereas Component 3 exhibited increasing specific fluorescence toward the downstream river. Site-specific changes in fluorescence during the short incubation suggest that fluorescence EEMs combined with PARAFAC can be efficiently used to investigate subtle changes in organic matter characteristics associated with biodegradation in inland waters under different levels of anthropogenic influences.

P1-11

Distribution and chemical characteristics of dissolved organic matter in Lake Biwa extracted by hydrophobic adsorbents

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Dissolved Organic Matter (DOM) is defined as organic matter which pass through the filter with pore size of 0.2~1 μm . DOM is a ubiquitous material that is a main energy source for bacteria and affects the stability of other chemicals by adsorption and complexation in natural waters. However, there has been very limited information about quality of DOM mainly because DOM is a mixture of thousands of unknown compounds. Solid phase extraction methods using hydrophobic adsorbents such as C₁₈ silica gel (C₁₈) and DAX-8 (DAX) are widely used for extracting organic materials. Cumulating the information about chemical characteristics of DOM separated by these adsorbents from natural waters is important. Purpose of this study is to find the chemical differences between DOM extracted by these two methods which have different surface chemical structures.

Water samples were collected from the north basin of Lake Biwa on May, September, November 2010 and February 2011. Collected samples were filtered with GF/F filters and stored at 4 °C under dark condition until analysis and experiments. For C₁₈ extraction, samples adjusted at pH2 with 2M hydrochloric acid were passed through C₁₈ discs (Empore Disk, 3M Japan) which were activated with Methanol and washed with ultra-pure water to remove Methanol. For DAX-8 extraction, samples adjusted at pH2 with hydrochloric acid were passed through a column packed with DAX-8 (Supelite DAX-8, Sigma-Aldrich, USA) beads pre-washed by the method that international humic substances society recommended. For ¹³C NMR analysis, extraction using large volume column packed with C₁₈ and DAX resin was done for surface water (2.5 m) and deep water (60 m) taken on September, 2010.

From ¹³C NMR spectra, aliphatic carbon ratio was higher in C₁₈ extracted DOM (46.8%) than in DAX (32.8%) in the surface water. Methoxyl and aromatic carbon ratios were higher in DAX (27.2%, 16.3%) than in C₁₈ (21.6%, 12.9%). At deep water, methoxyl carbon ratio was higher in C₁₈ extracted DOM (28%) than in DAX (20.2%). Aromatic carbon ratio was higher in DAX extracted DOM (22.5%) than in C₁₈ (12.3%). There were clear differences in characteristics between the extracted DOM samples by C₁₈ and DAX. In the surface water, adsorption rates of DOM from these two extraction methods were similar in May and September. While DAX adsorption rate increased in November and February and showed higher than that of C₁₈. These results suggested that these two hydrophobic extraction methods distinguished the partial composition of DOM in surface water by their surface chemical structures.

Distribution and chemical characteristics of dissolved organic matter in Lake Biwa extracted by activated alumina

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Dissolved organic matter (DOM) plays important roles in the biogeochemical cycles in aquatic ecosystem. However, there have been quite limited information of the chemical compositions and behaviors of DOM because of the difficulty in separating the components of DOM in molecular level.

Separation techniques using variety of adsorbents are widely used for extracting DOM. We tried to separate DOM in Lake Biwa using activated alumina, which adsorbs polar materials, and compare the distribution and chemical characteristics of the extracted fraction with one separated by hydrophobic C₁₈ silica gel (C₁₈).

Water samples were collected from the north basin in L. Biwa on February, August and November in 2013. Collected samples were filtered with GF/F filters and stored at 4 °C under dark condition until analysis and experiments. Extraction experiments of DOM were done using activated alumina powders (aluminum oxide, Wako) and C₁₈ discs (Empore Disk, 3M Japan). Extraction pHs were adjusted around 3, 5, 7, 9 using 2M hydrochloric acid and 0.5 M Sodium hydroxide solutions. Adsorption rate was calculated by subtracting DOC value of a non-adsorbed fraction from the bulk DOC value. 3D excitation emission matrix spectroscopy (3D EEMs) was conducted for bulk and non-adsorbed DOM using FP-6200 fluorescence spectrometer (Jasco, Japan). Wavelength ranged from 260 to 450 nm for excitation, and from 260 to 500 nm for emission. Fluorescence intensities were converted into quinine sulfate units (QSU).

Adsorption rate of L. Biwa DOM for alumina varied 27 ~ 69% with pH for February sample. The maximum adsorption rate was obtained in acidic condition around pH3. In contrast, adsorption rate for C₁₈ varied 0 ~ 39% with pH, and the maximum adsorption rate was obtained weak acidic condition around pH5. In the 3D EEMs spectrum, a humic-like peak at Ex/Em=330/407 nm was observed in all bulk samples. This humic-like peak was separated by C₁₈ with acidic condition efficiently but showed weak affinity with alumina. We will also present about the chemical characterization of DOM upon the results from Fourier transform ion cyclotron resonance mass spectrometry (FT ICR MS) and Nuclear magnetic resonance spectroscopy (NMR) analyses.

P2-1

The effects of sampling frequency on the results of water quality modeling during the rainy season in Lake Soyang, Korea

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The high-frequency data measured real-time water temperature and turbidity in 2006 and 2008 during rainy season in Lake Soyang, Korea, were employed to assess the effects of sampling frequency on the results of modeling in a 2-D hydrodynamic and water quality model, CE-QUAL-W2 (v.3.6). The model accurately simulated surface water levels from 2004 to 2010 with Root Mean Square Error (RMSE) of 0.53m. The RMSE of water temperature, DO, TSS, and TP during verification period were 1.87°C, 1.58 gm⁻³, 13.43 gm⁻³, and 0.025 gm⁻³ respectively. The model scenarios set boundary conditions as model input data, inflowing water temperature and water quality constituents, to various time intervals with 3, 6, 12 hours and 1, 2, 3, 7, 15, 30 days. The effects of sampling frequency for water temperature on the results of modeling didn't show a big difference up to the interval of every 7 days. The RMSE of water temperature was less than 0.10°C and 0.39°C each until sampling intervals were every 3 hours and 7 days. Unlike water temperature, the RMSE values of DO, TSS and TP showed a sharply increasing tendency with longer sampling frequency. The range of RMSE for DO, TSS, and TP were 0.01-1.12 gm⁻³, 0.23-7.79 gm⁻³, and 0.001-0.096 gm⁻³ respectively at sampling interval of every 12 hours. These values of DO and TSS were less than the RMSE during the model verification. The RMSE of TP showed the lower values than the RMSE of the model verification when it was at sampling interval of every 6 hours. It is important to use the high frequency sampling data of water temperature and water quality of inflowing water during rainy season, in order to simulate the modeling related to the longitudinal transport phenomena of turbid storm runoff in the lake. For a low error range and an accurate water quality modeling, sampling interval of the main inflowing water is necessary to carry out more than 4 or more times a day (at least 6-hour interval). Model user should be decided the sampling interval for model input data based on allowable error range according to the purpose of modeling application.

Assessment of Water quality changes of the Gunwi Reservoir after dam impoundment

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The Impoundment of the reservoir brought changes on the river's environment such as hydraulic characteristics, water quality, and ecosystem. To estimate these environmental impacts, water quality simulations are conducted before a dam's construction. Inflows during a summer monsoon can cause a severe influence on the receiving waterbody. Thus, appropriate field surveys should be conducted to estimate a monsoon's effect. Monthly water quality data is used for water quality trend analysis in Korea, and it can cause a misunderstanding that the impoundment caused degraded water quality. In case of the Gunwi reservoir, the impoundment was conducted in 2009 and after the impoundment high COD concentrations were shown in comparison to the modeling results from the EIA report. A water quality simulation model was used to analyze water quality changes after the impoundment and to perform test trial impoundment scenarios in order to minimize the impact on the reservoir waterbody. Elution from bottom sediment was not considered because there was no discrete trends of water quality by depths. 2D water quality with a hydrodynamic model was used for this analysis. Monthly water quality data from 2010 to 2011 with storm sampling were used and a model was calibrated using monthly monitored data from dam sites. Three impoundment scenarios were used; actual operation case (case 1), shorten the lasting periods of maximum water level in 55 days (case 2), and shorten the lasting periods of maximum water level in 110 days (case 3). Simulation results show that periods showing under COD 4 mg/L were 15, 19 and 71 days, respectively. It was shown that to minimize the retention time of water during the test impoundment was effective for water quality stabilization after impoundment.

P2-3

Water quality simulation of trial dam impoundment of the Boohang Reservoir

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Since 2009, a trial impoundment for a reservoir was conducted to test the stability of its hydraulic facilities. During the trial impoundment periods, stagnation of contaminants entered from the watershed causing significant water quality degradation. To minimize water quality degradation caused by the impoundment, three different reservoir operation scenarios were put in place according to water levels (elevation 161.5m, 165.0m, 170.0m, Case 1, 2, and 3). After the trial discharge (Case 4) no trial impoundment scenarios were considered. A two-dimensional water quality and hydrodynamic model was used for simulation. Grid generation was conducted using a topographical map and a computational grid that consisted of 38 segments with 200m longitudinal spacing and 46 layers with a 1m depth. Both the monthly water quality data from 2006 to 2012 and parameters from the Gunwi reservoir model were used. Inflow was calculated based on flow monitoring data from the Gumi gauging station considering the watershed area. Simulation results show that case 1 (trial impoundment and discharge at elevation 161.5 m) shows a lower concentration of COD compared to case 4 (no trial impoundment and discharge) and the maximum COD concentration difference was 1.35mg/L. Previously impounded reservoirs showed a COD decrement trend of about 0.1mg/L/year and simulation results showed the trial impoundment and discharge was effective to shorten the water quality stabilization period.

Comparison of spatial characteristics of algae occurrence in Daecheong reservoir and Chungju reservoir during the summer season using ELCOM-CAEDYM

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Daecheong reservoir and Chungju reservoir are large artificial lake that capacity 14.9 billion ton and 27.5 billion ton respectively, important drinking water resources supplying water to the capital and central region of South Korea. Several artificial lakes in Korea, algal-bloom frequently occur impact of climate change, pollution increase according to urbanization and industrialization. Blue-green algal bloom have been reported in Daecheong reservoir more than 30 days every year. On the contrary, Chungju reservoir which nutrient concentrations are relatively similar doesn't have algae problems, comparative study are needed on the occurrence mechanism of algal bloom between the two reservoirs. A three-dimensional, coupled hydrodynamic and ecological model, ELCOM-CAEDYM, was applied to the two reservoirs in order to analyze the cause of algal-bloom by comparing the spatial characteristics of algae occurrence. Simulation result shows that for the period of june to october 2007 in Daecheong and july to august 2008 in Chungju, each reservoir has the similarities and differences in the spatial algae appearance. Both the two reservoirs algal-bloom started in the highly contaminated river tributaries, So-ok stream in Deacheong reservoir, Je-cheon stream in Chungju reservoir. In Daecheong reservoir, blue-green algal bloom which started from So-ok stream have spread to the mainstream through Hoenam near front of dam after the rainfall occur. However, in Chungju reservoir has a relatively small algae occurrence, because of the high concentration of algae from the Je-chon stream did not spread to the mainstream. The result shows that the cause and spatial difference of algal bloom closely related to hydraulic characteristics of the two reservoirs.

P2-5

A study on development of prediction system for algal-derived taste and odor compounds using two dimensional model

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For several years, taste and smell problems of tap water occurred during the summer season in metropolitan cities of Korea. Taste and odor(T&O) compounds such as geosmin and 2-MIB, is produced by some species of cyanobacteria(blue-green algae) and can be detected by consumers at concentration as low as 5~10 ng/L. In this study, 2-D hydrodynamic and water quality model, CE-QUAL-W2, is applied to predicting the algal-derived T&O compounds occurrence. Modifying the source code of existing model, we added a function to calculate T&O compounds, geosmin production amount per algae biomass was the main parameter. Model divided into five serial impoundment waterbodies in the North Han River - 3 reservoirs(Uiam, Cheongpyeong, Paldang) and 2 streams between the reservoirs, and simulation period was 2009~2013. Computing constituents were 14 items including diatom, cyanobacteria, other algae groups. The model results showed a good agreement with field measurements from upper reservoirs to Paldang reservoir and it can efficiently predict the occurrence of blue-green algae bloom. Blue-green algae was simulated growth rapidly especially sensitive to physical conditions such as water temperature and residence time, actual odor event and the simulation results were consistent.

Distribution and sources of organic matter in the surface sediments of the three rivers (Han River, Geum River and Younsan River) estuaries, western coast of Korea

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The composition and distribution of n-alkanes and total organic carbon (TOC), total nitrogen (TN), isotopic composition ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$) were analyzed for the surface sediments collected at 16 sites from Han, Geum and Younsan River, west coast of Korea. These proxies have been determined to identify the sources of this material to coastal sediments. The average values of TOC/TN (C/N) ratios and $\delta^{13}\text{C}$ show 5.24, -21.76 ‰, 4.58, -21.35 ‰ and 4.38, -20.79 ‰, in the sediments of Han, Geum and Younsan River estuaries, respectively, demonstrating strong correlation between C/N ratios and $\delta^{13}\text{C}$ values. The C/N ratios and $\delta^{13}\text{C}$ values indicate that the origin of sediment organic matter is mainly autochthonous organic matter, suggesting that relatively small contributions of land-derived organic matters. Also, the average concentrations of total n-alkanes are 15.50 ug/gdw, 20.54 ug/gdw and 16.03 ug/gdw, in three river estuaries respectively. In general n-alkanes present almost ubiquitously in sediments and their distributions have been widely used to identify OM sources. The surface sediments of the Geum River contained comparatively larger contribution of autochthonous organic matter. The Carbon Preference Indexes (CPI) of all surface sediments varied between 0.89 and 2.48, showing an average of 1.55. In this study, chain length and carbon stable isotope signatures of individual n-alkanes, carbon isotopic signature are applicable to distinguish source and characteristics of organic matter at the estuary sediment of Han, Geum and Younsan River, western coast of Korea.

P3-2

Effects of removal efficiency with an atyid shrimp (*Caridina denticulata*) and a bagrid catfish (*Pseudobagrus fulvidraco*) on cyanobacteria (*Microcystis aeruginosa*) bloom : *in situ* mesocosm experiment

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The removal efficiency of *Caridina denticulata*, an atyid shrimp, on *Microcystis aeruginosa* bloom were evaluated in a mesocosm study with stable isotope tracers (¹³C and ¹⁵N) in a eutrophic reservoir. The accumulated assimilation (atom %) of *M. aeruginosa* into *C. denticulata* was increased, causing a significant reduction in the concentration of Chl-*a*. The ingestion rate of *M. aeruginosa* by *C. denticulata* was influenced by predation pressure exerted by bagrid catfish *Pseudobagrus fulvidrao* and was dependent on biomass ratio. *C. denticulata* affected zooplankton density, species composition and ingestion rate, demonstrating that the number of cladocera (*Bosmina coregoni* and *Bosmina longispina*) increased because the *M. aeruginosa* colony was a food source for them. This study suggests that *C. denticulata* and *P. fulvidraco* can be used to control *M. aeruginosa* bloom.

Microcystin (LR and RR) accumulation of three freshwater bivalves in *Microcystis aeruginosa* bloom through dual isotope tracer experiment

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Stable isotope tracers were first applied to evaluate the *Microcystis* cell assimilation efficiency of *Anodonta* bivalves, since the past identification method has been limited to track the changes of each chl-*a*, clarity, and nutrient. The toxicity profile and accumulation of microcystin-LR, -RR and YR in different organs (foot and digestive organs) from the three filter-feeders (*Anodonta woodiana*, *Anodonta arcaeformis*, and *Unio douglasia*) were assessed under the condition of toxigenic cyanobacteria (*Microcystis aeruginosa*) blooms through an *in situ* pond experiment using ¹³C and ¹⁵N dual isotope tracers. Chl-*a* concentration in manipulated pond was dramatically decreased after beginning 2nd day, ranging from 217.5 to 15.6 µg/L. The highest amount of microcystin was incorporated into muscle and gland tissues in *U. douglasia* during study period, which were nearly 2 or 3 times higher than *A. woodiana* and *A. arcaeformis*. In addition, the incorporated ¹³C and ¹⁵N atom % of *U. douglasia* bivalve showed lower value rather than other bivalves. The results demonstrated that *U. douglasia* had smaller capacity to assimilate the toxic cyanobacteria derived from diet. However, the incorporated ¹³C and ¹⁵N atom % of *A. arcaeformis* showed a larger feeding capacity rather than *U. douglasia* and *A. woodiana*. These results also included that *A. arcaeformis* can eliminate the toxin more rapidly than *U. douglasia* by larger detoxification capacity.

P3-4

Spatial and temporal variation in zooplankton $\delta^{13}\text{C}$ depending on autochthonous organic matters

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To understand dynamics of zooplankton and phytoplankton between pre- and post-monsoon, we compared temporal changes in the phytoplankton community, Chlorophyll-*a* (Chl-*a*) concentration, DOC (dissolved organic carbon) concentration and stable carbon isotope ratio ($\delta^{13}\text{C}$) of zooplankton in aquatic ecosystems. The dominant phytoplankton assemblage changed from diatoms in pre-monsoon to blue green algae in post-monsoon. Zooplankton $\delta^{13}\text{C}$ values during the pre- monsoon were lighter than that of post-monsoon at all study sites indicating that it is likely related to seasonal variation of phytoplankton density and $\delta^{13}\text{C}$ values. Cyclopes copepods and *Daphnia galeata* $\delta^{13}\text{C}$ values were higher post-monsoon than pre-monsoon. In the South Han River, zooplankton $\delta^{13}\text{C}$ values was positively related to both Chl-*a* and DOC concentrations, indicating the dependence of zooplankton on autochthonous organic matter as a food source. Carbon stable isotope analysis can be give useful information for more detailed understanding of aquatic environment in monsoon region.

Vertical distribution and sources of dissolved organic matter stable isotope composition in Lake Soyang

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In previous studies, vertical distribution of DOM concentrations in Lake Soyang have mainly focused on the spatial and temporal variations whereas there is little known about DOM sources by depth. The purpose of this study is to understand the cause of formation about the two oxygen deficit of water column and the vertical distribution of DOM sources according to seasonal variation in Lake Soyang. The oxygen deficit in the epilimnion was formed in the vicinity of compensation depth during stratification periods and in the metalimnion, there is formed on the 50 m in monsoon season. The vertical distribution of DOC concentrations and SUVA values, respectively, ranged from 1.11 to 1.94 mg·L⁻¹ and from 0.95 to 4.42 m⁻¹·L·mg⁻¹. The vertical distribution of DOC concentrations was little different, but the SUVA values showed difference among depth depending on monsoon rainfall. The vertical distribution of DOM stable isotope composition also differed among depths, which decreased from surface to 30m in metalimnion and increased at 60m during monsoon rainfall. The DOM $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values ranged from -25.3‰ to -9.3‰ and from 1.3‰ to 8.4‰, there may be reflected in difference of relative contribution of organic matter such as autochthonous or allochthonous organic matter. This study suggested that the oxygen deficit in epilimnion may be result in decomposition of origin of autochthonous organic matter unlike in metalimnion and hypolimnion by SUVA values and stable isotope analysis. To understanding the vertical distribution of DOM and the origin at artificial lakes, carbon and nitrogen stable isotope analyses may be one of useful method.

P3-6

The seasonal dynamics of Saemangeum food web in relation with desalination and eutrophication

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The Saemangeum reservoir is enclosed brackish reservoir created by huge dyke construction. Additionally, this reservoir has been received strong eutrophication impacts from the basin and sea water input through the sluice gates of the dyke simultaneously. The Saemangeum reservoir provides the various habitats for freshwater, brackish and marine species, therefore the ecosystem structure is dramatically changing spatially as well as temporarily. Generally, the food web analysis using carbon and nitrogen stable isotope ratio ($\delta^{13}\text{C}$ and $\delta^{15}\text{N}$) is utilized to estimate the ecosystem structure and function. Dual $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ composition indicate the origin of organic matter and nutrients flows (i.e. distribution of food sources and pollutants) and trophic relation. Thus the food web analysis is often necessary to understand the complicated ecosystem structure for quantitative evaluation. In this study, we carried out food web analysis using stable isotopes to understand spatial and temporal dynamics of the food web and their interactions with environmental changes. Species composition including plankton, macroinvertebrates and fish, and their carbon and nitrogen isotope ratios were monitored in 17 sites of Saemangeum reservoir from July 2013 to April 2014. The results have showed that the food web structure and biological interactions in Saemangeum respond sensitively to seasonal changes of salinity. The $\delta^{13}\text{C}$ values showed that impact of freshwater input and consequent eutrophication was the most important factors for the distribution of organisms while seawater input through sluice gate induced typical brackish food web structure particularly in April. On the other hand, the food web showed intermediate status. The impacts of eutrophication on Saemangeum food web and the application of stable isotopes of organisms to long-term monitoring of food web in response to environmental changes were discussed in the present study.

Inorganic nitrogen uptake by heterotrophic bacteria and phytoplankton in the Yeongsan River, Korea

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The inorganic nitrogen uptake rates of heterotrophic bacteria and phytoplankton were estimated using ¹⁵N-labelled nitrogen substrate in the Yeongsan River at November 2009 and January 2010. The experimental periods were characterized by the absence of cyanobacteria which is the photosynthetic prokaryote. The specific metabolic inhibitors of eukaryote and prokaryote were used to inhibit nitrogen metabolism of each group. The ammonium nitrogen was preferentially utilized rather than nitrate by both groups, and the uptake rates of inorganic nitrogen by heterotrophic bacteria were higher than those by phytoplankton during the initial four hours. The contributions of heterotrophic bacteria to nitrate and ammonium uptake were higher than 57% and 84%, respectively. Our results suggest the possibility that severe competition between heterotrophic bacteria and phytoplankton for inorganic nitrogen uptake. The estimation of inorganic nitrogen assimilation would be significantly influenced by the contribution of heterotrophic bacteria.

P4-1

Studies on nitrification in the riparian zone of Longmenkou reservoir in Tai'an, China

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Riparian zone is an important ecological ecotone between land and water, its function of prevention and control of agricultural non-point source pollution, conservation of soil and water as well as amelioration of soil play an important role in controlling the eutrophication of the water, protecting water sources, sustaining biological diversity and functional integrity of ecosystem. In this research, nitrogen, nitrobacteria, nitrification rates and their impact factors were discussed in the riparian zone with and without hydrophytes of Longmenkou reservoir with agricultural runoff in July, August and September 2012. The result showed the number of ammonia-oxidizing bacteria (AOB) and nitrification rates at the area with agricultural runoff and hydrophytes were highest, ranged from 65.0×10^4 to 110×10^4 cells·g⁻¹ and from 25.75 to 45.21 mg·kg⁻¹·d⁻¹ in top soils respectively. And the numbers of AOB and nitrification rates obviously decreased with the increase of soil depth. The numbers of AOB increased from July to September, which was similar to the change of NH₄⁺-N concentrations. The characteristic of nitrification rates showed that summer was faster than autumn. The number of AOB, NH₄⁺-N, TN, TP, moisture content and temperature were key impact factors of nitrification in the riparian zone of Longmenkou reservoir. The results further verified that the ammonia oxidation was limiting step of nitrification.

Development of a new cultivation technology, I-tip, for studying microbial diversity and its application to freshwater sponges of Lake Baikal, Russia

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Microbial diversity is nowadays going to more important topics for economic and industrial purpose. One of the fundamental methods for cultivating bacterial strains is conventional plating on solid media, but this method does not reveal the true diversity of the bacterial community. In this study we develop a new technique and introduce a new device we term, I-tip. The I-tip was developed as an *in situ* cultivation device that allows microorganisms to enter and natural chemical compounds to diffuse, thereby permitting the microorganisms to grow utilizing chemical compounds in their natural environment. The new method was used to cultivate microorganisms from Baikalian sponges and the results were compared with conventional plating as well as a pyrosequencing-based molecular survey. The I-tip method produced cultures of 34 species from five major phyla, *Actinobacteria*, *Alphaproteobacteria*, *Betaproteobacteria*, *Firmicutes*, and *Gammaproteobacteria*, “missing” only two major phyla detected by pyrosequencing. Meanwhile, standard cultivation produced a smaller collection of 16 species from three major phyla, *Betaproteobacteria*, *Firmicutes*, and *Gammaproteobacteria*, failing to detect over half of the major phyla registered by pyrosequencing. With this method, the I-tip method can narrow the gap between cultivated and uncultivated species, at least for some of the more challenging microbial communities such as those associated with animal hosts.

P4-3

Feeding efficiency of cladoceran (*Daphnia* and *Simocephalus*) and ostracod species on blue-green algal bloom

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Cladoceran species often play a key role in controlling phytoplankton abundance in freshwater ecosystem since they have superior grazing ability with wide spectrum of ingestable particle size. Despite the previous studies could not guarantee the efficient consumption of major large *Daphnia* species on blue-green algal species, the *Daphnia* consumption on phytoplankton is still considered as core top-down controlling force in the application of biomanipulation to eutrophic systems. This ability is also applied to nutrient removal system in wastewater treatment using the food chain interaction where *Daphnia* removes phytoplankton biomass which absorbed nutrients from the wastewater. In the present study, we tested removal efficiency of large cladoceran species including *Daphnia similoides* and *Simocephalus cf. vetulus*. We also analyzed foraging efficiency of *Daphnia galeata*, most widely distributed genus in lakes as well as large rivers. Especially, we tested removal ability of ostracod species which has been suggested as applicable animal for algal biomass removal. We used blue-green algal species collected from eutrophic water body (Giheung and Chodae reservoirs), and the responses of cell number and colony size, and consequent chlorophyll *a* concentration, against the short-time exposure (24 h) to each grazer. The somatic growth of grazer species and changes of available nutrient concentration by grazing activity of each grazer species were also estimated through laboratory experiments.

Spatial and temporal distribution of plankton community and its relation with water quality and fish community in recently created reservoir by multi-purpose dam

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Dam has an important function to secure water resource, and creates a variety of added values such as taking advantage of power production. On the other hand, in terms of ecological aspect, dam construction may effect aquatic ecosystems and terrestrial ecosystems. Especially, when the reservoir is made by the construction of a new dam, a totally new freshwater habitat can be formed. Consequently, the secondary succession of plankton and fish communities occur, due to the initial water body formation. Therefore, It provides opportunity to track the process of the formation of aquatic biological community and its succession. Especially, initially formed community will change in accordance with eutrophication which proceeds over time. This study was performed in Gunwi dam made in December 2010, to understand such succession process. The survey was carried out at 4 selected sites(near dam site and sites near inflow rivers) April 2013 to March 2014. Species composition consisted with rotifer, cladoceran and copepod, showing typical composition of oligotrophic water with dominances of *Daphnia galeata* and calanoid copepod. Predacious cyclopoid copepods often showed high abundances. During spring, *D. galeata* and copepod species showed diel vertical migration pattern even though the water depth of studied site was shallow as 5 m deep. We estimated the spatial and temporal distribution of plankton community and its relation with water quality and fish community.

P5-1

The impact of land uses on benthic macroinvertebrate diversity in the coastal ecosystem of Lake Biwa

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In freshwater ecosystems, at present, biodiversity loss has progressed rapidly, with an accelerating rate, due to anthropogenic disturbances ranging from local human activities to global climate change. Change in land uses is considered one of primary drivers for the biodiversity loss in lakes through alteration of nutrient loadings from rivers. However, we have difficulty in detecting such a driver because multiple anthropogenic stressors simultaneously operate on a focal lake ecosystem on a variety of scales. Comparative approaches also have a fundamental problem because historical and biogeographical backgrounds cannot be controlled for each of study lakes. Here we try to examine how land use pattern affects diversity of benthic macro-invertebrates in coastal waters of Lake Biwa, in which catchment areas are highly heterogenous in land uses and thus nutrient loadings vary in quality and quantity across tributary rivers. We conducted within-lake comparison of benthic macro-invertebrate communities in coastal waters, all of which share the species pool within the lake basin but vary in community composition depending on local environments. We used a dataset of zoobenthic communities at 33 coastal sites, their biological and physico-chemical environments, and GIS-based land use pattern in catchment of tributary rivers adjacent to these coastal sites. According to a causal framework of DPSIR, we performed structural equation modeling (SEM) to describe indirect interactions between land uses in the river catchment and zoobenthic community responses in coastal waters. The SEM showed that wave-driven turbulence and coastal substrate types are primary environmental factors to alter the zoobenthic diversity. In coastal waters with sandy and muddy bottoms, the zoobenthic diversity was the lowest. The SEM also detected a significant path in which the coastal substrates become sandy and muddy with the increasing area of paddy fields in the catchment, suggesting that the paddy fields enhance sedimentation in coastal waters. Since implementation of Lake Biwa Comprehensive Development in 1972, the paddy field irrigation has been transformed into a modern system in which irrigation waters are pumped up from the lake and agricultural waste waters are directly drained into coastal waters, with increased loadings of paddy field-derived suspended substance. Considering that the paddy fields serve as a hotspot of wetland-dwelling organisms, the best solution is to improve the paddy field irrigation system into the traditional one which serves as habitat networks with the decreased nutrient loadings. We also discuss the possibility and difficulty in promoting the traditional irrigation system in the paddy fields.

Fish resources change trend in the Hanjiang River and the Danjiangkou Reservoir, China

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The Hanjiang River is the biggest branch of the Yangtze River and the Danjiangkou Dam was built in 1958 in the middle and upper reach of the branch. During the past over 50 years, fish resources changed significantly in the middle and lower reach of Hanjiang River and the Danjiangkou Reservoir. Some of fish spawning grounds disappeared below or up the dam. Spawning time of important commercial fishes was delayed and their growth rate decreased. Catch of commercial fisheries decreased below the dam, but increased up the dam. The spawning scale of main carps has shown the trend of decrease both below and up the dam. Some exotic fish species appeared in the reservoir area because of escape from cage culture farms. Changes of fish resources are related with narrower range of year-round water temperature below the dam decrease of seasonal water flow fluctuation range below the dam and changes of food organisms below and up the dam. In order to implement the water diversion policy from South China to North China, the dam was increased 10 meters in 2012 and the new impoundment will begin in the end of 2014. Further change of fish resources could be expected and conservation strategies for fish resources are suggested.

P5-3

Distributional characteristics of alien plants in riparian zone of the North Han River, Korea

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Riparian vegetation gives basic habitats for animal and other biological organisms. It is one of essential landscapes in river ecosystem. This floral study was conducted to give basic information for management of the North Han River ecosystem. We discovered total 71 species and 17 dominant communities out of 65 sites studied and mean 12.7 species and 1.17 dominant communities were analyzed per study site. *Robinia pseudoacacia*(23 sites), *Erigeron annuus*(9 sites) and *Ailanthus altissima*(8 sites) were most dominant as community and *Erigeron annuus*(55 sites), *Rumex crispus*(49 sites), *Ambrosia artemisiifolia*(46 sites), *Oenothera biennis*(45 sites) and *Bidens frondosa*(43 sites) were frequently appeared as species. The most abundant site was H194, main stream of North Han River site (28 species) and the least abundant sites were in H172, H176, H195, inflowing tributary(1 species). Riparian zone of the North Han River were covered with alien plant communities 3,558 m² per sites, averagely. H190 sited, Soyang River was most covered with *Aster pilosus*, invasive alien species (33,512 m²). 25 sites of 65 sites were not covered with alien plants. We suggest that continuous alien plants monitoring in riparian zone should be carried out to manage water environment ecologically.

Relationship between epilithic diatom and environmental variables using four different gradient analysis : A case study in Han River, South Korea

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This study was conducted to understand the relationship between epilithic diatom and environmental variables using four different gradient analysis : Correspondence Analysis (CA), Multidimensional Scaling (MDS), Redundancy Analysis (RDA), Canonical Correspondence Analysis (CCA). 35 environmental variables and 6 epilithic diatoms (*Achnanthes minutissima*, *A. convergens*, *Nitzschia amphibian*, *N. fonticola*, *N. inconspicua*, *N. palea*) were used to perform four gradient analysis. This field dataset was monitored in fifty eight sites along the Han River in spring and autumn of 2008 to 2010 and obtained from water quality monitoring networks operated by the Korea Ministry of Environment. CA showed that *Achnanthes minutissima* was positively correlated with high altitude and percent forest and *Nitzschia palea* positively with high TN and TP concentration. As a result of CCA, relative abundance of *A. minutissima* was affected by high altitude and *N. palea* by TN and conductivity. MDS displayed that *A. minutissima* was positively correlated with high altitude, percent forest, depth of water and percent shrub and *A. convergens* positively high DO. *Nitzschia amphibia* was affected by high percent herb and *N. inconspicua* by high percent canopy. RDA showed that *A. minutissima* was positively correlated with high chlorophyll *a* and low run, and *A. convergens* positively with high chlorophyll *a* and run. RDA by Euclidean distance appeared to be in different pattern to CA and CCA using chi-squared distance.

P5-5

Influence of land use of riverside area on the species structure of epilithic diatom assemblage: A case study in Han River, South Korea

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This study examines the influence of land use of riverside area on the structure of epilithic diatom assemblages. Physico-chemical variables and epilithic diatom were monitored in fifty eight sites along the Han River in spring and autumn of 2008 to 2010. The dataset was obtained from water quality monitoring networks operated by the Korea Ministry of Environment. Fifty eight sites were classified into four groups according to the land use of the riverside areas near the sites. At groups A (i.e., urban area) and B (i.e., mixed area of urban and agricultural use), the dominant species were *Nitzschia amphibian* and *N. fonticola* in spring and *N. inconspicua* in autumn, respectively. *Achnanthes convergens* and *A. minutissima* were dominantly found at group C (a well reserved area) and D (a reference site). The field data of environmental variables were further analyzed by Canonical Correspondence Analysis (CCA) to establish potential relationships between environmental variables and epilithic diatom assemblages. Altitude and percent forest had an effect on the composition of diatom assemblages regardless of seasonal changes. Conductivity, turbidity and BOD had an effect on the change of diatom assemblages with long sunshine duration and a little flux in spring, dry season before rainfall event. In autumn, the composition of diatom assemblages was affected by SS, PO₄, NO₃ and fecal coliform increasing polluted materials flowed in water after rainfall. Diatom taxa's abundance is affected by interactive and complex environmental variables. We should consider the environmental preferences of indicator diatom in establishing any policy of river restoration and quantitative evaluation criteria for biological assessment.

Classification of Lake Ecosystems Based on Vegetation Communities and Physico-chemical Factors in South Korea

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Natural lakes are rare in Korea, and most of lentic ecosystems are man-made for water use and other purposes. Lack of understanding on structure and function of lentic ecosystem lead to the construction of artificial lakes unsuitable to accommodate wetland plants physically. Additionally, the pollution in the process of the urbanization and industrialization of the watersheds has lowered the water qualities in lakes of Korea. Current plant communities are a reflection of site history as plant species respond to site factors throughout changing their distribution and abundance. Therefore, we investigated the littoral vegetation and the site factors from the thirty six lakes with three aims: first to classify lake ecosystems of Korea by plant communities, second to characterize plant communities and environmental factors of the classified lake groups, and third to identify major physico-chemical factors influencing distribution of plant communities and species. The lakes include lagoons, reservoirs and dam lakes, which vary in lake size and the level of disturbances. In response to disturbing or unsuitable factors, the thirty six lakes are classified into six groups. Environmental factors such as quality of water and fluctuation in seasonal water level were main factors to divide group 1~4 away from group 4 and 5 on axis 1 of nonmetric multidimensional scaling. Other variable as latitude are also influential on axis 3. Lake group 1 with eutrophication, gentle slope and less fluctuation in water level include most of natural lagoons in east coast regions. Littoral vegetation of group 1 is characterized by high diversity of macrophytes, especially submerged plants (26%). *Phragmites communis* and *Typha angustifolia* are the most dominant. Group 2 is similar to Group1 in terms of physical site conditions, but is eutrophicated. *P.communis* and *Potamogeton crispus* are dominant. Lakes of group3 are in central region of South Korea. Also these are eutrophication lakes. The most dominant species of group 3 are *Zizania latifolia*, *Trapa bispinosa* var. *inumai* and *Utricularia japonica*. And richness of floating-leaved and floating plant are higher than other lake groups. Group 4 is a moderate eutrophication and water level fluctuation. Littoral vegetation of group 4 is characterized by highest the proportions of hydro-macrophyte (60%) and submerged plants (27%). Group 5 and 6 does not provide suitable bed space for plants to be established because of fluctuation in water level and slope degree of littoral zone problems. The seasonal fluctuations in water level make plants to be exposed to drought for a long time. Therefore proportion of annuals and biennials plant is highly in group 5 (51%) and 6 (63%). Results of classification and regression tree, eutrophication and water level fluctuation are the main limiting factors for annuals and biennials plant. Degree of land use and eutrophication are limiting factors of macrophytes distribution. Overall, it is clear that physico-chemical factors such as water fluctuation, eutrophication and latitude are the major factors to establish littoral vegetation in lakes.

P5-7

Analysis of non-point source pollution reduction project effect in Lake Doam and improvement ways

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Lake Doam, a small-medium water storage capacity dam of 51 million ton , is constructed in Songcheon, upstream of South Han River and receives discharge from ranches, recreational facilities, highland farming area and sewage from Hoenggye. Lake Doam watershed is selected for the non-point source pollution reduction area and project target is to achieve below SS 5mg/L. The current research includes the installation of vegetative waterway, stone embankment and sedimentation structures and dispersion in wide areas to reduce pollution but not sufficient reduction is achieved. This study focused on the evaluation of Lake basin non-point pollution reduction facilities installed in Daegwallyeong area, current performance, maintenance and improvement for the better reduction efficiency and promotion of this project. Non-point source pollution reduction project from 2008-2011 was allocated in 212 areas and 437 cases. By basin, they were divided as follow: S2-1(Chahang 1-ri) with 116, the most cases, S3 (Daegwallyeong stream) with 91 cases, S1 (Samyang stream) with 88, S2 (Chahang stream) with 68, S4-1 (Yongsan-ri) with 44, S1-1 with 28 and S5 (Song stream) with 2 cases. All study areas resulted with good efficiency for reduction of muddy water. Since 60% agricultural land which is 7% of watershed, is located in the steep slope, soil runoff and muddy water flow is common during rainfall in Lake Doam watershed. Slope stabilization facilities (multi-stage farm, stone embankment and revetment etc.) and stromwater control and vegetative waterways are required. It is better to consider the slope of farming area and manage first to achieve better result for soil runoff reduction. Alternative crops need to be introduced for the 15% of steep slope farming area. Lake Doam SS concentrations from 2011 to 2013 of May to September are compared. SS observed in 2013 as 9.9 mg/L is lower than 16.9 mg/L of 2011 but higher than that 6.1 mg/L of 2012. However, based on below 5mg/L target, the lowest number of days exceeded the limit were 22 in 2013. But this result is based on only one sample monitored per day. So, this did not give whole result of the day properly. Also, it is difficult to predict the actual effect because of changes in rainfall and rainfall intensity year by year. It is important to have a long term monitored data to have proper assessment.

Random Forest Simulation of the Epilithic Diatom Communities in Geum River Large Influencing Area of South Korea

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Water quality and epilithic diatoms in Geum River Large Influencing Areas of the South Korea were examined to simulate the importance of environmental variables to the distribution of diatom community. Over the survey, a total of 198 taxa were taxonomically appeared from 170 sampling sites, and the diatom community was divided into four groups (cluster) based on the number and density of diatom appeared over the sampling sites. Random forest (RF) model was applied to simulate the importance of environmental variables to the distribution of the epilithic diatom, especially, indicator species in each group or cluster. G1 was characterized as a clean water and low percentage of urban, while electric conductivity was the important variable to the indicator species, *Fragilaria pinnata* var. *lancettula* and *Gomphonema quadripunctatum*. G2 also showed the clean water and low percentage of urban, whilst electric conductivity was the most important variable to the indicator species, *Navicula cryptocephala* and *Navicula contenta*. G3 was not good in water quality, and high percentage of urban, whereas, electric conductivity the important variable to the indicator species, *Fragilaria elliptica* and *Navicula subminuscula*. G4 did not show an indicator species. Collectively, above results indicate that although the epilithic diatom community of Geum River Large Influencing Areas of the South Korea was divided into four groups and a cluster-specific indicator species based on the number and density of species, all indicator species over the groups were strongly correlated with electric conductivity without locality and land-use.

P6-2

Spatial and Temporal Distribution of Epilithic Diatom Communities in Major River Mouth of Korean Peninsula

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Water quality and epilithic diatoms in major rivers mouth of the Korean peninsula were examined to simulate the importance of environmental variables to the distribution of diatom community. Over the survey, a total of 300 taxa were taxonomically appeared, while the community was divided into four group (cluster) based on the number and density of diatom appeared over the sampling sites. G1 was mainly consisted of the sampling sites located in the East estuary, which characterized as a clean water and a wide number of species, while turbidity was the most important variable to the indicator species, *Achnanthesconvergens* and *Fragilariacapucinar.gracilis*. G2 also showed a clean water, no locality and less number of species, but turbidity was the most important variable to the indicator species, *Rhoicospheniaabbreviata*. G3 was not good in water quality, no locality and the lowest number of species and density, however, turbidity still remained as the most important variable to the indicator species, *Naviculasalinarum* and *Suriellaminuta*. G4 was similar to G3 in view of water quality and no locality, but turbidity was the most important variable to the indicator species, *Tabulariafasciculata*, and *Cyclotellaatomus*. These results collectively indicate that the epilithic diatom community in major rivers and estuaries of the Korean peninsula was strongly influenced by turbidity without locality and water quality.

Changes of fish fauna after weir constructions in the South Han River, Korea

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To prevent floods and secure a certain amount of water, three large weirs were constructed in the mid-lower part of South Han River in South Korea. However, for most cases, constructions of large artificial structures across the river and stream commonly generate dramatic changes of water qualities and aquatic ecosystems. Thus, long-term intensive monitoring of changes of water qualities and aquatic biota is required after constructions to elucidate the effects of artificial weir on aquatic systems. In this study, to estimate the impacts of weirs on fish fauna, we conducted fish sampling from 2010 to 2013 at the weir constructed area in the South Han River. A total of 5,196 individuals classified into 47 species were sampled at the study sites. Totally, 3,868 individuals and 45 species, and 1,328 individual and 28 species were collected at the main channel and four tributaries, respectively. The dominant and subdominant species were *Pseudogobio esocinus* and *Zacco platypus*, respectively, throughout the whole study sites. Two endangered species, *Gobiobotia macrocephala* and *G. brevibarba* that are designated as level II by MOE (Ministry of Environment) were intensively inhabited at the Sum River, which is one of main tributaries of the South Han River. However, habitat condition of these two species at the weir constructed area in the South Han River has been gradually reduced, and most of appropriate habitats will be disappeared near future. *Lepomis macrochirus* which is designated as an ecosystem disturbing alien species by MOE was appeared at the downstream of the Gangcheon and the Ipo weirs after constructions. A number of species collected each four study years from 2010 to 2013 were 52, 49, 48 and 47, respectively, and showed slight decrease

P6-4

Variation in fungal activity due to changes in habitat characteristics along a river continuum

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The ecology of aquatic hyphomycetes is mainly affected by variability in environmental conditions in aquatic ecosystems. Spatio-temporal changes in general environmental conditions may induce the differences in fungal activity on submerged substrate and the variation in fungal community structure. Although the studies on aquatic hyphomycetes have been carried out mainly in small headwater streams having large input of organic matter from the riparian vegetation, the fungi also inhabit on leaf litter in large rivers. The main objective of this study was to identify the main habitat characteristics affecting the variability in fungal activity and community structure along a river continuum from headwater to downstream reach. Fungal biomass on submerged leaves and community structure of aquatic hyphomycetes in stream water were measured at the four sites along the longitudinal gradient of Gapyeong-chen during October 2012 through November 2013, except winter months. Environmental variables were measured at the sites on a monthly basis, including water quality, hydrological factors, habitat types, and CPOM standing stock. Fungal biomass was variable through time and sites. The values were relatively higher in summer and lower from late autumn to early spring. Fungal biomass was higher in upper reaches than downstream reaches. The results of cluster analysis and PCA exhibited clear discrimination between the headwater site and three lower reach sites, and temporal separation in the two downstream sites. The major factors explaining the spatio-temporal variation in fungal activity include the proportion of canopy cover, the amount of CPOM standing stock, stream width, the relative proportions of habitat types, and conductivity. Greater number of fungal species and conidia were found in the headwater site than the downstream reach. The dominant species include *Flagellospora curvula*, *Articulospora tetracladia*, *Anguilospora furtiva*, *Anguilospora filiformis*, *Alatospora acuminata*, *Anguilospora crasa*. There was an overlap in the species composition of dominant taxa, but the relative proportion of each species was variable between the two sites. The difference in fungal community structure was more apparent when comparing the species whose relative proportions were low. The results suggest that the variability in habitat characteristics induced changes in fungal activity and conidial community structure along the longitudinal gradient of a river.

Study on Zooplankton dynamics in different lakes of Southern portion of South Korea

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Understanding of freshwater system of Korea progressed primarily with desire to improve water usage for agricultural development. For that reason, many swamps and agricultural ponds were built and researchers began studying these bodies of water more in depth. Zooplankton eventually gained more research attention for water and ecosystem management. Many years have passed since, but understanding freshwater zooplankton community of Korea is still quite lacking. The aim of this study was to survey zooplankton community within 30 freshwater lakes with additional water quality analysis. Spatial distribution of zooplankton community is shown to fluctuate between different water bodies. Moreover, hydrological environment changes play an important role in forming zooplankton community. It will be critical to survey different freshwater habitats to determine the factors affecting formation of zooplankton community.

P6-6

Species diversity of the cladocera (Crustacea: Branchiopoda) on the Korean Peninsula and Jeju Island

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Cladocera is one of the major dominant zooplankton groups in freshwater environments. They typically prefer lentic water, but can still be found in lotic water bodies in less amount. Some island can act as important refuge for freshwater endemics, but studies of cladocera on the island of the East Coast of Pacific Oceans are insufficient for any determinations. My work is aimed to make progress and increase knowledge of taxonomic diversity of Cladocera in Korea from biogeographical point of view.

Ecological Characteristics on the Habitat of Manchurian Trout (*Brachymystax lenok tsinlingensis*) Populations in Gyebang Stream and Naerin Stream, Korea

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We investigated the effects of ecological characteristics on the habitat of cold water fish such as Manchurian trout (*Brachymystax lenok tsinlingensis*) populations in Gyebang stream and Naerin stream from May to September 2013, Korea.

Vegetation: Plant communities were investigated by a phytosociological method. A total of 11 plots were collected and numerically analyzed by r-NCD and UPGMA (unweighted pair-group method with arithmetic averages). These plots were classified into 8 plant communities; *Phragmites japonica* community, *Salix gracilistyla-Phragmites japonica* community, *Salix gracilistyla* community, *Acer tataricum* subsp. *ginnala-Salix koreensis* community, *Betula platyphylla* var. *japonica* community, *Pinus densiflora* community, Mixed forest, *Quercus mongolica* community. These communities were distributed according to the cross-sectional position in the survey area.

Water quality: In this study, Water quality (BOD, COD_{Mn}, T-N, T-P, SS) analysis of the Gyebang stream and Naerin stream. All site analyzed very good grade using Korea Environmental Criteria.

Benthic macroinvertebrates: Qualitative and quantitative sampling (Surber sampler: 50 × 50 cm; mesh size, 0.2 mm) was conducted at 7 study sites in the study area. We thus sampled 90 species belonging to 36 families, 10 orders, 6 classes, and 5 phyla; the Ephemeroptera, Plecoptera, and Trichoptera group (EPT-group) represented the majority of the benthic macroinvertebrate community (76 species; 77.7%). The community indices for the study sites, such as McNaughton's dominance index (DI) (mean ± SD, 0.50 ± 0.18; range, 0.32–0.78) and the Shannon diversity index (H') (2.38 ± 0.57; 1.57–2.90) were similar in the study area. In the study sites, gathering-collectors (mainly Chironomidae species) and predators were relatively abundant, as were clingers.

Fish: The total number of fish species observed were 19 among them 12 species (63.2%) were Korean endemic species. The endangered species were 3 species (15.8%). Fish community indices has shown that Dominant index (DI) were 0.55 (St. 8) to 1.00 (St. 5), Diversity index (H') were 0.00 (St. 5) to 1.99 (St. 8), Evenness index (EI) were 0.00 (St. 5) to 0.72 (St. 8), Richness index (RI) were 0.00 (St. 5) to 2.51 (St. 8). Index of biological integrity (IBI) value were 30 (St. 5) to 40 (St. 2, 4, 6, 8). With these results, we might say that *B. lenok tsinlingensis* habitat was shown high value of DI and IBI, whereas H', EI, and RI were relatively low.

P6-8

An Evaluation of Habitats for Freshwater Bivalve Unionid Mussels in terms of Water Qualities in Brooklets Running through Rice Paddy Fields in Himi City, Japan

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In the Red Data Book of Japan, many species of freshwater mussels Unionidae are being designated as endangered species caused by the environmental deterioration of their habitats. These mussels play important roles in the river aquatic ecosystem; they not only purify the water with their filtration systems, but also act as the host species for the Japanese bitterling (subfamily Acheilognathinae), which lay their eggs inside the mussels. Since the population of Unionidae mussels is dwindling rapidly, the conservation of them is an urgent issue in Japan. In order to conserve the mussels, we should investigate the mussels' habitable water environmental conditions. Our previous studies revealed that the most urgent target was to clarify the source of their foods; which remains unknown in many respects. Himi City, located in the North West coast of Toyama Bay, is famous for delicious foods gathered from the sea such as "Winter yellowtails". There are brooklets running through paddy fields in the central part of the city. The habitats remain good for living the Japanese natural monument deepbody bitterling (*Acheilognathus longipinnis*), and the mussels (*Unio douglasiae*) in the brooklets. In this study, we evaluated the mussel habitat in brooklets in terms of the water quality parameters; such as Chlorophyll a, TN, TP, COD and BOD. Moreover, we analyzed bacterial gene and essential fatty acids to identify the food source. The chlorophyll a concentration and other water qualities showed seasonal changes. The results strongly indicated that the changes in water qualities depended on the irrigating term in rice farming. In the habitats, sufficient amounts of food organisms have been supplied year after year, and the foods were able to support the growth of mussels. The fatty acids found in the bulk of the bivalve were composed of many essential fatty acids originated from green algae, cyanobacteria (blue-green alga), diatom and bacteria. Furthermore, some bacterial species were detected in river waters and intestinal contents of the mussel. These results indicated that the mussels used some microalgal and bacterial species as their food. Acknowledgment: This work was supported by JSPS KAKENHI Grant Number 25290084.

Chironomid fauna of Fuji Five Lakes

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From the 1990s, a benthic macroinvertebrates investigation in Fuji Five Lakes has been carried out by our research group, and we reported on the Chironomid fauna, especially, the dominant species, their density, biomass and distribution etc. of the profundal zone in each lake. In addition, we can follow the change of the chironomid fauna over time by comparing them with the previous reports. In this report, we summarized our research on chironomid fauna in the Fuji Five lakes in recent years. In Lake Motosu, the oligotrophic and deepest lake (121.5 m), the dominant species is *Micropsectra yunoprime*. *M. yunoprime* larva is also collected from the deepest station, 121 m depth. In Lake Sai, the same trophic level of Lake Motosu, *Micropsectra chuzeprima* of the closely-related species has predominance. The species number of chironomids is greater in Lake Sai than in Lake Motosu. Thus, in Lake Sai, *M. chuzeprima*, *Polypedilum nubeculosum* and *Procladius choreus*, carnivorous species, show high density in the shallow region. In Lakes Yamanaka, Kawaguchi and Shoji, three kinds of large-size chironomid species (*Chironomus plumosus*, *Chironomus nipponensis* and *Prosilocerus akamusi*) appear, and *P. akamusi* becomes the dominant species. In Lake Yamanaka, a mesotrophic lake, *C. nipponensis* increases as a dominant species in addition to *P. akamusi*. On the other hand, there is little *C. nipponensis* in Kawaguchi and Shoji, eutrophic lakes, and *C. plumosus* becomes the dominant species in them. The identification of *C. plumosus* and *C. nipponensis* is extremely difficult at the larval stage and they can be identified in the adult male. Many *C. nipponensis* were collected when we capture adult chironomid midges around Lake Yamanaka, but sometimes, *C. plumosus* is also collected. Similarly, though most were *C. plumosus*, the *C. nipponensis* is also sometimes captured when we collected chironomid midges around Lake Kawaguchi. As a characteristic of Fuji Five Lakes, there are some springs partially arising from the bottom of the lake. At such places, improvement of the water quality is carried out locally, and it is possible that the species composition of the chironomid fauna are affected.

P6-10

Community Structure and Fluctuation of Benthic Macroinvertebrate in 8 Weir Constructions of Nakdong River

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8 weirs were constructed through the Nakdong River by 'Four Major Rivers Project' during 2010 to 2012. These constructions were expected to make some changes to the community structure of benthic macroinvertebrates, so we sampled benthic macroinvertebrates on the construction sites from 2010 to 2013. Total 19 surveyed sites were established based on upstream and downstream area of each weir (Sangju weir, Nakdan weir, Gumi weir, Chilgok weir, Gangjeong-Goryeong weir, Dalseong weir, Hapcheon-Changnyeong weir, Changnyeong-Haman weir). There were 84, 98, 95 and 84 species in the surveyed sites from 2010 to 2013, so total numbers of species have no noticeable change in each year. As a result of the survey during 4 years, the species number of non-Insecta, Hemiptera, and Coleoptera had been increased: non-Insecta were increased from 17 species in 2010 to 23 species in 2013, order Hemiptera had been changed from 3 species in 2010 to 5 species in 2013, and order Coleoptera had been changed from 4 species in 2010 to 13 species in 2013. The species number of Ephemeroptera and Trichoptera had been decreased: order Ephemeroptera were decreased from 22 species in 2010 to 13 species in 2013, and order Trichoptera were decreased from 10 species in 2010 to 4 species in 2013. These tendencies show that the flowing water habitat is being changed to sub-stagnant water habitat, and the number of non-flowing water preference species might be much increased after stabilizing the river-bed and water environment.

Community Structure of Benthic Macroinvertebrates in 9 Artificial Lakes of Nakdong River System

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We surveyed the community structure of benthic macroinvertebrates in 9 artificial lakes of Nakdong river system. We carried out twice of surveyed in each lake: Lake Gyeongcheon, Lake Unmun and Lake Jinyang were surveyed on April and August, 2011; Pungrak Reservoir, Lake Hapcheon, Lake Yeoncho and Lake Hoedong were surveyed on April and September, 2012; Yongyeon reservoir and Lake Daeam were surveyed on April and August, 2013. In the 9 of artificial lakes, Pungrak Reservoir had the most number of species (30 species) and Lake Unmun had the least number of species (13 species). The orders Archiologochaeta, Decapoda, Ephemeroptera, Odonata, Hemiptera and Diptera were commonly appeared taxa in all of the lakes. Individual ratio on each functional feeding groups (FFGs) was the largest on Gathering-Collector (GC) (81.31%~99.69%) in all of the surveyed sites. In biological indices of benthic macroinvertebrates, diversity index (H') and richness index (R') were the largest in Lake Hoedong, 2.516 and 4.481 effectively. Dominance index (DI) was the largest in Lake Hapcheon, and Evenness index (E') was the largest in Yongyeon reservoir. In analysis of community stability, section I (high resistance and resilience section) appeared the highest species ratio (62.50%~85.71%) in all lakes. As a result of cluster analysis of each lake by collected species, Lake Gyeongcheon and Lake Unmun were determined for a similar group I, and Pungrak Reservoir, Yongyeon Reservoir, Lake Hapcheon, Lake Daeam, Lake Jinyang and Lake Hoedong were determined for a similar group II. Lake Yeoncho, which had the lowest similarity with the other lakes, had 19.6% of similarity with a similar group I and 23.9% with a similar group II.

P6-12

Community Fluctuation of Benthic Macroinvertebrates in Upper Nakdong River

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The biological community of urban stream and river, especially adjusted streams, can be different from rural ones. In upper Nakdong river of Andong-si, Gyeongsangbuk-do, Korea, had been adjusted by the large-scale river restoration project, which was initiated by a government, in 2011. After the project, the river bed of partial area was changed to artificially stacked rocks, and the water turbidity was temporarily increased by the construction. These sudden changes were predicted to influence on community of benthic macroinvertebrates, so we surveyed the effects on the benthic macroinvertebrates by the river restoration project. The survey was carried out from 2012 to 2013, 4 times (March, June, September and December) per year. In 2012, immediately after the construction, the numbers of species were gradually increased seasonally (13 species in Mar., 17 species in Jun., 24 species in Sep. and 25 species in Dec.). In Mar. 2013, the number of species was consistently increased to 27 species, but in Jun. 2013, temporarily decreased to 15 species by the maintenance work on downstream of Andong weir. After the maintenance work, 29 species in Sep. 2013 and 39 species in Dec. 2013 were surveyed. These increases, except in Jun. 2013, mean that benthic macroinvertebrates of the surveyed areas are adding consistently, and local construction on downstream of weir can be a cause of temporary confusion, but can't be a long-term influence factor.

Maternal transfer and multi-generational toxicity of waterborne of copper to apple snail

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Apple snails are the species which have long life, fast generation cycle and everywhere. Maternal transfer of bio accumulated contaminants to offspring may be an important and overlooked mechanism of impaired reproductive success that affects other species. Copper will affect competition with minerals (i.e., Ca^{2+} , Mg^{2+}), and reduce survival. Previous studies have shown that copper can affect their offspring. However, there is no idea if apple snails have maternal transfer to protect themselves.

Thus, we would like to know that the aims of this proposal seek to (1) understand if apple snails have maternal transfer; (2) know that offspring of these apple snails will more adapt to the environment. In this study, we will use subcellular partition model (SPM) and $^1\text{H-NMR}$ analysis to explain the mechanism of detoxification and metabolism. It is going to do field investigations among many high to low pollutant site. Therefore, the conclusion will be more correct and have more referenced.

We expected that apple snails might influence the development, growth and behavior of their offspring via maternal transfer to match their future environment. In the future, we can control the number of apple snails in the field and make environmental cost down. Other, we can get the faster method to know the situation of environmental pollution.

Keyword: maternal transfer, multi-generational toxicity, copper, apple snail, subcellular partition model, $^1\text{H-NMR}$

P6-14

Altitudinal distribution of macroinvertebrates in Seom River in Korea

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Based on the river continuum concept (RCC), the physico-chemical properties of lotic system such as temperature, streambed condition and the water quality continuously change along with longitudinal gradient. In respond to such changes, aquatic biota particularly macroinvertebrates also shows change in terms of species composition and abundance. While RCC is broadly accepted to the understanding of lotic ecology, the relationship between altitude and macroinvertebrates are poorly understood. Seom River located in the middle part of Korea stretches for 93 km, starting from forest region (relatively well preserved-upstream) through mixed region of agricultural and urban area (mid- and downstream). Field surveys were conducted for physico-chemical factors and macroinvertebrates at total of 27 sites of the Seom River from May 2012 to September 2013. The relationships among environmental factors and macroinvertebrate assemblages along with altitude were analyzed. Altitude displayed negative correlation with all the physico-chemical variables except for dissolved oxygen. Total of 147 species belonging to 59 families, 15 orders, and 9 classes in 5 phyla of benthic macroinvertebrates were identified during the whole sampling period, including more than a half of Ephemeroptera, Plecoptera and Trichoptera species (86 taxa). Both taxa richness and abundance of Ephemeroptera gradually decreased with decrease of altitude, whereas those of Trichoptera, displayed no clear patterns. In the analysis of functional groups, positive relationships were confirmed between altitude and scrapers in taxa richness and abundance, while negative relationships existed for collector-gatherers and collector-filterers. According to biological assessment using benthic macroinvertebrates, the regions with lower altitude showed poorer condition of water quality. These results indicate that concurrent changes of environmental quality and macroinvertebrate assemblages apparently occur along with longitudinal gradient in lotic system, reflecting the effect of altitude, but human disturbance strong towards middle and lower reaches of rivers and streams is also manifest to influence taxonomic composition and abundance of macroinvertebrates.

This study was supported by the project 'Aquatic Ecosystem Health Survey and Assessment' funded by the Ministry of Environment and National Institute of Environmental Research, Korea.

Diet composition of predatory fish species in relation with predator size class in a lentic freshwater ecosystem, South Korea

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A predator's foraging pattern strongly affects prey assemblage, and determines trophic interactions between aquatic organisms in freshwater ecosystems. Among aquatic animals, fish have an ecological role as apex consumers in the freshwater food web, and influence the spatial and/or temporal distribution of prey. Investigating gut contents to understand the freshwater food web structure. We tested the hypothesis that diet composition of predatory fish species might be affected by size class. We collected fish from the littoral zone of a shallow wetland (Upo Wetlands) using a cast net (7 mm× 7 mm) and a scoop net (5 mm× 5 mm) in 2011. Among the collected fish samples, length of predatory species was measured to obtain size class information, and their guts were removed and stored in a methanol-formaldehyde solution for further analysis. We collected seven species (*Lepomis macrochirus*, *Micropterus salmoides*, *Carassius auratus*, *Pseudorasbora parva*, *Misgurnus anguillicaudatus*, *Cyprinus carpio*, *Pseudobagrus fulvidraco*) of fish, and two predatory species *L. macrochirus* (n=145) and *M. salmoides* (n=43) accounted for ca. 80% of the total collected fish. *L. macrochirus* frequently appeared throughout the sampling period, but *M. salmoides* was observed in late spring to early summer (May to Jun). The gut contents consisted of a total of 20 different groups including fish, zooplankton, and macroinvertebrates. A Self-Organizing Map (SOM) model was used to pattern the composition of 20 diet species in accordance with predator species and their morphological characters (i.e. size classes). Nominal data such as fish size class, species, and seasons were compared with the trained SOM results, by masking process (i.e. null weighting method). Four clusters were identified based on the U-matrix, and the diet composition of *L. macrochirus* was clearly distinguishable in terms of their body size. Micro-invertebrate groups were related to relatively small sized fish (ca 1.5 to 4.7 cm), and macro-invertebrate groups were consumed by larger predators. Epiphytic micro-invertebrate species were used by only tiny predators (1.5 to 2 mm). In contrast, *M. salmoides* utilized copepods and some macro-invertebrates, whose size was relatively larger than those consumed by *L. macrochirus*. Moreover, *M. salmoides* seemed to be able to consume prey which had rapid swimming ability (e.g. Copepods). Consequently, we suggest that diet composition of predatory fishes was determined by body size, and habitat type for prey species would be also important factors for successful predation.

P6-16

**A Molecular phylogeny of Japanese Planorbidae (Gastropoda, Pulmonata):
Investigation of Japanese Planorbid fauna**

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The freshwater gastropods Planorbidae are one of the most common and diverse families of freshwater pulmonates. Because of their high diversity and limited distribution, planorbid species provide excellent model systems to understand how regional freshwater communities have been created and how geographical patterns of biological diversity have arisen. Recent progresses in phylogenetic analyses of planorbid species have revealed some incongruence between taxonomy and phylogeny, whereas it is still largely unclear how phenotypically delimited species reflect phylogenetic relationships. In the present study, we investigate molecular phylogenetic relationships among the species of Planorbidae in Japan. The inferred phylogeny showed that the Japanese planorbid have been composed of the lineages immigrated from the Asian continent independently in different times. Fairly high diversity of the Japanese planorbid reflects multiple immigrations from the different regions of the Asian continent in the past. The molecular phylogeny of the Japanese Planorbini lineages represented marked incongruences between nominal taxonomy and phylogeny. Many of the species discriminated morphologically were polyphyletic. These incongruences are likely to reflect rapid morphological evolution or interspecific hybridization. Although further surveys are needed, the present findings suggest that substantial revisions of taxonomy are needed in Japanese planorbid species.

Appearance of filamentous green algal *Mougeotia* due to water quality restoration in Lake Suwa, Japan

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In Lake Suwa, *Microcystis* has been dominated 99% during the summer months in the 1970s. A number of attempts including the operation of sewage treatment plants decrease of phosphorus and nitrogen external load contributed to the change of its phytoplankton composition, and blue-green algae decrease since 1999.

The *Mougeotia* of filamentous Zygnemataceae Zygnematales, appeared from August to December of 2011. In our DNA analysis based on the 18S rRNA region, *Mougeotia* in Lake Suwa was divided into two groups (Clade A, Clade B). The intergenic distance as an extremely dramatic differentiation. *Mougeotia* which a diameter was smaller than 6 μ m did predominance in Lake Suwa. *Mougeotia* observed form of the zygospore from Lake Suwa, It was shown to probably resemble *M. elegantula*. The *Mougeotia* occurs in oligotrophic to mesotrophic lakes, As for the appearance of *Mougeotia* of Lake Suwa in 2011, it will be a result of the quality restoration of the water from has been dominated by blue-green algae.

P6-18

Benthic macroinvertebrates in the small and shallow Lake Nakatsuna, Nishina Three Lakes, Japan

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In order to clarify the current status of the benthic community of Lake Nakatsuna (location of the center: 36°36' N, 37°51' E; surface area: 0.14 km²; mean depth: 5.7 m, maximum depth: 12.0 m; altitude: 815 m above sea level), and to examine the difference with the last quantitative data of the lake by Miyadi(1932) and Kitagawa(1973), the distribution of benthic macroinvertebrates in this lake was studied. Also, a comparison of the benthic fauna and density was made between the present and previous studies, with a discussion concerning the succession of benthic macroinvertebrates in relation to changes in the lake bottom environment. On April 29, and June 10, 2014, bathymetrical sampling surveys were carried out using a standard Ekman-Birge grab at each of the 3 stations (St.1: 15.2m depth, St.2: 11.5m, St.3: 8.3m) in Lake Nakatsuna. The average densities of the benthic communities for all the stations were 4751 ± 5490 Inds. m⁻², comprised principally of oligochaetes 49.5%, chaoborid 32.9% and chironomids 17.6% in April, whereas in June, the average density was 3637 ± 5227 Inds. m⁻², and mostly comprised of oligochaetes 57.2%, chaoborid 7.9% and chironomids 34.9%. In St.2, the mean density of oligochaetes was ca. 100 times higher than the reported by Miyadi in 1928 and 5 times higher than the reported by Kitagawa in 1972. In recent year, the density of oligochaetes has tended to increase and the anoxic-layer and anaerobic-layer are thickening.

Occurrence pattern and classification of phytoplankton community during cold seasons in the Yeongsan Lake, Korea

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A dike was created in the Yeongsan River in 1981 to supply agricultural water for the extensive rice fields in the basin of the freshwater reservoir. Freshwater from the reservoir inside the dike remains eutrophic and algal blooms frequently occur. In this study, we conducted the weekly monitoring (Dec. 2012~Apr. 2013) to examine the phytoplankton community in the Yeongsan Lake. Phytoplankton species were identified and counted using the optical microscope and SEM. The results showed that there were 6 classes (Bacillariophyceae, Chlorophyceae, Cryptophyceae, Cyanophyceae, Dinophyceae, Euglenophyceae), 30 genera and about 41 species. Phytoplankton composition showed high abundances of diatoms in winter and *Aulacoseira* sp., *Cyclotella* sp. and *Stephanodiscus* sp. were dominant. Among the species, *Stephanodiscus* sp. was relatively abundant compared with other diatoms.

Stephanodiscus sp. appeared from December 2012 to April 2013 and their abundance peaked in January. Abundances of diatoms especially peaked (21,080 cells mL⁻¹) in January 15, 2013 when *Stephanodiscus* sp. also bloomed (20,560 cells mL⁻¹). The abundances of *Stephanodiscus* sp. were gradually decreased from March and reached as much as 60 cells mL⁻¹ in the April 26. The circular diatoms, *Cyclotella* (*C. meneghiniana*, *C. pseudostelligera*, *C. stelligera*), *Cyclostephanos* (*Cyclostephanos invisitatus*) and *Stephanodiscus* (*S. hantzschii*, *S. minutulus*) were classified by SEM. Abundance of *S. hantzschii* was extraordinarily high compared with *S. minutulus*.

P6-20

Inhibition of *Myriophyllum spicatum* on Bloom-causing Cyanobacteria and Other Phytoplankton Species in a Coexistence Experiment

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There have been many studies trying to control cyanobacterial blooms such as *Microcystis* and *Anabaena*. Eurasian watermilfoil (*Myriophyllum spicatum*) is a submerged macrophyte species known to inhibit *Microcystis aeruginosa* growth. Our previous studies showed that *M. spicatum* inhibits the growth of *M. aeruginosa*. In this study, we conducted a coexistence experiment using *M. spicatum* with five phytoplankton species of three taxonomic groups: *Selenastrum capricornutum* and *Senedesmus obliquus* (Chlorophyta), *Cryptomonas ovata* (Cryptophyta), *Microcystis aeruginosa* and *Anabaena sp.* (Cyanobacteria). To see the different responses of unicells and colonies of *M. aeruginosa*, we used both cultured strain (UTEX 2385) and colonies collected from a reservoir. The growth rates of *M. spicatum* and other phytoplankton species were observed while metabolites of *M. spicatum* and the microalgae from the coexistence experiment were extracted and analyzed using a GC-MS to investigate potential metabolites responsible for the inhibition.

Aquatic molluscan fauna of the Upper Yenisei River basin (The Republic of Tuva, Russia)

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Species composition of aquatic molluscs living in water bodies within the Republic of Tuva is poorly known. Tuva lies in geographical centre of Asia and there is one of biggest watersheds in the world. Four endemic species were described by Y.I. Starobogatov, E.A. Streletzkaja and Z.I. Izzatullaev in freshwater Tore-Khol' Lake of the Central Asian inland basin in southern Tuva. Forty one species were represented in the Yenisei River basin in northern Tuva. First data on the Upper Yenisei River molluscs fauna from Tuva were reported by V.N. Greze and I.I. Greze in 1957–1958; first checklist included seven species: *Radix ovata*, *Gyraulus albus*, *Valvata aliena*, *Anodonta anatina*, *Sphaerium scaldianum*, *S. lacustre*, *Pisidium amnicum*. Later in 1969, A.N. Gundrizer and M.A. Ivanova reported in a short publication about 31 species with special attention to the Upper Yenisei River basin in north-eastern Tuva. The Upper Yenisei River is one of a few rivers in Siberia with minor human transformation. The focus of this report is to show species composition of aquatic molluscs in the Upper Yenisei River basin within the "Azas" State Nature Reserve and "Ubsunur Hollow" State Nature Biosphere Reserve (UNESCO list) where during 1994 and 2004 in all freshwater kinds of lotic and lentic habitats were collected the freshwater molluscs. Almost 5000 shells and specimens were fixed in 75% alcohol; the collection is now deposited at the Institute of Biology and Soil Science FEB RAS, Vladivostok. Shells and specimens were investigated by conchological, anatomical and SEM methods based on original study. Conchological characters include shell outline, sculpture, features of hinge, ligament, muscle scars and pores; the most important structures are illustrated on the SEM photographs. Anatomical characters were studied in situ and figured with a camera lucida. At present, in total 108 aquatic molluscs species were found – 56 snails and 52 bivalves. Ten species in 5 genera of the Sphaeriidae were represented. Three species in 2 genera of the Pisidiidae were distinguished: *Europisidium tenuilineatum* (Stelfox, 1918), *Pisidium amnicum* (Müller, 1774), and *P. decurtatum* Lindholm, 1909. Thirty nine species in 11 genera of the Euglesidae were represented: *Cingulipisidium*, *Conventus*, *Cyclocalyx*, *Euglesa*, *Henslowiana*, *Hiberneuglesa*, *Pseudeupera*, *Pseudosphaerium*, *Pulchelleuglesa*, *Roseana* and *Tetragonocyclas*. Fifteen species were listed for the first time for Republic of Tuva, eleven species were found in the Upper Yenisei River basin for the first time, six European species were noted to have disjunction in Siberia for the first time: *Sphaerium mamillanum* Westerlund, 1871, *Euglesa obliquata* (Clessin, 1874), *Henslowiana ruut* (Timm, 1975), *Pseudosphaerium favrei* (Kuiper, 1947), *P. pseudosphaerium* (Favre, 1927), *Roseana rosea* (Scholtz, 1843). The majority of species are distributed in the Palaearctic Region, while the other species have Siberian distribution. This study was supported by grant № 12-I-П30-01 (Dr. V.V. Bogatov).

P7-1

Relationship between a Dense Population of Cyanobacterium *Anabaena* spp. and Rainfalls in the North Han River System in 2012 and 2013

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To evaluate the relationship between dynamics of phytoplankton population and rainfalls, a monthly monitoring of water quality and phytoplankton in three serial lakes (Lake U-am, Lake Chung-Pyung and Lake Paldang) within the North Han River System were examined 12 times from May 2012 to March 2013. A dense bloom of cyanobacterium *Anabaena* spp., was occurred through three lakes between 2012 and 2013. In Lake U-am, the bloom of *Anabaena* spp. appeared in June, showed a peak in July (43,850 cells/mL), and entirely disappeared in November. In Lake Chung-Pyung and Lake Paldang, *Anabaena* population commonly appeared in July, showed the peaks (31,648 cells/mL and 7,136 cells/mL, respectively) in August, and then, disappeared in September. Over the study, phytoplankton community was dominated by diatoms before Monsoon, cyanobacteria during Monsoon, and diatoms after Monsoon, respectively, indicating a seasonal succession. Correlation analysis revealed that dynamics of *Anabaena* population in three lakes was directly related with rainfall ($r=0.72$, $r=0.83$, $r=0.88$, $P<0.01$ for three lakes), and indirectly by nutrients via flow and outflow of lakes. Therefore, this study indicates that the outbreak and destruction of cyanobacterium *Anabaena* spp. in North Han River System 2012~2013 was crucially impacted by rainfalls. However, even though other cyanobacteria species, a high density of phytoplankton in Lake U-am still remained even after Monsoon, and then, may produce a bad-order and toxic materials.

Development of a water quality index model for lakes and reservoirs

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Lake water quality and trophic state are evaluated using various parameters which may have different interpretations. Therefore it is useful to adopt a proxy index that shows normalized values of parameters having different units and distribution characteristics. In this study, a model for integrated water quality index was developed for lakes and reservoirs in Korea. Water quality and phytoplankton were examined in 36 lakes; two natural lakes and 34 artificial lakes. The study lakes were selected to represent the range geographic regions and lake morphology in Korea. After investigating the interrelationships among water quality parameters, four parameters (total organic carbon, chlorophyll-a, total phosphorus, and turbidity) were selected as surrogate indicators of overall water quality. A relative evaluation system was developed by adopting a logistic function index that describes a cumulative distribution function and reflects the relative position of each parameter among the study lakes. The cumulative distribution probability ranging from 0 to 1 was multiplied by 100 and then transformed into the Korean Lake Water Quality Index (LQI) ranging from 0 to 100. A score of 50 was assigned to the median value of the data set, 0 to the highest concentration value, and 100 to the lowest concentration value. Thus, the LQI is an integrated easy-to-understand index that provides information about the relative status of each lake. The results of this study can represent a model to provide a relative evaluation system for lake and reservoir water quality, which can be useful for ecosystem management within an ecoregion or a jurisdictional district.

P7-3

Export characteristics of non-point pollutants from agricultural watershed with dammed streams

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The export pattern of non-point source (NPS) pollutants was studied in an agricultural watershed, with dammed three streams, of Lake Sihwa in Korea. Seasonal variations of rainfall, flow rate, and NPS pollutants (SS, COD, nitrogen, phosphorus) were surveyed at the stream mouth that three streams meet the lake, including extensive sampling during storm events. Most of the rainfall during the study period was concentrated during heavy showers from June to August. Inflows responded quickly to these short-term rainfall events, but no increases in flow rate were observed unless rainfall amounts exceeded about 50. This is because the sluice gates of weirs installed in stream only operate during the heavy rains of >50 mm/d. Concentrations of NPS pollutants, with exception of nitrogen, corresponded closely with variations in flow rate. Consequently, much of the NPS pollutants that accumulated in the watershed during the dry season were exported during the heavy showers. This result indicates that the presence of weirs for agricultural water can play a role as a factor affecting on the export pattern of NPS in agricultural watershed.

Algae-derived particulate organic matter in the upper regions of a brackish Lake Sihwa

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The aim of this study was to estimate the contribution of algae to particulate organic matter in the upper regions of brackish Lake Sihwa. Temporal and spatial variations of particulate organic carbon (POC) and phytoplankton pigments (chlorophyll a; Chl-a, pheophytin-a; Pheo-a), and their relationships were studied at seven sites of the brackish regions from March to October 2005 and 2006. POC concentration varied from 1.0 to 76.6 mg L⁻¹ (mean 7.4 mg L⁻¹), with maximal concentrations occurring in the middle parts of the study area in spring of 2005 and 2006. Concentrations of Chl-a and Pheo-a varied from 1.3 to 942.9 μg L⁻¹ (mean 71.0 μg L⁻¹) and 1.4 ~ 1,545.5 μg L⁻¹ (mean 59.9 μg L⁻¹), respectively, and corresponded closely with variation in POC. During the study period Pheo-a concentration was 44.2% of total Chl-a, implying that non-living or inactive phytoplankton is also the important part of phytoplankton-derived POC in brackish regions of Lake Sihwa. From the positive linear relationships between POC and phytoplankton pigments (POC with Chl-a (r=0.93), total Chl-a (r=0.88), and Pheo-a (r=0.81)), it is suggested that phytoplankton was a significant component of POC in the upper regions of brackish Lake Sihwa. On the other hand, the ratios of POC/Chl-a and POC/total Chl-a (Chl-a+Pheo-a) were 82.9 and 35.9, respectively. The ratio of POC/total Chl-a is similar to those reported in previous studies, including 40 ~ 60 in estuaries. Our results suggest that Pheo-a concentration is considered in estimation of POC concentration derived from algae in aquatic systems with high content of Pheo-a, like an upper region of brackish Lake Sihwa.

P7-5

A study on the cause of algal bloom and water quality improvement method in Tongyeong Yokji Island, Korea

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Resulted from clogging of the filtering system due to algal bloom, water quality deterioration occurs and intermittently yields problems of unstable water supply in Yokji reservoir. In the reservoir located in Yokji island in Tongyeong city, the resources of the algal bloom the concentrations of water quality constituents including organic matters, inorganic matters, and Chl-a were relatively low. Since concentrations of po_4-p observed in the inflow and reservoir were very low ranging 0.2~7.6 ppb, consistent algal bloom will not occur. However, the standing crop of *Fragilaria* and *Aulacoseria* which are classified as large size bacillariophyceae were relatively high from the result of algae monitoring in the upstream river. Accordingly in the Yokji reservoir, the standing crop of *Fragilaria* and *Aulacoseria* were very high ranging 3,100~7,700 cells/ml, 340~520 cells/ml, respectively. Bacillariophyceae species in this study was main sources of clogging of the filtration system which can results in problems of water treatment facility. Based on the monitoring results, field oriented and applicable water quality improvement scheme is required such as algae fence, algae removal technologies in the reservoir considering the environmental characteristics of target site. For water quality improvement in the Yokji Reservoir, seasonal water treatment scheme and mitigation of bacillariophyceae is important based on the consistent monitoring.

The absorption character of inland eutrophic water based on optical classification

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Optical property of inland eutrophic water varies spatially and temporally corresponding to change of concentrations of water components. The same water type classified by optical property may have uniform character which may make water components deriving algorithm simpler and accuracy. Our purpose of this study is to elaborate water type classification scheme for inland eutrophic waters according above water reflectance, and compare the difference of absorption properties between different water types. Field measurements were carried out in August 2006, November 2006, 2007 and 2008, April, June, July and September 2009 in Taihu Lake, Chaohu Lake, Dianchi Lake and Sanxia Gorges Reservoir (China). The waters were classified into six optical water types (type A, B, C, D, E and F) by comparing peak and trough of remote sensing reflectance (R_{rs}) between 500-750 nm. All of the samples in Dianchi Lake belong to type A water, while other water bodies have several types at the same time. When parameterized a_{CDOM} and a_{NAP} by power function, the slope of CDOM could be clustered into two groups, i.e. one group for type A and one for type B, C, D, E and F; there is no significant difference of SNAP between different water types. Absorption coefficients of phytoplankton were calculated by absorption coefficient of 440 nm and 675 nm using quadratic function and the coefficients varied in different water types.

P7-7

Response of phytoplankton to the cessation of aquaculture in a subtropical lake: a case study

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We assessed the response of phytoplankton communities to the cessation of aquaculture in Lake Dianshan, Shanghai, China. Quantitative analyses of plankton and nutrient content were undertaken monthly from 2004 through 2008. After the cessation of aquaculture, the chlorophyll-a and phytoplankton density declined sharply, while the proportion of green algae and cryptomonads were increased. The dominant phytoplankton species shifted from *Microcystis* sp. to *Merismopedia* sp. and *Chroococcus* sp.. However, there was not significant improvement in the overall water quality. CCA revealed that soluble reactive phosphorus concentration, nitrate concentration and water temperature play important parts in structuring phytoplankton communities in this subtropical eutrophic lake

Carbon contents of suspended particulate matter in stream and reservoirs

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We investigated organic matter and organic carbon content of total suspended solids (TSS) and particulate organic matter (POM) in streams and lakes. Samples were collected in nine streams and twenty six lakes from the years of 2005 to 2013. The organic matter and organic carbon content of the streams and lakes were compared among three of landuse type and four trophic state classes. Stream TSS had different organic matter content by landuse but there was no significant difference among the lake trophic state classes. TSS containing the lowest organic matter content indicated that the agricultural streams were affected by soil erosion. There was no significant difference in POM organic carbon content among either the landuse types or trophic state classes. The average organic matter content in TSS was 10%, 39%, 55%, 53% in rural, urban, forested streams and lakes, respectively. The average organic carbon contents in POM was 39% and 38% in streams and lakes, respectively. These results will be useful for estimating organic matter and organic carbon loading as TSS and POM to streams and lakes.

P7-9

Assessment of Water Quality Variations Under Non-rainy and Rainy Conditions by Principal Component Analysis Techniques in Lake Doam Watershed, Republic of Korea

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Water quality data of streams in Lake Doam watershed, monitored over 4 years (2010-2013) at 8 different sites with multiple physiochemical parameters, was subjected for this study. Monitored dataset was pooled into two sub-datasets, namely, non-rainy and rainy, according to the monitoring conditions. Multivariate statistical techniques such as principal component analysis (PCA) and factor analysis (FA) were applied on both datasets to identify the principal component/factor having significant variance and the most important parameters contributing for the variance. These multivariate techniques were able to identify major five components explaining over 80% of total variance for both datasets. Non-rainy and rainy first principal components accounted for 26% and 30%, respectively. PCA and FA results identified total nitrogen, nitrate nitrogen, electrical conductivity and chemical oxygen demand were the most important parameters influencing water quality under the non-rainy condition and were largely contributed by Chahang (S2, S2-1) and Yeongpyeong (S4-1) tributary sites. In the case of rainy condition, turbidity, suspended solids, chemical oxygen demand and total phosphorus were the most important parameters having significant variances and largely contributed by upper stream sites of Samyang (S1-1), Chahang (S2, S2-1) and Yeongpyeong (S4-1). Overall, this study reduced the large datasets of water quality into principal components/factors and helped to identify the most meaningful parameters to be managed.

Water quality variation of Gyeongpo Lake before and after submerged weir removal

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Lake Gyeongpo, located in the east coast of Korea, is a lagoon connected to sea and influenced by inflow of seawater. Lake Gyeongpo water quality is deteriorated due to inflow of sewage, agricultural discharge and eroded soil and swamp area around lake is declining (Jeon et al., 1998). In 2004, submerged weir (under Gyeongho bridge) was removed to improve the water quality of lake and water purifying and ecological wetlands, and flood regulator wetland were constructed after purchasing agricultural land in early 2010. Water quality data from 1998 to 2013 was analyzed by dividing data into two periods as before and after the weir removal except for winter season. To analyze statistically, Mann-Kendall test and Sen's slope test were applied. Annual average precipitations before and after weir removal were observed as 1,666 and 1,403 mm/year. Salinity were observed 11.2 and 22.4 PSU in surface and 13.4 and 25.0 PSU in bottom water in before and after weir removal periods, respectively. Salinity was increased by 10 PSU after weir removal where no significant fluctuation was observed after period compared to slight fluctuation before. Dissolved oxygen before and after weir removal were 11.6 and 9.4 mg L⁻¹ in surface and 8.0 and 6.5 mg L⁻¹ in bottom water, respectively. Bottom water p-value 0.44 of after weir removal was statistically significant and showed decreasing trend, but the rest was greater than 0.1 and not significant. Sen's slope method showed increasing trend in surface and bottom water before weir removal, but decreasing trend were observed after weir removal, especially in bottom water. COD concentrations before and after weir removal were 7.6 and 4.7 mg L⁻¹, respectively. The p-values were 0.664 and 0.001, respectively, where after weir removal was significant. Sen's slope test showed decreasing trend before and increasing trend after weir removal. Before and after weir removal, TP values were recorded 0.161 and 0.100 in average, respectively. The p-values were 0.086 and 0.834 where significantly decreasing trend was shown for before weir removal. Sen's slope test determined decreasing trend before weir removal but not significant change after. Average TN values for before and after weir removal were 1.786 and 1.062 mg L⁻¹, respectively. The p-values for both period were 0.003 and 0.006 as shown with significantly decreasing trend Sen's slope were analyzed as -0.030 and -0.015 where decreasing trend after weir removal was in decline. SS values were observed as 27.1 and 31.2 mg L⁻¹ from before and after weir removal period, respectively. The p-values for before and after period were 0.080 and 0.785 where before data showed significant increasing trend. Sen's slope test resulted increasing trend for both periods. Lake Gyeongpo water quality was improved for some time after weir removal but again started to deteriorate. So, it is important to manage the surrounding area, discharge from point and non-point sources to improve and preserve the water quality of lake.

P7-11

Changes of trace elements vertical distribution associated with the appearance of all anoxic layer in Lake Fukami-ike

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Lake Fukami-ike is a small eutrophic lake of 2.1 ha with a maximum depth of 7.75 m. This lake is located in a mountain area in central Japan (35 ° 32'55 "77 north latitude, 137 ° 81'93 "56 east longitude) and is well protected from the wind. Lake water stratified from March to October and circulated from November to March. Anoxic conditions prevailed below 4-5 m depth from April to October, and a photosynthetic green sulfur bacteria (BChl.c) accumulated in the oxic and anoxic layers, upper hypolimnion. The anoxic layer prevailed throughout the water column from 0m to maximum depth, which was a very unusual phenomenon on November 16, 2013. Vertical changes for chlorophyll-a, bacteriochlorophyll-c, nutrients and trace elements were studied by the appearance of such a phenomenon. Chlorophyll-a and bacteriochlorophyll-c did not coexist on November 2 but Chlorophyll-a and bacteriochlorophyll-c coexisted throughout the water column on November 16. These amounts were 50 µgL⁻¹ and 80 µgL⁻¹, respectively. Chl.a was only present in all layers on December 21. The dissolved organic carbon (DOC) amount at each depth was almost 5 mgL⁻¹ except for 10 mgL⁻¹ at 7.5 m depth, with no change from November 2. The DOC was observed in all the layers on December 21. NO₂-N was not observed in all layers on November 16 but 0.07 mgL⁻¹ had been observed at each depth up to 5.5m on November 2. It was also not observed in all layers on December 21. The NO₃-N amount at each depth was almost 0.06 mgL⁻¹ except for 0 mgL⁻¹ at 7.5 m depth on November 16. It was not confirmed in all layers on November 2. The dissolved manganese (DMn) amount at each depth was almost 0.1 mgL⁻¹ except for 1.5 mgL⁻¹ at 7.5 m depth on November 16. It was not observed at the 0-5m, 2.2 mgL⁻¹ and 1.5 mgL⁻¹ 6m and 7-7.5m, respectively. 0.13 mgL⁻¹ was observed in all layers on December 21. The dissolved iron (DFe) amount was almost 0.02 mgL⁻¹ at each depth up to 6m and it increased to 0.2mgL⁻¹ from 0.03mgL⁻¹ as it became deeper from 7 m to 7.5 m. Dissolved chromium (DCr) amount was also almost 0.1 µgL⁻¹ at each depth up to 6m and it was increased to 3 µgL⁻¹ in 7m. DMn, DFe and DCr amounts increased with depth but the amount of dissolved aluminum (DAI) decreased.

Dynamics of Phytoplankton from major Lakes in the Yeongsan River system

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Phytoplankton plays important roles in lake ecosystem as producers of oxygen and food, which sustain all other forms of life. In order to clarify the structure and seasonal dynamics of phytoplankton community, the present study was attempted from March 2010 to November 2012 in 4 major lakes of the Yeongsan River system (Jangseong, Damyang, Gwangju and Naju Lake) Korea. As a microalgal flora, a total of 264 species of phytoplankton were identified. They were 123 Bacillariophyceae, 79 Chlorophyceae, 31 Cyanophyceae, and 31 other algal taxa. The general seasonality of phytoplankton in Jangseong, Damyang, and Naju lakes were Bacillariophyceae (March, June) → Chlorophyceae/Cyanophyceae (August) → Bacillariophyceae (November) and Gwangju lake was Bacillariophyceae (March, June) → Cyanophyceae /Bacillariophyceae (August, November). TSI (Trophic status index) evaluations of water quality status indicated mesotrophic states. Correlation coefficient showed that factors (water temperature, TN, TP) had influence on the biomass and the number of species of Chlorophyceae, Cyanophyceae.

P8-2

Effect of long-term water quality improvements on zooplankton community in at urban river (Geum-ho River, South Korea)

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The Geum-ho River (total length: 199 km, catchment area: 2,092 km²), which passes through the Daegu Metropolitan City, with a population of 2.5 million people, has been subject to increasing urbanization and its accompanying pollution since the 1970's. To improvement of polluted water in Geum-ho River, therefore, which has resulted in improvements in the water quality at a cost of ca 3,500 billion in 1990's (e.g. Particularlyly BOD; 1994: 11.28 ± 1.2 , 2013: 3.47 ± 1.1). With the increase in water quality, there has been a corresponding change in aquatic organisms. In empirical studies, the zooplankton community has been shown to be strongly influenced by aquatic environmental variables. We investigated species composition differences and community density for zooplankton communities in relation to water quality improvements, based on biweekly sampling at Gangchang-gyo (1994–2012, n=439). To perform this analysis, a 19 database for water quality was utilized to develop a Self-Organizing Map (SOM). 33 variables comprising 27 zooplankton groups and 10 physico-chemical parameters were patterned into the SOM and each variable was then compared with three environmental variables (rainfall, year, and season). The SOM analysis produced 3 clusters within which there were three distinct groupings. The largest structure was determined by the three environmental variables, while the subgroups were partitioned based on specific zooplankton features i.e. abundance, appearance. TN, TP, BOD, and COD all decreased gradually during the study period ($p < 0.05$); however, dissolved oxygen increased. With respect to the environmental factors the zooplankton community was also affected during the study period. During the study period, the genus *Brachionus* decreased; however, *Bosmina* had a contrary distribution pattern relative to *Brachionus*. Consequently some zooplankton species were significantly influenced by nutrient availability, particularly *Brachionus* and *Bosmina*. Therefore, both of these genera are suitable indicators for measuring water quality.

Seasonal distribution of phytoplankton community in estuarial lakes in the Yeongsan river, Korea.

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This study was performed to analyze the seasonal dynamics of phytoplankton and the relationship between environmental factors and phytoplankton in three artificial lakes in estuary area of Yeongsan river from April 2011 to November 2013. A total of 245 taxa were identified as phytoplankton including 98 Bacillariophyceae, 100 Chlorophyceae, 23 Cyanophyceae and 24 other algal taxa. Cyanophyceae including *Anabaena sp.*, *Phormidium sp.*, and *Merismopedia tenuissima* was dominated in these lakes. The standing crops ranged 20 ~ 19,634 cells·ml⁻¹, with mean value of 1,106 cell·ml⁻¹. The total biovolume of phytoplankton was 21,168 ~ 5,079,904 μm·ml⁻³ and phytoplanktonic biomass was 1790.5 ~ 765,618.01 pg·ml⁻¹. In the correlation coefficients between environmental factors and standing crops, T-N showed a significantly highest positive correlation at Yeongam lake (R=0.817, p<0.05) and conductivity was a highest negative correlation at Kumho lake (R=-0.676, p<0.01). The number of species was positively correlated with T-P (R=0.732, p<0.05, Yeongsan lake), NH₃-N (R=0.767, p<0.05, Kumho lake) and negatively correlated with T-N (R=-0.725, p<0.05, Yeongsan lake), water temperature (R=-0.785, p<0.05, Yeongam lake) and conductivity (R=-0.743, p<0.05, Kumho lake).

P9-1

Phytotoxicity of Engineered nanoparticles nano-titanium dioxide and silver nanoparticle on submerged aquatic plants.

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Engineered nanoparticles (NPs) can migrate through biological ecosystems and create toxicity on living organisms. However, effects of NPs on plants, especially submerged aquatic plants are not well examined. Therefore, in this research, phytotoxicity of two NPs, nano-titanium dioxide (nano-TiO₂) and Silver Nanoparticle (AgNPs) on two submerged aquatic plant *Ceratophyllum demersum* and *Myriophyllum spicatum* are investigated, considering dynamics of NPs. Seedlings of plants were grown in cylinder type mesocosm with 5% Hoagland solution for 1 month in growth chamber before treatment. After a month, solution was replaced to fresh solution and NPs was sprayed onto the water surface to provide a target concentration. From environmentally realistic conditions (0.01, 0.1 and 1mg/l of NPs) and High concentrations (10, 100, 500 mg/l) were used to check effects of NPs on plants. Shoot length, chlorophyll contents and cell size of plants were measured for 1,2,4,8,16 and 32 days after NPs treatment. Plants were sampled after 32 days and weight and NPs accumulation was measured.

For environmentally realistic conditions, both NPs showed no significant effects on plants. Chlorophyll contents and cell size of plants were not different from control. Plants in 0.01mg/l AgNPs treatment even showed significantly better shoot elongation compared to control. However, for AgNPs treatments over 100mg/l concentration showed significantly decreased chlorophyll contents (4,8 and 16 days) and cell size (16 and 32days). Though there was no significant differences in shoot length, biomass of *M. spicatum* in 500mg/L treatment showed significantly decreased values compared to control. For nano-TiO₂ treatment, plants showed significant increase on shoot elongation in high concentrations but biomass showed similar values to control. These results indicate that for AgNPs, the NPs itself is toxic that plants exposed to high concentrations of NPs shows stress but somehow the levels of stress decreases. Reasonable explanation of this results is that the NPs in solution agglomerates and particles become large for plants to uptake. The hydrodynamic diameter of NPs becomes more than 100 times larger than original particle size within 8 days. However, nano-TiO₂ does not show any acute toxicity even in high concentrations. Overall, since both NPs showed no significant toxicity for environmentally realistic conditions, it seems NPs have very few concerns for use

Impacts of low-level pollution by pesticides on freshwater ecosystem structure

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Aquatic ecosystems have many real problems due to anthropogenic impacts. Chemical pollution by pesticides is one contributing factor to these problems. Population dynamics of the organisms are controlled by complex combinations of biotic interactions and abiotic environmental factors. Vulnerability to the pesticides differs between each species, so the chemicals should induce different community structures. Moreover, the chemicals not only affect the individual survival or the reproduction rate, but also disturb the prey-predator interactions at very low concentrations. Here, we have examined the impacts of low level exposure of three pesticides (insecticide, herbicide and bactericide) on freshwater ecosystem by conducting species-, population- and community level experiments. The results of those experiments suggests that pesticides affect significantly on food web structure and ecosystem functions at lower concentrations than PNEC or HC₅.

P9-3

Ecological risk assessment of waterborne copper to freshwater zooplankton community by mesocosms experiment using DGT (gel sampler)

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In this study, we investigated the zooplankton community response against various levels of waterborne copper toxicity stress using mesocosms. Freshwater zooplankton and phytoplankton assemblages which were originally collected from Sakuraga pond were raised in fifteen plastic mesocosms (20L) and exposed to different chemical stresses (0ppb, 31.2ppb, 62.5ppb, 125ppb and 250ppb copper sulfate CuSO_4) during 7days at outside. The measured concentration of total copper on each tank was maintained at about 3.78ppb (Control), 25.15ppb, 56.19ppb, 80.52ppb, and 137.59ppb during the experiment period. The concentration of chlorophyll *a*. as an abundance of phytoplankton was low at 3.78ppb tanks and 137.59ppb tanks. The density of *Daphnia* sp. which is an important species in zooplankton community showed almost zero in 137.59ppb tanks and showed 57% decreasing in 80.52ppb tanks when it compared to 3.78ppb and 25.15ppb tanks. From the result, the reduction of daphnia abundance was affected by copper concentration (over80.52ppb). Otherwise, the decline of phytoplankton abundance was caused by both top-down effect from *Daphnia* and high concentration of copper at 137.59ppb.

Hydrogen sulfide in water and interstitial water in Lake Youngrang and Lake Hwajinpo

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Hydrogen sulfide is a highly toxic compound produced by sulfate reducing bacteria. Sulfate reducing bacteria are exclusively anaerobes, that is to say this bacteria function only in an anaerobic environment. Therefore, hydrogen sulfide is a useful environmental indicator of anaerobic conditions. Lake Youngrang and Lake Hwajinpo are located on the east coast of Korea. In recent years, the blue tide has been observed, however, there is little literature concerning the determination of hydrogen sulfide which is dissolved in both water and sediment. In this study, we focused our attention on hydrogen sulfide in the water and in the interstitial water of bottom sediment.

The observations were carried out at 2 stations in Lake Hwajinpo on October 9, 2009 and 3 stations in Lake Youngrang on October 10, 2009. The water samples were taken using a Kitahara-type sampler and then directly taken into a glass syringe without head space. 1 mL of zinc acetate solution was injected and the syringe was then sealed with a rubber cap. H₂S was determined by using the methylene blue method (Cline, 1969). The sediment sample was taken by KK-type core sampler (ID: 51mm, Length: 670 mm). The core sample was cut for each 1 cm layer (0-1, 1-2, 2-3, 3-4, 4-5, 5-6, 9-10, 15-16 & 29-30 cm), and the sample was used for determination of hydrogen sulfide (H₂S+HS⁻) dissolved in lake bottom sediment. The method of Sugahara et al. (2010) was used as the pre-treatment method for determining the dissolved hydrogen sulfide in lake bottom sediment.

In Lake Hwajinpo, the whole water column formed an oxic environment, so H₂S was not observed. On the other hand, in Lake Youngrang, where a halocline was observed at a depth of 2.5 to 3.5 m, the bottom layer became an anoxic environment. 22 to 58 mgS L⁻¹ of H₂S was observed at that bottom layer in Lake Youngrang. 100 to 500 mgS L⁻¹ of dissolved sulfide in the bottom sediment was observed in both Lakes. These lakes are eutrophic lakes, which waste water flows into. From the results of this survey, it has been shown that the lakes have organic matter available for sulfate reducing bacteria and a anaerobic environment, which caused quite a high concentration of hydrogen sulfide in the bottom sediment.

P9-5

Microcystin accumulation in marine Mollusca, *Crassostrea gigas*

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Blue-green algae are often blooming in eutrophic waters during the warm season. It is reported that a kind of algae that is blue-green also produces hepatotoxin and neurotoxin. Hepatotoxic microcystin (MCs) influence not only aquatic organization, but also domestic animals and humans. WHO has set TDI (Tolerable Daily Intake, 0.04 $\mu\text{g kg}^{-1}$) for MC-LR (WHO, 1998). In 1952, the government recommended cleaning up the Isahaya Bay. In 1982, this project was launched. In 1997, the part of Isahaya Bay (3550ha) was disconnected. Three years later, blue-green algae were present. There are three purposes in this study. First of all, the blue-green algae that bloomed in freshwater system (reservoir) were released into the Isahaya bay (sea). Second, animal samples living in the seawater system store MCs. Finally, how much MCs do they accumulate. The study area is the Isahaya Bay located in the western part of the innermost areas of the Ariake Bay in Kyushu, Japan. We take the surface water in the reservoir, the bay water and animal samples marine Mollusca (*Crassostrea gigas*) for MC analysis. We extracted MCs from the water and animal samples used by BuOH: MeOH: H₂O (1:4:15). We measured the amount of MCs with LC/MS.

We detected MCs (0.7-34 $\mu\text{g L}^{-1}$) from almost all water samples in the reservoir and bay. We could confirm MC-RR and MC-LR from LC/MS. This result was a lot higher than the previous report (Umehara et al., 2014). They had obtained that MCs were 0.05-9 $\mu\text{g L}^{-1}$. Water samples from the reservoir contained about thirty times the amount of MCs as those taken from the bay. *Crassostrea gigas* from the bay have MCs (1.2 $\mu\text{g gDW}^{-1}$).

We recorded higher levels of MCs with LC/MS than the previous report because they used ELISA method. It became clear that MCs do not only occur in the reservoir, but also flow to the outside of the system, where they are stored in the benthos of the bay near the reservoir. All year around, MCs were supplied from the reservoir to the bay so that *Crassostrea gigas* always got MCs and accumulated them in its body. WHO recommends no more than 2.0 μg in a day. Thus we need pay attention to eating the fish and clam from the reservoir and bay which was contaminated cyanotoxin.

Inhibitory effects of the plant secondary metabolites growth of *Microcystis aeruginosa*

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Inhibitory effects of Acacia extract (AME) from *Acacia decurrens* Willdenow and on growth of two species in cyanobacteria, *Microcystis ichthyoblabe* Kützing (M 95) and *Microcystis aeruginosa* (Kützing) Kützing (NEIS 298). AME showed negative effect on cyanobacterial growth in both species at 6 ppm, and induced algicidal effect of negative growth at 12 ppm. On the contrary, there was no effect of AME on growth of green alga, *Chlamydomonas reinhardtii* Dangeard (IAM C-9) even at 12 ppm. Analysis using a thin-layer chromatography separated four bands, band 1-4, from the AME with a mobile phase solvent (1-Butanol:Acetic acid:H₂O = 4:1:2), and the band 2 induced the most inhibitory effect on both *M. ichthyoblabe* and *M. aeruginosa* growth.

Liquid chromatography-mass spectrometry showed the band 2 included gallic acid, epicatechin, and polymer (dimer, trimer, tetramer and pentamer) catechins. High-performance liquid chromatography indicated that polymer catechins extracted from the band 2 might influence cyanobacterial growth even at ca. 3 ppm. These results suggest that the catechins may be main inhibitor in the band 2 separated from AME on cyanobacterial growth.

P9-7

Determination of the intra- and extracellular cylindrospermopsin produced by the filamentous blue-green algae

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Cylindrospermopsin (CYN) is an alkaloid toxin with a low molecular weight (415Da), produced by some species of cyanobacteria including *Anabaenabergii*, *An.lapponica*, *Aphanizomenonflos-aquae*, *Ap.ovalisporum*, *Cylindrospermopsisraciborskii*, *Lyngbyawollei*, *Raphidiopsiscurvata* and *Umezakianatans*. CYN inhibits protein synthesis and causes pathological symptoms in the liver, kidneys, spleen, thymus and heart. Moreover, CYN has been shown to induce genotoxicity and carcinogenicity. CYN was first discovered after an outbreak of a mystery disease on Palm Island, Queensland, Australia. The outbreak was traced back to a bloom of *Cylindrospermopsisraciborskii* in the local drinking water supply, and the toxin was subsequently identified. Analysis of the toxin led to a proposed chemical structure in 1992, which was revised after synthesis was achieved in 2000. Several analogues of CYN, both toxic and non-toxic, have been isolated or synthesised.

CYN producing strains, *U.natans* and *Cy. raciborskii* isolated from Japanese lakes. *U.natans* was a new species in the family of Stigonemataceae. According to the original description, this planktonic filamentous species grows well in a growth media with pH being 7 to 9, and with a smaller proportion of seawater. Results of the DNA analysis showed that *U. natans* appeared in a cluster containing *Ap.ovalisporum* and *An.bergii*. *Ap.ovalisporum* was produced CYN and a large fraction of CYN concentration occurs extracellularly in CB medium. We suggested that in the case of *Aphanizomenonovalisporum* the release of toxin into water could be even higher.

CYN is highly water soluble and stable toxin which can persist in water sources and pose health hazards to human, animals and plants. Due to its chemical stability and slow degradation, CYN shows a high persistence in many lakes. This is of an important concern for water authorities if concentrations in water sources used for drinking and irrigation purposes exceed the proposed guideline value.

The influence of N:P ratio on toxin and off-flavor production of different cyanobacteria isolated from Han River: Comparison of *Anabaena*, *Microcystis* and *Aphanizomenon*

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Nutrient condition is one of the key factors that regulate the production of cyanobacterial toxin and odor material during bloom formation period. In Han River, cyanobacteria genera, *Anabaena*, *Microcystis* and *Aphanizomenon*, often cause blooms during summer when the water temperature and nutrient input are high. This study was conducted to elucidate the production of unfavorable materials by these cyanobacteria species in different nutrient conditions and growth phase. *Anabaena circinalis*, *Aphanizomenon flos-aquae*, and *Microcystis aeruginosa*, isolated from Han-River, were incubated at 25°C with the light intensity of 60 $\mu\text{mol}/\text{m}^2/\text{s}$ in different nutrient conditions to measure the production of toxin (Microcystin-LR, RR, YR, LA and anatoxin) and odor material (geosmin, 2-MIB). While total nitrogen was fixed to 1 mg/L and 10 mg/L, to the range of the nitrogen fluctuation in Han River during last decade, total phosphorus was adjusted to five different N:P ratios (100, 40, 20, 10 and 1). During four different growth phases (measured by Chlorophyll-*a* concentration), microcystin and geosmin were measured in all nutrient ratio conditions. Among all three tested species, 2-MIB was not detected at all growth phases. As for the geosmin production, *A. circinalis* showed increase of geosmin concurrently with increase of Chl-*a* concentration ($r=0.900$, $p<0.05$) at high nutrient condition (N=10 mg/L). In the case of *M. aeruginosa*, the highest geosmin concentration was shown at the N:P ratio of 100 when the nutrient and growth was low (N=1 mg/L condition) and at N:P ratio of 1 when the nutrient and growth was high (N=10 mg/L condition). The highest geosmin production occurred for *A. circinalis* and *M. aeruginosa* during the stationary phase of growth. In all the species tested, MC-LR and YR were detected but MC-RR, LA and anatoxin were not detected. Variation was shown among the species in highest MC-LR production according to their growth phase. In terms of nutrient condition, microcystin production was the highest at N:P ratio 100 (N=1 mg/L) and N:P ratio 10 (N= 10mg/L) for *A. circinalis* and *M. aeruginosa*, respectively, while it was shown at N:P ratio 20 (N=1 mg/L) and N:P ratio 100 (N= 10mg/L) for *A. flos-aquae*. These results indicate that the production of unfavorable material among cyanobacteria genera is affected by the nutrient condition and their growth phase and that the optimum condition of the production are likely to be species-specific.

This study was supported by "The Project of Basic Investigation of Environment in Han River Watershed (2013)".

P9-9

Effects of the temperature and light intensity on the growth and production of geosmin and microcystin-LR of cyanobacteria

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Cyanobacteria often cause harmful algal blooms in eutrophic waters; and furthermore, certain cyanobacterial species produce toxin and odor compounds during their growth that raise the public concerns in usage of the water source. Two environmental factors (i.e. light condition and temperature) are closely related with the growth of cyanobacteria. Also, the production of the unfavorable flavor compounds is closely associated with the phase of their growth. To elucidate the environmental factors in the growth of the cyanobacteria and geosmin and microcystin-LR production characteristics in different growth phase, we investigated on three cyanobacteria species isolated from Han River (*Anabaena circinalis*, *Aphanizomenon flos-aquae* and *Microcystis aeruginosa*). The temperature variations for the growth conditions were set for 10, 15, 20, 25 and 30 °C at 60 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ (light : dark = 14: 10) light condition. The light conditions were set for 30, 60, 120 and 240 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ light intensity at the temperature of 25 °C. During the incubation period, the growth phases of each species were determined to lag, exponential, stationary and death phase for the analysis of geosmin and MC-LR production. The highest growth rate for *A. circinalis* was shown in 30 °C (0.245 d⁻¹) and 30 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ (0.233 d⁻¹) while that of *A. flos-aquae* was shown in 20 °C with 60 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ light condition (0.196 d⁻¹). The optimum temperature and light conditions for the growth of *M. aeruginosa* was 25 °C and 30 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ showing the growth rate of 0.262 d⁻¹ and 0.274 d⁻¹, respectively. The maximum geosmin concentration of *A. circinalis* was detected at the stationary growth phase under the 30 °C and 10 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ conditions showing two folds higher concentration (201,189, 199, 645 ng/L) than two other species. For *A. flos-aquae* and *M. aeruginosa*, the maximum production of geosmin concentration was detected at 10 °C, under the light condition of 120 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ and 30 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$, respectively. *M. aeruginosa* showed the highest MC-LR production among three tested species, especially during lag phase. All the tested species produced MC-LR during lag and exponential phase, and maximum yield detected for *A. circinalis* in 20 °C and 120 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$, *A. flos-aquae* in 15 °C and 120 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$, and *M. aeruginosa* in 25 °C and 120 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$. These findings indicate that the optimum growth condition for the cyanobacteria in Han River is 20~30 °C and 30~60 $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$. The geosmin production is likely to happen when the water temperature is low with high light intensity due to synthesis of geosmin rather than Chl-*a* when the environmental condition is unfavorable for their growth. Similarly, MC-LR is synthesized when the temperature and light intensity is low.

This study was supported by "The Project of Basic Investigation of Environment in Han River Watershed (2013)".

Habitat restoration for the promotion of biological diversity in artificial lake

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Domestic reservoir's high water level fluctuation all year round is causing severe physical disturbances on micro-habitat of organisms for spawning and inhabit. Lake Soyang has water level difference of 40m between dry and flooding season which significantly deteriorates inner Lake environment of habitat. Reduction in biodiversity occurs due to river channel breakdown into upstream and downstream after dam construction and downstream organism inhabited environment significantly alters due to changes in physical environment according to dam outflow. In this study, we developed the structures and guidelines for complex and alternative biological habitats of organism, ecological wetland and organism movement pathway to improve the inhabited environment. Based on this, test and diagnosis, design and ecological construction techniques were completed, throughout a model experiment and on site application. Domestic reservoirs not only contain dry steep slope but also section of gentle slope with wetland distribution. In this study, such gentle slope wetland were considered riparian wetland for organism and technology is developed to create fish habitat and pathway, and applied and evaluated in reservoirs, such as Gunwi and Soyang.

In Lake Soyang, fish conservation facilities, floating fish spawning platform (3 areas), artificial reefs (3 areas), near shore submerged reefs (2 areas) and riparian wetland habitat (2 areas) were developed for ecological restoration and fish spawning, species and population were investigated. Research result of 2010 to 2013 showed fishes of 12 families, 41 species and 93,120 individuals where smelt fish (80.57%) as dominant and minnow (5.82%) as subdominant species, inhabited around the facilities. Each facilities under water recording showed species appeared around artificial reefs, floating spawning platform, near shore submerged reefs and riparian wetland habitat were 10, 11, 9 and 9, respectively. Observation of ecological characteristics of appeared fish species confirmed that proportion of swimming species were high at floating spawning platform and benthic species were high at artificial reefs. Floating spawning platform (886m²) observed 700 thousand to 1 million fish eggs (carp fish) of which over 50 thousand at each unit or 56 individuals of young fish per m² can survive considering the production and survival rate. Each year, 340 thousand fry fish are released in Lake Soyang as of now, which can be substituted with the installation of fish conservation facilities. Therefore, proper installation of fish conservation facilities can improve the deteriorated fish spawning platform and habitat by dam fluctuation. Also, building species-horizontal ecological network can have great contribution on movement, proliferation, diversity promotion and biomass increase of fish.

P10-2

Changes in depth and decrease flow shields in the sediment rate before and after a building breakhead maintenance construction in Lake Fukami-ke, Japan

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Changes in depth and decrease of the sediment rate before and after a building breakhead maintenance construction were studied in small monomictic and eutrophic Lake Fukami-ike in central Japan. Lake Fukami-ike in nature lake is located north latitude 35°32'55"77、 east longitude 137°81'93"56 and breath(150 m), length (300 m), area (2.1 ha), volume (1.0 × 10⁵ m³) having the maximum depth of 7.75 m. Inflow rivers six locations and the river outflow is one place. Lake water stratified from March to October and circulated November to March and water color is a dark green or brown color. A cause of eutrophication is considered to be the surrounding houses (12 units), an influx of nutrients (12.4km²) from field paddy (17.9km²). In addition, dissolved oxygen content is high in the epilimnion and zero at depth of 4 m or deeper during the summer stratification hydrogen sulfide generated in the bottom of the lake was included in the water. Photosynthetic sulfur bacteria accumulated in the hypolimnion (at the depth of less than 3.5 m) in the stagnation period. The maintenance of farm village drainage and the waterfront function was carried out for the activation of the town in 1992, and the water quality improvement was expected. However, variations of transparency (70 cm to 280 cm in the 1950s, 50 cm to 150 cm in the 1980s, and significantly large 35 cm to 470 cm from 1992 to 2010) were observed and no blue-green algal bloom (*Microcystis aeruginosa*) outbreak had occurred before recently observed. Maximum depth changed from 9.3 m (1951), 8.5 m (1979), 8.1 cm (1992) to 7.8 m (2012), respectively. Therefor the changed 30 cm depth from 1992 to 2012 was nearly equal to the calculated data 24 cm depth. (1.2 cm year⁻¹ ×20 year). Changes in the autochthonous and allochthonous matters in the lake were thus considered. Sediment rates of 19.5 ± 10.19 gm⁻²d⁻¹ (1978 to 1979) and 4.40 ± 2.27 gm⁻²d⁻¹ (2007 to 2008) were observed, and decreased 22.6%. These deposition rate data corresponded to 3.1 cm year⁻¹ (1979) and 1.2 cmyear⁻¹ (2009), respectively. 1.1 cmyear⁻¹ (2011) were also obtained in the ²¹⁰Pb age determination method. The ignition loss, specific gravity and sum of carbon & nitrogen in the sediment surface in 1979 were 1.08, 16.3% and 64.53 mgg⁻¹, respectively. That of data in 2008 were 1.05 ± 0.02, 14.5 ± 1.27% and 57.40 mgg⁻¹, respectively. The decreased percentage of organic matter and the reduced deposition rate were because rice fields and forest around the lake give way to take concrete roads. It was considered to be because the inflow of sediment stopped when it rained, and allochthonous inorganic matter (mud) was significantly reduced.

Long-Term Runoff Simulation in Gamcheon Watershed using SWAT and K-DRUM Models

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Gamcheon river has a length of 69 km and a catchment area of 1,004 km². It composes 4.3% of the Nakdong watershed, second of the four largest watersheds in South Korea. The watershed is located at 127°52' 32"~128°21' 10" longitude and 35°50' 52"~36°18' 11" latitude. Gamcheon watershed is situated within Gyeongsangbuk-do administrative district and includes Gimcheon and Gumi Cities. One national river and 17 local streams composes the watershed. Due to the aggravating effects of climate change and rapid urbanization, the occurrence of extreme rainfall events and social damages are inevitable. Such events includes torrential rainfall, which frequently results to water disasters such as flood inundations. In year 2003, Typhoon 'Maemi' caused extensive damages on both life and properties. The hydrological characteristic of the watershed shows that the streamflow are concentrated during summer season, annually, with large fluctuations. Therefore, the Korean government constructed Buhang Dam to reduce the risks of flood inundations. The dam is situated at the upstream of the watershed, and thus manages only 7.2% of the total catchment area of Gamcheon watershed. Due to these circumstances, the continuous occurrence of downstream flood inundations should be managed. Therefore, this study aims to determine the feasibility of constructing a new dam, Daedeok flood mitigating dam, in the upstream of Gamcheon watershed. In this study, the assessment on the accuracy of SWAT and K-DRUM models for simulating streamflow from year 2000 to 2011. The average coefficient of determination (r^2), for SWAT and K-DRUM, were 0.78 and 0.85, respectively. Based from these results, both models are capable of simulating streamflows which can be used to assess the hydrological condition of Gamcheon watershed. Furthermore, the results of the simulations from SWAT and K-DRUM will be used to determine the hydrological effects of Buhang Dam and the suggested construction of Daedeok Dam on downstream flood mitigation.

P10-4

Habitat restoration plan and applied technology for the river ecology

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This study proposed seven priority steps as a procedure for making a master plan for restoring destroyed aquatic system with biological consideration. Step 1 is to set up the basic concept of restoration by considering the characteristics of the target river. The objective of Step 2 is to survey and evaluate the channel form changes of the target river. Step 3 is to estimate the natural environment including ecological habitat and the extent of damage. Step 4 is to analysis the change of biota, endangered species, dominant species, and select the restoring species. Step 5 is to establish the restoring plan including selection and restoration of ecologically functional area, security of biodiversity. Step 6 is to select the applied facilities such as wetland, fish habitat block, fishway. Finally, Step 7 is to establish the master plan of restoring plan through the consultation and consensus of various stakeholders.

Development and application of fish habitat block and methods applied to reservoirs and streams

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In this study a new technology of fish habitat block (fish block) was developed to restore the destroyed fish habitats in reservoirs and streams. In addition, we introduced some case studies applied the developed fish block to channel, stream, and dam reservoir. In case of channel and stream with straight and simple riverbed, the application of the fish block provided various habitats by changing the flow distribution, inducing the circumstance of erosion and sedimentation. Furthermore, the zigzag arrangement of the fish blocks created the various riverbed and resulted in increase of the species diversity of benthos. On the other hand, in Korean dam reservoirs, a wide range of water level fluctuations suppresses the development of a macrophyte community, and as a result, a spawning ground and habitat of fish are lack. We installed the fish blocks to shore of reservoir, by considering the annual variation of water level and various habitat of fish species. The installed fish blocks will play a role as a good habitat in the destroyed reservoir ecosystems.

P10-6

Establishment of biological habitat data base (DB) for aquatic ecosystem restoration

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This study was conducted to provide a substantially important information in implementing the plans for aquatic ecosystem restoration. The Data base (DB) for the habitat of the restoring target species consisted of generic characteristics of target species, environmental conditions of habitat, a spawning ground, food source etc. Fish, aquatic insect, amphibian/reptilia, bird, and mammalia (otter) were selected as a restoring target species. On the other hand, the habitat models for fish, aquatic insect, and amphibian were established by considering their habitat characteristics. The proposed DB and models of habitat in this study will be useful in deciding the boundary of restoration and making a guideline to restore a destroyed lakes and streams.

Fluorescence characteristics of dissolved organic matter(DOM) at inflow streams with different land uses

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Spatial-temporal runoff patterns change of dissolved organic matter(DOM) fluorescence characteristics at inflowing stream of industrial(4TG), urban(AS), and rural(MS) areas in Lake Sihwa. The result of synchronous analysis in 4TG, PLF(Protein-like fluorescence) variation characteristics clearly appeared while no clear peaks appeared in the FLF(Fulvic-like fluorescence) and HLF(Humic-like fluorescence) wavelength ranges. The results of analysis using 3D-EEMs(3-Dimensional Excitation Emission Matrix Spectroscopy) showed a difference that fluorescence distribution and variation clearly appeared in the FLF and HLF regions along with the PLF region and DOM variation over time tended to be similar between the results of the two fluorescence analyses. The results of synchronous analysis in AS showed that PLF, FLF and THLF(Terrestrial-like fluorescence) region peaks were clearer during rainfall than when there was before rainfall. AS showed a distribution characteristics that PLF characteristics did not disappear even during rainfall but continuously appeared during the duration of rainfall. The spatial-temporal DOM variation and distribution characteristics during rainfall appeared through the synchronous method and the 3D-EEMs method showed similar tendencies although in the results of 3D-EEMs analysis. A characteristic that Peak A region fluorescence intensity did not decrease during the duration of rainfall but maintained at least a certain range of fluorescence intensity and spatial-temporal changes in the HLF region clearly appeared. The results of synchronous analysis over time during rainfall in MS did not show great changes in PLF and FLF concentrations while showing a regional characteristic that fluorescence intensity changes over time in the THLF region increased greatly. The results of 3D-EEMs analysis, the Peak C region showed a characteristic of gradually decreasing fluorescence intensity over time while the Peak A region continuously showed high fluorescence intensity distribution without any great changes over time. In conclusion, our results showed significant differences in the fluorescence characteristics of DOM in industrial, urban and rural area, and these differences should be considered for the scientific management of non-point pollutant sources in the watershed.

P10-8

Environmental improvement plans of the Moshui River in Qindao City, China, to reduce pollutants into the Yellow Sea

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This study was conducted to establish the appropriate improving plan for a river that flows into the Yellow Sea, the Moshui River in Qingdao City, China. The river has been damaged by a rapid industrialization and urbanization for several decades. The river's environmental improvement plans consisted of three phases between 2015 and 2023. The first phase (2015-2017) is to restore the river's function by implementing the various action plans, including the securing water for the river maintenance flow from the treated wastewater, the managing the pollutants load from the river's watershed and the contaminated sediments within the river. The second phase (2018-2020) focus on water quality management of the river by installing the advanced treatment systems or facilities for wastewater, first-flush, and separate sewer overflow (SSO). The aim of the third phase (2021-2023) is to rehabilitate the degraded river ecosystem toward the aim of ecologically healthy the Moshui River. Our results will provide a helpful information in planning to breathe life other urban rivers suffering from the water pollution, droughts, and habitat loss.

Engineering technologies for high efficiency green-tide harvesting system at the water-bloom of river

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Many kinds of technologies have been developed to improve the water quality in drinking water resources and polluted water body. However, using a simple or one specific technology, it is very difficult to directly apply to field condition because of complexity of reservoir ecosystem and its temporal and spatial changes increasing time. Most technology and its effects were just obtained from laboratory study. Recently, to solving the green algae problems of rivers and reservoirs in a variety of field studies are being promoted. Above all, the temporal and spatial environmental characteristics of the study area should be considered, advance response and field available techniques need to be developed. This technology is consist of four modules such as green-tide collector, scum transfer, algal biomass collector, attached matters separator. Because this device is ultra-light and assembling, equipment is available for one vehicle (5 ton truck) loaded and developing equipment does not require a ship mooring facilities. This developing equipment is mobility and immediate is a very excellent new technology. It is can be reached within 3 hours in green algae outbreak area and the removal green algae is possible to within 4 hours of after arrival. The goal of the developing equipment are removal efficiency is more than 90% and removal water volume is more 100,000tons/day targeted. Technique is completed, the outbreak green algae is effectively removed from water body in extensive area. In this study, the development and commercialization of the eco-friendly high-efficiency green-tide harvesting system, the nation's leading green algae management plans to complete the on-site practical technique. This study was performed by research funds of KIST-ORP.

P10-10

Water Quality Projection in the Geum River Basin in Korea to Support integrated Basin Wide Water Resources Management

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When establishing long and short term reservoir operation to support integrated water resources management (IWRM), reservoir operation emphasizes not only water quantity but also water quality in downstream of the reservoir. This study proposes water quality projection scheme in the Geum River basin based on the pollutant loadings of BOD, TN, and TP combining with long term hydrologic simulation model. In the Geum River basin in Korea, two multi-purpose dams, Daechung and Yongdam Reservoir exist. Especially downstream of the Daechung reservoir is subject to the pollutant loadings released from the metropolitan cities which contribute to water quality degradation in main stream of the Geum River. To identify hydrologic cycle in the Geum River basin, long-term hydrologic simulation model have been employed and calibrated with two control points from 1983 to 2008. Water quality simulation based on the flow rates and pollutant loadings estimated in the Geum River basin show a good agreement with observed ones along the main stream of the Geum River. Combining the long term hydrologic simulation model SSARR with water quality model QUAL2E, it is possible to estimate water quality variation in mainstream of the Geum River. It will contribute to propose systematic water quality projection scheme to support reservoir operation considering downstream water quality. As a result, the combination of water quality and hydrologic simulation model provides systematic approach to project water quality in downstream of the in determination of discharge release identifying the water quality variation to check the possibilities of exceeding specified target water quality standard.

Application of HEC-RAS for the purpose of flood routing in the Ara Waterway

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For successful and efficient operation of the navigation channel, various water management schemes including flood control, flow circulation, water quality management, ice problem, and sediment control are necessary. Especially flood control requires flood level computation considering operation of the hydraulic structures such as weir, flood gate, and storage area. To support decision making for operation of the Gyeong-in Ara waterway, components of water management system especially for flood control have been developed using HEC-RAS. HEC-RAS is to estimate water level variations in navigation waterway based on the hydrograph computed from HEC-HMS. Various boundary conditions are specified for operation of the hydraulic structures and based on the simulation results it is possible to establish guidelines necessary for efficient flood control in the Gyeongin Ara waterway. This study applied HEC-RAS for the purpose of decision making to support operation of the waterway during flood. Especially operation of flood gate in the west sea should be able to consider tidal and flood level in the navigation channel simultaneously. For this boundary condition of the model is applied to consider operation of the hydraulic structure. Applying the flood event in September 2010 for model verification, simulated water level computed at the upstream and downstream of the regulation weir shows good agreement with observed data.

P10-12

Measurements of Velocity Distribution at the Entrance of Hydro Power Plant at Sejong Weir

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To confront with frequent floods and secure water supply of industrial, agricultural, and living during dry season and at the same time afford ecologically sound river environment to people in Korea, four major rivers restoration project was initiated. Its structural outcomes are 16 weirs in 4 major rivers – Han River, Kum River, Nakdong River, Youngsan River. Sejong weir is located in the mid reach in the Kum River. It is composed of fixed wier, movable weir, small hydro power plant, and fish way. The discharge of 37.8 cms is released through small hydro power plant in Sejong Weir continuously for hydro power generation. To investigate the ecological environment of fishes around the power plant during its operation, the need for depthwise velocity distribution measurement at the right upstream has been brought up. Appropriate equipment for the depthwise velocity distribution measurement is acoustic doppler current profiler (ADCP) which can measure velocities at every given depthwise interval. The author applied a RiverRay ADCP which can measure velocity until 40 m from water surface. Sections for ADCP transects were selected based on the distance from the gate of the power plant. Four sections which were located at 0 m, 21 m, 32 m, 51 m from the entrance were selected to investigate velocity change in front of it. The depth of the cross section at the end of guide wall of the power plant reached about 8 m, the depth of 21 m upstream from it was 5 m or so, and the depths of 32 m and 51 m upstream were around 4 m at the both section. The measured velocities at the cross section of the end of guide wall of the inlet of small hydro power were as follow: the fastest velocity spot of the whole section was located at the depth 3.2 m of gate No. 1 where the velocity was 2.09 m/s. the velocities at the other two gates were around 0.95 m/s at the depth of 2 m at both gate. The mean velocities went down as the distance from the gate increased – 0.60 m/s at 21 m, 0.4 m/s at 32 m, and 0.30 m/s at 51 m.

Fields Measurements on Conversion Factor between Surface Velocity and Average Velocity of Discharge Measurement Using Microwave Water Surface Current Meter

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During floods, it is very difficult to measure discharge using conventional methods such as current meter and buoy because water velocity is over 2 m/s even in urban watersheds and it reaches to 4 m/s or more at mountainous catchments. Strong drag force exerted to the current meter due to high velocity puts field investigators into dangerous situation and the instrument is exposed to the high possibility of damage and loss. In case of method of buoy, at least six peoples are needed to conduct discharge measurement in a field during floods. To overcome above situations, non-contacting technologies such as radar, laser, and image based techniques have been developed in the last couple of decades and currently some of technologies – radar technology and image velocimetry - have been applied for field discharge measurements successfully. Radar technology has been developed in Japan, China, USA, and Korea and image velocimetry has been developed in USA, France, Japan, Korea. In case of radar technology, K-water has developed Microwave Water Surface Current Meter (MWSCM) in 1999 and it has been distributed over 100 sets for field discharge measurements. These two technologies measure surface velocity and convert it into depth-averaged velocity by applying a conversion factor, 0.85. This conversion factor can be changeable within a range of 0.80~0.95 field condition. Users has been doubtful whether the single value of conversion factor 0.85 may cause severe error on discharge calculation or not. Therefore the range of the factor was identified through field experiments conducted at several spots in the Kum River. The results showed that the factor ranged from 0.828 to 0.910. These identifications make the user of surface velocity for discharge calculation confident that the error from the calculated discharge can be allowable because it is within 5% or so.

P10-14

Initial effects of large artificial structure construction on South Han River ecosystem, Korea

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This study was conducted to understand the initial ecosystem-level effects of large artificial structure (weirs) construction in South Han River watershed by comparing a variety of variables during the period of pre- (2005-2009), mid- (2010-2011), and post-construction (2012). Monitoring included variables of hydrology (precipitation, water velocity, discharge), water quality (temperature, pH, turbidity, nutrients, organic matter), and biology (phyto- and zooplankton, benthic macroinvertebrates, fishes). At construction sites, water quality appeared to be similar throughout the pre-, mid-, and post-construction period during the normal water and low water seasons, while there was the increase of both organic matter and nutrients during the flood season. Overall, the water quality difference between upstream and downstream of construction sites was not high during weir construction period, but the difference was noticeable in the Ipo Weir area, possibly due to nutrient introduction through the inflowing streams (Yanghwa and Bokha Streams). The effect of weir construction seemed to appear on phytoplankton communities, particularly the change of species composition and dominant taxa, through nutrients increase, especially in the area (Ipo Weir), in accordance with water quality change. However, community structure and biomass changes were largely related with the variation of discharge by precipitation. Zooplankton community also affected by river discharge, but unlike phytoplankton, zooplankton community was similar between upstream and downstream weirs even during construction period. Both benthic macroinvertebrates and fishes were considerably affected during weir construction period (especially in 2011) in terms of occurring taxa and total abundance, possibly due to the increase of depth and water velocity and habitat destruction by dredging the sediment and riparian area disturbance through construction activity. In conclusion, the changes of water quality and river communities appeared during weir construction period, and they were largely related with the variation of river discharge by the storm events. However, these changes and their possibility of endurance need to be studied through long-term monitoring and more comprehensive approach.

Evaluation of Sediment Oxygen Demand on river

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In waterbody, sediments are accumulated naturally and also by human activities. Bottom sediment have been transported from terrestrial environment by water or air. It pass through biological, physical and chemical processes like dissolution, diffusion, re-floating and disturbed by fish. Afterwards, it is released to the water and have influence on water quality and ecosystem. Sediment oxygen demand is due to the oxidation of organic matter in bottom sediment. The influences of sediments upon water quality vary with respect to the formulation and environmental condition and therefore appropriate measures need to be made according to the degree of contamination. The purpose of this study is to proffer the information of sediment oxygen demand in river for water quality management.

According to Four major river project, newly built barrage is to change the state of the flow in the river. The change of flow stream is affected oxygen consumption in the bed. This study evaluate the SOD of Baikje barrage and Chilgok barrage at representative of every Geum and Nakdong river. The results are intended to utilization of efficient water quality management.

SOD experiments were performed to samples collected from each berrage for two weeks. Experimental reactor consist of sediments sample(10cm) and river water(30cm) taken from the barrage. Time-dependent change of the dissolved oxygen was measured. To minimize the influence of the temperature change, the reactor was maintained at 20 °C.

Sediment oxygen consumption in the short-term (1 day) and long-term (2 weeks), respectively, were evaluated at each sediment. SOD is estimated to be short-term test results were $0.284 \text{ gOm}^{-2}\text{d}^{-1}$, long-term SOD was estimated to be $0.047 \text{ gOm}^{-2}\text{d}^{-1}$ at Baikje site. It is estimated to be short-term test results were $0.224 \text{ gOm}^{-2}\text{d}^{-1}$, long-term SOD was estimated to be $0.043 \text{ gOm}^{-2}\text{d}^{-1}$ at Chilgok site.

P10-16

Water quality impact assessment of river sediment

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The main sources of inorganic sediment are the erosion of uplands, lateral movement of channels into streambanks, and downcutting of streambeds. Particle size of both inorganic and organic sediments is of major importance to the distribution and growth of many benthic invertebrates and microbial metabolism. Sediment has several forms and sources, but of greatest concern in stream and river sediment problems are the fine inorganic particles that either flow with the current or that are deposited on the streambed. In this study, the multi-purpose weir sediment component was analyzed and evaluated the impact on the stream water quality.

Five multi-purpose weirs which is built on the Geum and Youngsan river was surveyed for sediment at the main point. According to the results of particle size analysis, average composition of Geum river is classified as loam(L) and Yongsan River is a silt loam(SiL). When we compare to data of published in leading, Geum river and Yongsan River were analyzed much more content of silt or clay. But the result of sediment ignition loss at Geum river and Yongsan River was assessed low levels compared to the other published results and the contents of organic matter was not higher than the Sediment quality criteria of 13% at all points.

Chemical properties of each sediment were appeared low level compared to established regulation of Korean EPA. At several points, there is some different concentration between before and after flood. Release experiments were performed to assess the water impact of river sediment. Leaching of heavy metals and organic matter from sediment did not affect on river water quality. The above data will be used basic information of water quality management in the future.

Improvement of Microwave Water Surface Current Meter for Efficiency on Discharge Measurements

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Discharge measurement is very important for water resources planning and management but flood discharge measurement is very difficult because river velocity is so high. Current meter or float is applied to measure flood discharge for high flow seasons. When current meter is used for flood discharge measurement, field staffs are exposed to safety problems due to high velocity and the possibility of loss or damage of applied current meter is also high. To improve such severe situation of flood discharge measurement, several non-contact velocimetries have been developed globally. Among them, radar technology has been applied on flood discharge measurement in Japan, China, USA and Korea. In Korea, Radar velocimetry is called Microwave Water Surface Current Meter (MWSCM) and it has been applied in river discharge measurement since 1999 and 78 set of MWSCM has already distributed. Recently many users requested the performance improvement of MWSCM for velocity measurements efficiency – waterproof, weight decrease, longer battery hour, cheap price, and expansion of measurable velocity range of MWSCM. Since its commercialization in 1999, any improvement has not conducted in K-water but the related technology has been progressed more than imagination. To satisfy the users' requests, current cutting edge radar technology were reviewed and the MWSCM was redesigned totally. Main changes are microwave frequency band from 10 GHz to 24 GHz, antenna type from parabolic antenna to waveguide slot array antenna, and adoption of smart device for signal processing. Through these changes, waterproof of IP67 of international standards was achieved, the weight of instruments decreased 11.7 kg to 3.3 kg, its battery operation duration is extended from 1 hr to 7 hrs, MWSCM's price is cut down 25%. and velocity range is extended from 0.5~10 m/s to 0.03~20 m/s so it can be used to measure flow velocity of normal and low flows.

P10-18

The removal efficiency for unicellular and colonial *Microcystis* sp. and the effect of electrode materials by electrochemical oxidation

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Cyanobacteria can form blooms given the favorable conditions of high nutrient loads and warm temperatures. Cyanotoxins produced by freshwater cyanobacteria have been reported to cause negative effects in both wild and domestic animals, and in humans.

Microcystis sp. often occurs as large colonies. Colony formation plays an important role for the domination the freshwater phytoplankton community. However, after isolation from the lake and cultivation in laboratory, the colony disaggregates and develops into unicellular cell. Thus, the results of laboratory studies using unicellular strain could not explain natural environmental phenomenon.

Electrochemical oxidation is widely used to remove harmful organic and inorganic substances as well as pathogenic microorganisms. The electrode material has a significant impact on the electrochemical kinetics and the reactions occurring.

Therefore, this study was conducted to evaluate the removal efficiency for unicellular and colonial *Microcystis* cells and the effect of electrode materials (Pt/Ti and Oxides electrodes) by electrochemical oxidation. The removal of unicellular cells (>95%) was achieved after the passage of approximately 30×10^3 C (coulombs). However, colonial cells were remained more 40% after the passage of 100×10^3 C. The removal efficiency for *Microcystis* cells of oxides electrodes was better than Pt/Ti electrodes.

Cyanobacterial cell damage and cyanotoxin release by alum treatment as in-lake treatment

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The presence of cyanobacteria in reservoirs, lakes, and rivers is a worldwide environmental health issue because some cyanobacterial strains produce toxins, as well as taste and odor compounds, as secondary metabolites. Aluminum salt has long been used in several water treatment or lake restoration. Most studies have only investigated cyanobacteria removal by alum treatment during the coagulation process in water treatment processes. Although humans do not directly ingest cyanobacteria, they might be regularly exposed to sub-lethal dosages of extracellular microcystin in drinking water or several water recreational activities derived from contaminated lakes and reservoirs. Therefore, the release of toxins by the cyanobacteria removal treatment including adding alum should be considered not only in the conventional water treatment but also in-lake treatment. Therefore, in this study, the effect of alum treatment on toxic *Microcystis* cells was evaluated: the long term effect of alum coagulation and the effect of aluminum hydroxide on *Microcystis* cells through the analysis of precipitates.

A large amount of MC-LR was released to the water in the maximum treatment from 1 day after adding alum, meanwhile, the release of MC-LR was not observed in the control and half-maximum treatment until day 2, and precipitated *Microcystis* cells turned from dark green to light blue after 2 days in response to the maximum treatment. Therefore, the results of the considerable increase of the extracellular MC-LR concentration and the color change to light blue of precipitated cells indicate that alum treatment caused damage to the *Microcystis* cells. Moreover, the decrease of the chl.a and intracellular MC-LR concentrations in the precipitates, and precipitated cells were surrounded or coated with aluminum hydroxide floc, and cell membrane was torn, which was observed under a SEM. The various analyzed results of precipitated *Microcystis* cells such as SEM analysis in this study provided the more definite evidence that the alum treatment cause the cell damage. It could be concluded that *Microcystis* cells have seriously damaged by alum treatment, therefore, alum treatment with maximum dose is not suitable for removing cyanobacterial bloom without the release of cyanotoxin.

P10-20

Habitat preference in epilithic diatom using CART analysis : A case study in Han River, South Korea

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This study was conducted to draw habitat preference between epilithic diatom and physic-chemical environmental factors using classification and regression tree (CART) analysis. CART analysis recursively partitions observations in a matched data set, consisting of a categorical (for classification tree) or continuous (for regression tree) dependent (response) variable and one or more independent (explanatory) variables, into progressively smaller groups. Each partition is a binary split. During each recursion, splits for each explanatory variable are examined and the split that maximizes the homogeneity of the two resulting groups with respect to the dependent variable is chosen. In application, Classification tree (CT) and Regression tree (RT) were performed by 35 environmental variables and 6 epilithic diatom species (*Achnanthes minutissima*, *A. convergens*, *Nitzschia amphibian*, *N. fonticola*, *N. inconspicua*, *N. palea*) dominated in fifty eight sites along the Han River in spring and autumn of 2008 to 2010. This field dataset was obtained from water quality monitoring networks operated by the Korea Ministry of Environment. CART analysis is useful for visually facilitating interaction, and showing data structure. As a results of analysis, the high presence (0.94) of *Achnanthes minutissima* was determined by canopy<2.5% and DO>16.9 mg L⁻¹. Low TP concentration (TP<0.025 mg L⁻¹) predicted the high relative abundance of *A. minutissima* (50%<). The presence (0.67) of *A. convergens* was determined by DTN<4.218 mg L⁻¹. Swamp>3.5% and altitude>134.5m explained 29% relative abundance of *A. convergens*, and swamp<3.5%, TN<9.681 mg L⁻¹, run>12.5% and SS<17.8 mg L⁻¹ predicted 44%. The presence (0.73) of *Nitzschia inconspicua* was determined by altitude<90.5m and canopy>7.5%. Altitude<90.5m and BOD>2.2 mg L⁻¹ predicted 11% relative abundance of *N. inconspicua*. The presence (0.59) of *N. fonticola* was determined by altitude<134.5m. Altitude<116m, DO>8.8 mg L⁻¹ and Chl-a>5.2 mgm⁻³ explained 28% relative abundance of *N. fonticola*. The presence (0.78) of *N. amphibian* was determined by conductivity>120.5 μScm⁻¹. TP>0.041 mg L⁻¹ predicted 25% relative abundance of *N. amphibian*. The presence (0.83) of *N. palea* was determined by conductivity>172.5 μScm⁻¹. DTN>4.033 mg L⁻¹ predicted 43% relative abundance of *N. palea*, and DTN<4.033 mg L⁻¹ and conductivity>158.5 μScm⁻¹ predicted 16%. CART analysis may help to identify the hierarchical interaction among environmental variables in predicting the relative abundance of epilithic diatoms.

A study on the optimum installation plan of algae fence at yeoncho dam water intake tower in Geoje, Korea

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Recently water quality deterioration associated with algal bloom increases and taste and odor compound people's concern in drinking water. Thus, various water quality management is ongoing in each reservoir for stable drinking water supply. This study focuses on algae fence application to prevent algae entrainment in the water intake tower. As a result, the longer separation distance is the better between intake system and algae fence. However, considering maintenance and facility investigation the best separation distance is approximately 8~10m. The best type of algae fence is dodecagonal which can secure constant distance from all direction and moving frame type in the direction of upper and down is appropriate for maintenance when water level is changing. When the depth for algae fence is 2~3m, the possibility of algae entrainment still exist. Thus, this study proposed that the most efficient and desirable depth for algae fence is $2/3 \sim 3/4$ of total depth. Based on the results, the algae fence proposed in this study will contribute to reduce algae entrainment and to supply drinking water with good water quality. In addition, water quality complaints due to taste and odor occurrence is possible to prevent in advance. In water treatment plants, the occurrence of filter paper clogging will be reduced, water treatment efficiency will be increased, the chemical costs for water treatment and energy costs are expected to be reduced.

P11-2

A comparison and intercalibration of phytoplankton chlorophyll a concentrations determined by two spectrophotometric methods: the trichromatic method and the acidification method

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This Chlorophyll-a is a common indicator of algal biomass, and various methods are used to extract and measure this pigment. Chlorophyll-a (Chl-a) concentrations are often measured by conventional spectrophotometric methods, i.e., the trichromatic UNESCO method or the acidification method. These methods, both of which are considered to be standard methods, are based on different principles and produce significantly different estimates of Chl-a concentrations. However, these two methods are often considered as interchangeable procedures in the literature. In this study, Chl-a was determined in 1,259 samples from 126 freshwater sites using both spectrophotometric methods. The ratio of Chl-a concentration measured using the acidification method (ChlL) to the Chl-a measured using the trichromatic method (ChlU) was 0.62 for deep oligo-mesotrophic reservoirs and 0.77 for shallow eutrophic reservoirs and rivers. The total chlorophyll-a (TChlL = chlorophyll-a + pheophytin-a) concentrations measured using the acidification method ranged from 18 to 29% higher than the concentrations measured using the trichromatic method. These findings suggest that Chl-a measurements are method specific and that inter-calibrations are needed to compile datasets from various sources or compare data measured by these different methods.

ALGAL GROWTH CHARACTERISTIC IN ANAEROBIC DIGESTION EFFLUENT OF AQUATIC WEEDS

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The extraordinary expansion of aquatic weeds in Lake Biwa, Japan, causes social issues such as decreasing fish yield and/or a terrible smell. Anaerobic digestion process is suitable for aquatic weeds treatment because of reasonable costs for treatment and high moisture organic substances in the aquatic weeds. Anaerobic digestion effluent (ADE) is residual of anaerobic digestion treatment, including dense nutrients, especially NH₄-N. In the previous studies, microalgae have been used to remove nutrients from ADE made from animal manure. In this study, we determined growth characteristics of a green alga *Chlorella vulgaris* in ADE of aquatic weeds and nutrient removal from the ADE by the algal growth.

An aquatic weed, *Egeria densa*, collected from Lake Biwa was used as a substrate of the ADE in this study. The ADE including 1,013 mg-NH₄-N L⁻¹, 144 mg-PO₄-P L⁻¹ was filtrated through a 0.45- μ m membrane filter and autoclaved at 121°C for 20 min. and then used in the following two experiments. In the first experiment, we determined growth curves in *C. vulgaris* using five diluted ADEs (10x, 25x, 50x, 75x, 100x), while C medium was used as a control. In the second experiment, we examined effects of micro-nutrients on algal growth in the ADE of aquatic weeds with adding micro-nutrients of C-medium excluding each of MgSO₄·7H₂O, trace metals and vitamins into the 25x diluted ADE. *C. vulgaris* was inoculated in test tubes (10 mm) containing 6 mL of the diluted ADEs. The test tubes were incubated at 25°C under 12L: 12D photoperiod of 110 μ mol m⁻² s⁻¹ and the optical density at 680 nm was measured once a day as an indicator for algal density. Chl. a, pH and nutrient concentrations (NH₄-N, PO₄-P) were measured before and after an experiment. In the first experiment, the specific growth rates of *C. vulgaris* in both 10x and 25x diluted ADE during the first 7 days was 0.32 d⁻¹. This is almost same to that in C medium (0.34 d⁻¹). Although the algal growth in the diluted ADE saturated at day 7-8, nutrients (NH₄-N and PO₄-P) in the diluted ADE remained at the end of the experiment except for 100x diluted ADE. In the second experiment, the growth of *C. vulgaris* was depressed in the diluted ADE without Mg, Mn and EDTA, and nutrient removal efficiency was also low. The results of this study suggest that *C. vulgaris* can grow in the diluted ADE of aquatic weeds, and addition of Mg and/or Mn may enhance the algal growth.

P12-1

Long Term Changes in the Dominant Species in Lake Biwa, Japan

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In Lake Biwa, conditions for growth of submerged macrophytes in recent years can be divided into three stages: The period up to the 1960s, the period from the 1960s to 1993 and the period from 1994 onwards. During the first stage, the North Basin was oligotrophic and the South Basin mesotrophic, and the dominant species of submerged macrophytes was the endemic species, *Vallisneria asiatica* var. *biwaensis*. Submerged macrophytes were used as fertilizer during this stage, and records of such usage date back to books written 200-300 years ago (Edo period). During the second stage, the lake eutrophicated, and the invasive species, *Elodea nuttallii* and *Egeria densa* invaded and proliferated, resulting in the decline of native species. In the South Basin, where marked eutrophication occurred, any underwater plants could hardly be found. During the most recent stage, after serious water shortages (the water level dropped -1.23m from the standard level) in the summer of 1994, the native submerged macrophyte bed in the South Basin began to recover and there was an improvement in the transparency of the water and its quality. This so-called "regime shift" of the ecosystem took place mainly around the South Basin. After the regime shift, the distribution of submerged macrophyte community has been surveyed, 4 times for all the Lake Biwa.

109 transect lines were prepared around the shore of Lake Biwa in 1997, and since then a vegetation survey has been carried out once every 5 years in the range where the water plant grows from the lakeside toward the offing of every 2 m-wide, 10 m-long quadrat. Comparing the results of an investigation of 4 times, it turned out that *Potamogeton maackianus* which was a dominant native species is decreasing in the North Basin, and it turned out that one more kind of dominant species *Hydrilla verticillata* is seldom changing. From an outdoor experiment, it was guessed that the difference in the rise and fall in these two species is based on the difference in the nutrient concentration of the bottom sediment.

Macrophyte reaping affects macrophyte community at south Lake Biwa.

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In shallow lakes macrophyte and phytoplankton competes with nutrient (Wetzel, 2001), and macrophyte provide zooplankton physical shelter where zooplankton can escape from predator (Timm&Moss, 1984). Therefore, in macrophyte community, predation pressure decreases from fish to zooplankton, so zooplankton increases and they effectively graze phytoplankton (Timm&Moss, 1984; Schriver et al., 1995). That is why water quality is improved. At 2000 and 2002, south Lake Biwa (depth average: 3.5m, lake size: 51.6km², (Haga, 2006)) was lowered water level in summer to autumn because drought, after 1994 drought (water level 1994: -1.23m, 2000: -0.97m, 2002: -0.99m). After macrophyte luxuriated, transparency greatly improved, and water was clear in summer of 2000 (Hamabata 2005). But macrophyte luxuriated was occurred some problems. Abundant floating macrophyte came lakeshore and spoiled. It gave out bad smell. Moreover floating macrophyte twined around screw, so many boats couldn't sail. Therefore, not only surface reaping but also absolute reaping earnestly since 2011. Macrophyte community is essential element for improve water quality. But to grasp its growth conditions is important for its managing. Nozaki (2011) (2010, 10/22~11/6) and Otani (2013) (2012, 10/6~10/13) investigated macrophyte community with fish-finder. We did same investigation at December 23, 2013. We set 10 lines from the Lake Biwa bridge to Root 1. In principle between lines length is 1600m. After investigation, we read community height, depth and community type every 40meters from fish-finder chart. We sorted three community types that *Hydrilla verticillata* community, *Potamogeton maackianus* community and two species mix community. Moreover we estimated biomass each point and calculated biomass average value every 800meters with dominant species community biomass measured value with harvest (Haga et al., 2006). Then we made biomass distribution map by GIS and estimated total biomass at the whole south Lake Biwa. In addition, we calculated PVI(%) by water depth and community height. We also made PVI distribution map, and calculated weighted average. 2010 and 2012 also estimated total biomass and calculated PVI weighted average by Nozaki (2011) and Otani (2013). Moreover, we brought up *Elodea nuttallii* with separated water mass because we needed verify macrophyte's water purification system. Investigation result, each year's biomass estimated value is 2010: 11,850t, 2012: 4,236t, 2013: 7,873t, and each year's PVI weighted average is 2010: 32.8%, 2012: 17.1%, 2013: 25.7%. These results show biomass and PVI greatly degraded from 2010 to 2012. Especially, PVI degraded 17.1%. If PVI value exceed 15-20%, fish sensitivity goes down and predation pressure decreases from fish to zooplankton (Schriver et al., 1995). 17.1% is near under limit value. In spring 2013, macrophyte community was feared which will be lost. Because absolutely reaping might cause regime shift (Hamabata et al. 2013). But macrophyte community recovered in autumn 2013. So it might temporary decreasing.

P13-1

Characterizing geophysicochemical features of lakes and reservoirs associated with plankton composition and carbon biomass

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This study focuses on analyzing phyto- and zooplankton communities based on carbon biomass with respect to 29 lakes and reservoirs located in the southwestern area of Korea. The objective of the study aims to characterize geological, physical and chemical features of the lakes and reservoirs in conjunction with plankton composition and carbon biomass contingent upon water quality and trophic levels. We used a self-organizing map to relate plankton communities to characteristics of the lakes and reservoirs. The result demonstrates a clear pattern of ecological aspects of the lakes and reservoirs in six clusters. Each cluster identifies the dominant pattern of carbon biomass derived from plankton communities in both time and space. In conclusion, our study manifests that plankton community composition and abundance could be determined by geophysicochemical characteristics of freshwater ecosystems that relate carbon biomass to water quality and trophic states.

Bioaccumulation of mercury from seston to fish through the food web in Lake Biwa

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Mercury is recently considered to be a one of potential aerosol pollutants coming from a continent. It is important to determine the bioaccumulation of mercury in a lake ecosystem, not only providing the important information on environmental sciences but also on public health around there. In this study, we monthly determined mercury contents and stable isotope ratios of carbon and nitrogen in three dominant zooplankton taxa (*Daphnia* spp., *Eodiaptomus japonicus*, and *Cyclopoida* spp.), seston (< 100 μm), benthos and fish collected from north basin of Lake Biwa from May 2011 to May 2012, and evaluated the relationship between the trophic levels and mercury contents in order to clarify the bioaccumulation of mercury in food web of the lake.

The values of $\delta^{15}\text{N}$ in each three zooplankton taxa are quite stable during the study period, though a bit difference between those above and below 20 m. In the upper layer above 20 m, median values of $\delta^{15}\text{N}$ during the study period were 11.5 ‰ in both *E. japonicus* and *Cyclopoida* spp. and 8.8 ‰ in *Daphnia* spp. $\delta^{15}\text{N}$ in seston seasonally changed, being 6.0 ‰ as median except for June to July 2011, when the value was 7.9 ‰. In the lower layer below 20 m, median values of $\delta^{15}\text{N}$ were 14.3 ‰ in *Cyclopoida* spp., 12.3 ‰ in *E. japonicus*, and 10.1 ‰ in *Daphnia* spp. that was similar to those in seston. On the other hand, mercury contents in each zooplankton taxa changed seasonally, ranging 0.1-0.38 mg kg^{-1} in *Daphnia* spp., 0.04-0.7 mg kg^{-1} in *E. japonicus*, and 0.03-2.33 mg kg^{-1} in *Cyclopoida* spp. during the study period. While those in seston were stable in 0.1-0.4 mg kg^{-1} . The mercury contents throughout the water column were more than 10-fold higher in the zooplankton than those in the seston, being 4.3-480 ng m^{-2} in the zooplankton and 6-20 ng m^{-2} in the seston. This implied that mercury contents in the zooplankton mostly contributed to particulate mercury in the lake. Bioaccumulation of mercury through the plankton food chain was found in terms of $\delta^{15}\text{N}$, but *E. japonicus* was out of the relationship, having a bit low mercury content against $\delta^{15}\text{N}$.

In benthic animals tested, except for plecopteran and tricopteran larvae, mercury contents increased with increasing $\delta^{15}\text{N}$, implying bioaccumulation of mercury through the benthic food chain. The process of bioaccumulation of mercury in benthos seems to be different from that in plankton, because mercury contents of the benthos were almost below those in seston except for those in gammarids and earthworms. Positive correlation between mercury content and $\delta^{15}\text{N}$ in 16 species of the fishes tested, ranging 2-217 mg kg^{-1} of mercury content while 9-17 ‰ of $\delta^{15}\text{N}$, was also found.

P13-3

Species composition and primary production of benthic algae in two shallow blackish lakes located in the northern area along the eastern coast of Korea

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Species composition, biomass and photosynthetic activity of benthic algae found in the littoral area of two shallow blackish lakes (L. Youngrang and L. Hwajinpo) in Korea were investigated together with the environmental factors in October 2007, December 2008, April 2009 and August 2013, respectively. Salinity of surface water in both lakes did not change remarkably except for the higher values at L. Youngrang in August 2013. In L. Youngrang, DIN values of three investigation times were slightly higher than those of L. Hwajinpo. Several common brackish taxa of diatom such as *Achnanthes brevipes* var. *intermedia*, and *Fragilaria fasciculata* dominated in the two lakes except at August 2013 when large filamentous green algae was predominant in both lakes. Species composition of diatom changed seasonally in both lakes. Chlorophyll *a* amount of benthic algae in the middle area of each lake changed in the range of 14-152 and 8-129 chl. *a* mg m⁻² in L. Youngrang and L. Hwajinpo, respectively. The values of chlorophyll *a* did not much differ between the two lakes, but they were low in L. Hwajinpo in April 2009. Photosynthesis of benthic algae was measured by the modified *in situ* method. Primary net production of benthic algae was high in L. Hwajinpo at all investigation times.

Primary production and litter decomposition of macrophytes in the Sihwa Constructed Wetlands

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To provide the information for the wetland management considering the water treatment ability of macrophytes, the growth characteristics and primary production by reed (*Phragmites australis*) and cattail (*Typha angustifolia*), and the decomposition rate of organic matter produced were investigated in two sub-wetlands (Banweol and Donhwa wetlands) of the Sihwa Constructed Wetland (CW) with different chemistry of inflows. The shoot height of *P. australis* and *Typha angustifolia* began to increase in March, and reached its peaks in July and August (340cm and 320cm, respectively). The shoot density of *P. australis* ranging 100 ~ 170EA/m² was higher than that of *T. angustifolia* (max. 78EA/m²). Standing biomass of *P. australis* ranged from 1,350 ~ 1,980gDM/m², with maximal biomass in Banwol Upper Wetland. And it was larger in upper wetlands than lower wetlands. On the other hand standing biomass of *T. angustifolia* (1,940gDM/m²) was similar to that of *P. australis* in Banwol Upper Wetland. Primary productivity of *P. australis* was in the order of Banwol Upper Wetland (2,050gDM/m²/yr) > Donghwa Lower Wetland (1,840gDM/m²/yr) > Banwol Lowerr Wetland (1,570gDM/m²/yr) = Donghwa Lower Wetland (1,540gDM/m²/yr), and that of *T. angustifolia* (2,210gDM/m²/yr) was higher than *P. australis*. Annual production of organic matter produced by *P. australis* and *T. angustifolia* was 845tonDM/yr(423tonC/yr), and about 90% was comprised of that by *P. australis*. From the litter decomposition rate (*k*) (*P. australis*: leaf 0.0062/day, stem 0.0018/day; *T. angustifolia*: leaf 0.0031/day, stem 0.0018/day), leaf was rapid degraded compare to stem in both *P. australis* and *T. angustifolia*. The litter decomposition rate of leaf was two times rapid *P. australis* than *T. angustifolia*, whereas that of stem was same in both. Annual litter decomposition amount of *P. australis* than *T. angustifolia* was 285tonC/yr(67.3% of organic matter produced by macrophytes), indicating that 32.7% of organic matter produced by macrophytes is accumulated in the Sihwa CW.

P13-5

Impact on water quality from submerged soil by impoundment of dam reservoirs

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Generation of reservoir by dam construction can be understood as the beginning of a new water system. By changing from lotic environment to reservoir environment, the big change is to occur in the aquatic environment. It is estimated that organic matter in the soil adsorption material or the like remaining in the submerged land will give a significant impact on water quality of water bodies of initial impoundment of dam. In this study, we examined in each land use by status, the impact on water quality due to soil elution from the submerged land in flooded soil water storage at the time due to dam construction. In this elution experiments, acrylic column was made to reproduce the water situation of early dam impoundment. Analysis item for measuring the change in water quality, water temperature, DO, pH, Conductivity is measured for basic water quality and COD, T-N, T-P was analyzed as the index item of water pollution. Soil was sampled by land use situation before it is submerged. And it is examined the effects of soil flooding on water quality in two different dissolved oxygen condition of overlying water, aerobic and anaerobic. 6 ~ 8 mg / L DO concentration in water, anaerobic conditions were performed to the dissolution test by dividing the state of 0 ~ 2 mg / L under aerobic conditions. Analysis has been focused on implementing the level of contribution of pollution sources and elution volume analysis of to the water body. Results of the flux experiments under aerobic conditions, paddy soil showed highest COD elution amount per unit area of the submerged soil (94.5%, contribution rate by land use), In the case of TP, high flux rate appeared at the soil of paddy (57.1%) and orchard (31.6%). In the case of TN, the difference of flux rate by the land use did not appear significantly. Trend similar to the aerobic conditions appeared under anaerobic conditions, but in the case of COD, showed a high flux rate in the paddy (46.8%) and forest soil (40.5%). In the case of TP, was higher in the orchard (23.9%) and paddy (66.2%). A result of examining the differences in flux due to changes in the submerged area with the reservoir water level fluctuations, effect in response to changes in storage capacity of water and submerged area, effect of submerged soil to the water quality has changed. Elution amount is increased by increasing the submerged area as water level becomes higher, but the influence to the water quality is decreased with a dilution effect due to the increase of the storage capacity.

Early Holocene sea level rise and geomorphological development of the Yeongsan River, Korea

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A notable environmental change in the early Holocene was the sea level rise over most of the Earth. This has attracted a great deal of scientific attention because the sea level rise is critical in understanding the glacio-eustasy, isostatic responses, sediment flux and compaction, paleo-climate change, climate modeling, landscape evolution, and prehistoric human occupation. A complicated coastline of the west coast of Korea is bordered by numerous coastal embayment, estuaries, and islands formed by the inundation during the last postglacial sea level rise. These coastal embayments are major depocenters for the fine-grained sediments, resulting in the development of long stretch of broad, extensive Holocene marine tidal flats along the west coast of Korea. Sea level rise during the early Holocene would significantly alter sedimentation and erosion patterns as well as the topography of coastal areas. The sedimentary environments could have been unstable at the non-marine and marine boundary in the early Holocene as well. Erosion and re-deposition could occur frequently in coastal areas, meaning that the age datings for the lower part of marine deposit might be inaccurate. The boundaries between Holocene and underlying pre-Holocene deposits are largely classified into two groups: paleosol - marine deposit, and fluvial sand & gravel - marine deposit. Occasionally, peats or lacustrine deposits are also observed. Paleosol represents the subaerially exposed earth surface just before the sea water inundation, and fluvial the channel deposit of the Yeongsan River. Information on the distribution of these deposits along the Yeongsan River would help to delineate the channel path and size of the Yeongsan River and to reconstruct the timing and elevation of the sea level at that time. Here we provide a compilation of 80 drilling core data along the lower reach of the Yeongsan River, with particular emphasis on the Holocene and pre-Holocene boundary.

P13-7

Acoustic simulation for CAT deployment and now-casting system implementation in Lake Biwa (Jp)

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Throughout the year, Lake Biwa experiences severe meteorological events, such as typhoons and heavy rain events, and diverse mechanisms are taking place. Propagations of internal Kelvin waves have been observed, as well as gyres, gravity currents and overturn. Because of this variety of physical processes, transport of bio-material in Lake Biwa is difficult to grasp. Thus the authors are developing a now-casting system of Lake Biwa combined with the deployment of several Coastal Acoustic Tomography units, CATs, for monitoring.

The now-casting system is based on the simulator SUNTANS, and uses observed meteorological data for boundary conditions of heat fluxes and wind forcing. We show that in comparing against monthly observation in the lake, the results from the simulation consistently reproduce the stratification period. However the cooling period starts earlier in the simulation. To palliate this issue the authors implemented a nudging scheme with the aim of assimilating space-borne surface temperature measurements.

CAT systems provide horizontal averaged current velocity and water temperature between units, based on the time delay of sound between the stations. The bathymetry of Lake Biwa is steep on one side and gentle on the other, plus the water goes from a mixed state in winter to a strongly stratified state in summer. We show that acoustic ray propagations is sensitive to temperature and bathymetry changes, leading to a lack of signal from the monitoring system. Therefore we carry out acoustic simulations with various conditions of stratification state, various horizontal and vertical configurations of the CAT units to assess the performances of the configurations over the seasons. Results from the assessment provide us information on the optimal location in the vertical and in the horizontal plane. Moreover the results generate an estimated schedule for a CAT unit that would automatically change its depth depending on the depth of the thermocline.

3-Dimensional Hydrodynamic Simulation of Reservoir Sedimentation and Flushing Operation

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Patrind hydropower project is to generate electricity and provide for residence of the Patrind village. 120Km apart from Islamabad, the project site is located in northeastern part of Pakistan. The main components of this project include reservoir, sand trap, and turbine systems. For the purpose of the water storage a diversion weir is to be constructed across the Kunhar River near the start of the narrow gorge close to the Patrind village and the powerhouse placed in the Jhelum River is expected to generate up to 150MW electricity in each year. First, the Run of River (ROR) type reservoir will be constructed in the Kunhar River for the purpose of water storage. The Kunhar River is major tributary of the Jhelum River and the difference of the water surface elevation between these two rivers is 80m connected by the headrace tunnel which provides good opportunity for hydropower generation. The major component of the project is composed of diversion weir, sand trap, and the turbine system necessary for hydropower generation. Since it is subject to excessive sediment especially during monsoon season, a proper sediment management scheme is necessary. To minimize successive sedimentation in the reservoir sediment flushing is proposed based on the flushing gate operation. This paper presents long-term sedimentation in the reservoir and evaluates the efficiency of sediment flushing using EFDC 3-dimensional hydrodynamic. Total simulation period was 5 years assuming sediment flushing was done for 5 days in each year after the maximum discharge. Applying averaged inflow as boundary condition of the upstream the analysis focuses on the concentration and deposited particle in front of the sand trap which exceeds 0.02mm since it is known to damage turbine system significantly.

P13-9

Is nutritional quality of faeces of freshwater fish, *Danio rerio* upgraded by protozoa?

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Animal faeces is one of the composer of detritus. As detritus food chain is one of the important pathway of carbon, nutrient and energy, nutritional quality of faeces should have influenced benthic community in freshwater ecosystems. In this study, we compared the fatty acid composition, which have been widely used as indicator of food quality, of food source (green algae: chlorella) and faeces of freshwater fish *Danio rerio* in laboratory experiment. As the result, one of the essential fatty acid, 20:5n3 which have been known vital nutrient for survival and fecundity for animal was detected from faeces even though food source, chlorella didn't contain 20:5n3. Protozoa were also detected in faeces and there was significant positive relationship between the number of protozoa and concentration of 20:5n3 in faeces. Interestingly, protozoa was not observed from leftover of chlorella, which indicate that protozoa swarmed over faeces selectively. We cultured some species of protozoa with 20:5n3 free medium. Some of them contained 20:5n3, suggesting they can synthesize 20:5n3 themselves. Generally, 20:5n3 have been considered to be provided to ecosystems by diatom. However these results indicated that protozoa enhance nutritional quality of faeces and to be source of 20:5n3 for detritus food chain in freshwater aquatic ecosystems.

I hope publish Inland Water.

Re-assessment of dissolved organic matter in Lake Biwa using UV absorbance and fluorescence spectra

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Ultraviolet (UV) absorption and fluorescent spectrometry are powerful tools for characterization of dissolved organic matter (DOM) in freshwater and marine environments. Those analyses are so easy that the data have been accumulate several environments. However, the similar spectra of UV absorbance and fluorescence in the spatial and temporal sampling in the fields are to make it difficult for evaluating the DOM sources and dynamics. In the present study, we reassess the UV absorbance and fluorescent spectra measured in Lake Biwa for several years using in the derivative analysis and the statistical analysis (ex. Parallel Factor Analysis) for evaluating the DOM source and behavior in the lake. Water samples were collected from the north basin in L. Biwa from 2005 to 2008. The collected samples were filtered with GF/F filters. DOC concentrations were measured by Shimadzu TOC-V. Absorption spectra were measured at 230-500 nm by Hitachi U2001 spectrophotometer. 3D excitation emission matrix spectroscopy (EEMs) was conducted using Hitachi F4500 fluorometer. Wavelength ranged from 225 to 400 nm for excitation, and from 260 to 600 nm for emission. The Parallel Factor Analysis can be calculated by MATLAB program to distribute Stedmon and Bro (2008).

The spatial and temporal variations of UV spectrum are so small that interpretation of data set is not easy. However, the distinctive peak in the spectra is found in the derivative analysis, and can characterize autochthonous effect. In the EEM spectra, although there are characteristic peak of protein-like and humic-like substance in the lake samples, the similar distribution in the samples is difficult for assessment of DOM sources. The Parallel Factor Analysis of EEMs could be separated into three components, which are one protein-like and two humic (fulvic)-like peaks. The two humic-like peaks have inverse distribution in the samples data set. Therefore, humic-like fluorescence can have two sources or different dynamics of their production and behavior.

P13-11

Construction of environmental friendly algal harvesting system (AHS) to mitigate blue-green algae bloom in reservoir, Korea

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Water-bloom with blue-green algae is very serious problem that occurs in a eutrophic water body during summer season in Korean reservoir. K-water has developed the algal harvesting system (AHS) for management of algal bloom zone to prevent downstream algal propagation and suggested technology background for biomass resource recycling. AHS was designed and manufactured with total 7 independent technologies. The vessel of AHS is composed of two part, main and sub-body, and five individual components of suction, collection, filtering, gathering, and ultrasonic device. The body of AHS made of fiber glass reinforced plastic (FRP) was designed to have very stable structure to minimize the impact of wind and wave. It is a shallow draft vessel which is designed to remove the algal bloom in the very low water depth (below 1.0 m) area efficiently. A test result of AHS in Daecheong Reservoir and its tributary in Korea was very successful. The evaluation the efficiency of AHS was summarized in the aspect of low carbon, recycling, and water quality improvement. The removal rate of biomass and carbonate at 540 m³/day capacity of AHS was 30.78 g chl-a/day, 1.54 kg C/day, respectively. The development and application of AHS will lead to provide the base of establishing massive algal incubation plant that allows for producing bio-resources, and will contribute to suggest various technical deviations that support low carbon and green growth.

Understanding the historical degradation of floodplain wetlands in the lower Nakdong River, South Korea

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For a long time, the landscape has been experiencing the sustained change due to human activities. Wetlands were no exception and have been degraded or lost due to agricultural expansion, urban development, and reclamation. In South Korea floodplain wetlands were most common along lower Nakdong River; however, most in this area have disappeared. We selected two counties in the lower Nakdong River basin, which were subject to different land development patterns. In order to determine changes to the landscape we performed a comparison using a map series from 1918 and 2011. The eight maps (1:50,000) from each county were digitized and the wetland circumference delineated using ArcGIS. Negative changes in wetland circumference were determined as loss. We found that between 1918 and 2011, there was a loss of wetland area in the two counties in South Korea. This loss accounted for 80% in Haman County and 55% in Changnyeong County, respectively. In Haman county 70 % was due to agricultural reclamation, while 30 % was affected by industrialization. Similarly, in Changnyeong, 92 % was due to agricultural use and 8 % was from industrialization. In evaluating the causes for these losses it was determined that the primary cause for wetland conversion in two counties was agricultural conversion, whereas loss resulting from industrialization in Haman County was greater than in Changnyeong County. In Changnyeong County we could find the reverse relationship between rice paddies and wetland area. In Haman County, even though the area of rice paddy has decreased since the 1980s, the total area of wetland decreased due to factory construction. Changnyeong County has seen less conversion overall than Haman County because of national policies regarding a nationally protected area. In Asian countries, rice is the main staple, thus agricultural fields generally represent 'wet-field' as compared to Europe or American countries, where they primarily grow wheat, barley or corn (dry-field). Unlike dry agricultural fields, rice paddies maintain a wet environment. This characteristic could maintain wetland function and biodiversity with proper management

P13-13

Village ponds as important landscape components in Eastern India (1) Chilika Lagoon Basin : Patterns of distribution

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Village ponds are important as a group of wetland eco-systems, and work as bride habitats for the organisms that inhabit the area as an extension of a major aquatic ecosystem. Moreover, village ponds enhance local people's lives as drinking and agricultural water sources, and religious sites. Chilika Lagoon is the largest lagoon in Asia (1,100 km²) and is located on the east coast of India. The lagoon sustains more than 132 fisherman's villages on the shore and islands as a fishery resource. The catchment area (6,200 km²) that surrounds Chilika Lagoon contains many villages (population; approx. 690,000) and the associated agricultural fields. Even though village ponds are a very important landscape component throughout India, there have been very few scientific investigations on their distribution, or their ecological and socio-economical roles. All village ponds in the studied area were digitized using a GIS program, based on geo-referenced aerial photography and satellite images. This process allowed the village ponds to be analyzed in conjunction with other environmental variables such as elevation, slope, land cover, population, and distance matrix. Digitized village ponds were overlaid with the other variables using Spatial Analyst in ArcMap 10.2. Delineated ponds were then assessed visually via ground-truthing and baseline information collected for the study area. Village ponds in the Chilika catchment area were categorized into 4 major types based on community usage; residential, aquaculture, irrigation, and religious purposes. Residential village ponds are used daily for drinking, bathing, and cleaning. Aquaculture ponds are mainly used for freshwater fish and shrimp aquaculture purposes. Irrigation ponds provide water for local agricultural fields. Religious ponds are generally located adjacent to the temple and used in religious rituals. These ponds often have small pagodas constructed in the middle. Every village in the study area has more than two ponds. In total 6,077 village ponds were identified with a distribution density of 11.5/km². Village ponds covered 19.6km² and constituted 3.7% of the total catchment area. Average size was 3211±8834 m². Mean distance between ponds was 171.2±207.8 m. Analysis of the pond distributions identified that ponds are primarily located in flat land near the lake shore. Also, many irrigation ponds were identified in the northern parts of the Daya River floodplain. The village ponds are shared by the villagers as common village facilities. The traditional community governance of the village ponds allows villagers to use the ponds in more efficient and sustainable ways. Since their activities and ponds are closely related to each other, the ponds are critical to local rural economy and life.

Comparison and assessment of the fish community impacted by Newtown development in the Jwa-gwang stream, Busan Metropolitan City, South Korea

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Newtown development has spread rapidly into suburban areas since the 1970's to facilitate population growth and land development. Streams in these developed Newtown areas have been restored to improve water quality and provide a recreational area in light of modern ecological concerns since 1990's. Jung-Gwan Newtown (drainage area: 45.24 km²) in Busan was constructed between 2005 and 2009 and the associated stream was restored. To determine the impact of Newtown development on the fish community, we conducted a survey of fish community and water quality Before Newtown [BN] and After Newtown [AN] development. The study examined two streams; Jang-An (reference stream) and Jung-Gwan (test) for both periods. The study itself was subdivided into two periods before construction (BN) 2001 and following completion (AN) 2012-2013. A total of 10 sites (5 for each stream) upstream and downstream of the construction were selected for the study. Both cast net (7 × 7 mm), and scoop-net (5 × 5 mm) were used to collect fish specimens. In Jang-An stream, a total of 8 species in 5 families collected in 2001 and 12 species in 5 families were collected in 2013. The number of species seemed to increase in these study sites, but there was no statistical difference. And in Jwa-Gwang streams, a total number of 18 species in 9 families were collected in 2001 and 13 species in 6 families were collected in 2011. After Newtown development, the number of species decreased in Jwa-Gwang stream. With respect to the water quality measurements, there were no statistical differences between the two study sites. In Jang-An stream the dominant species between 2001 and 2013 changed, *Squalidus multimaculatus* (relative abundance, RA: 51.1%) was the dominant species in 2001 (BN), whereas in the case of 2013 (AN), *Zacco koreanus* was the dominant species. Also, the dominant species was different in Jwa-Gwang stream changed between 2001 and 2013, *Zacco platypus* (RA: 28.3%) was dominant in 2001(BN), while *Rhynchocypris oxycephalus* (RA: 49.8%) was dominant in 2013 (AN). Jang-An stream, which lacked the influence of Newtown development, had no change in fish community compared to Jwa-Gwang stream. The number of species in Jwa-Gwang stream decreased from 18 to 13 species. In addition to Newtown development, *Zacco temmincki* and *Oryzias latipes* disappeared in this stream. We could recognize impact of alteration or channelization on the restored stream due to the Newtown construction as shown by the results of this study. Therefore, there should be continuously biological monitoring of the stream ecosystem and the stream segment designated as a protected area of for reducing human interference. In addition, it is strongly recommend that ecosystem structure of streams under the consideration of the Newtown development should be analyzed carefully and microhabitat and habitat complexity also incorporated into the basic restoration plan.

P13-15

Fish utilization of Ice harbor-type fishway installed in the Gongju weir by time periods using a trap sampling method

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For efficient use of water many in-stream artificial structures such as dams and weirs which block the longitudinal connectivity have been constructed in streams and rivers. To overcome blockage of migration and movement of fish, fishway is commonly installed. In this study, we investigated fishway utilization of fish in different time periods at the Ice harbor-type fishway installed in the Sejong Weir using a trap sampling method. The research monthly conducted from June to October, 2012. For the research, the traps (width 1m x length 0.7m x height 1m, mesh size 5mm) was installed at the exit of the fishway. To investigate fishway using time of fish, we divided 24h into 4 time periods (A: 08:00~16:00, B: 16:00~20:00, C: 20:00~04:00, D: 04:00~08:00), and examined fish occurrence and measured fish size. All of collected fishes were released upstream of fishway after measurements. A total of 21 species classified were collected at the fishway, and *Hemibarbus labeo* (35.6%), *Squalidus chankaensis tsuchigae* (28.5%), *Opsariichthys uncirostris amurensis* (15.1%) were dominantly collected species. In case of fishes using time periods, fishes more utilized the fishway at day time (A+D, 91.6%) than night time (B+C, 84%) each species used fishway at different time, and it was related with ecological characteristics of each species. These results are useful to efficient management of the fishway.

Fish utilization of fishway installed in the Sejong weir by time periods using a trap sampling method

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Because a nature like fishway imitates a natural stream, its morphology and characteristic is similar with a natural stream. Therefore, it is expected that various fish species can conveniently use a nature-like fishway. However, each fish species has its own ecological character; thus different utilization patterns might be expected depending on species. In this study, we investigated fishway utilization of fish in different time periods at the nature-like fishway in the Sejong Weir using a trap sampling method. The research monthly conducted from June to October, 2012. For the research, the traps (width 1m x length 0.7m x height 1m, mesh size 5mm) was installed at the exit of the fishway. To investigate fishway using time of fish, we divided 24h into 4 time periods (daytime: 08:00~16:00, evening: 16:00~20:00, night: 20:00~04:00, dawn: 04:00~08:00), and examined fish occurrence and measured fish size. All of collected fishes were released upstream of fishway after measurements. A total of 29 species classified into 6 families were collected at the fishway, and *Squalidus chankaensis tsuchigae* (23.4%), *Zacco platypus* (16.5%), *Erythroculter erythropterus* (10.0%) and *Squaliobarbus curriculus* (8.9%) were dominantly collected species. There were no fish usage differences between time periods except dawn which showed rather small occurrence number than others. Nine species were collected during night time, and this number of species was relatively smaller than other time periods which showed 17 species. The major time period according to the species were as follows; *S. chankaensis tsuchigae* at the dawn and the evening, *Zacco koreanus* at the daytime, *E. erythropterus*, *S. curriculus* and *Hemibarbus labeo* mostly at the nighttime. In the case of *Z. platypus* and *Opsariichthys uncirostris amurensis*, they moved to upstream mostly at the daytime and the evening. The biggest fish that was caught by the traps was *S. curriculus* (410.0 ± 75.5mm), and *Z. koreanus* (43.8 ± 6.1mm) was the smallest. It means that fishes of smaller than 50.0mm in length can pass the fishway.

P13-17

Optically stimulated luminescence dating of Nakdong River deltaic sediments and their accumulation rate, southeastern Korean Peninsula

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55-m-long core was collected from the Nakdong River estuary in southeastern Korea, which is characterized by a thick Late Quaternary deltaic sequence. The applicability of OSL to the dating of deltaic sequence was tested by a single aliquot regenerative dose (SAR) procedure using chemically purified (H₂SiF₆ or HF) fine- (4–11 μm) and coarse- (90–212 μm) grained quartz. The suitability of the material for OSL dating was confirmed by the luminescence characteristics. Optical dating results were compared with ages obtained from ¹⁴C dating of shell and wood fragments. 25 OSL ages ranging from 0.4 ± 0.03 ka to 26.9 ± 2.4 ka were obtained from the whole sequence. The sedimentation rate shows roughly constant values of 0.5 cm/yr between 10 and 5.2 ka. The sedimentation rate remarkably decreased between 5.2 and 1.9 ka as 0.15 cm/yr, and shows a trend of sharply increasing values (0.77 cm/yr) thereafter. These differences in sediment accumulation rates show that it is important to take account of the relative sea level change. Constant and rapid sedimentation rate between 10 and 5.2 ka is the result of a relative sea-level rise and abrupt transgression of the shoreline. On the other hand, a decreased sedimentation rate between 5.2 and 1.9 ka may be associated with sea level high stand and gradually falling of sea level. Rapidly increased sedimentation rate since 1.9 ka may be controlled by progradation of a coastal area.

AUTHOR INDEX



Contributor Name	Paper NO.	Page
A		
Ajit Pattnaik	O3-5	46
	P13-13	235
Akihiko Yagi	P10-2	199
	P13-3	225
	P1-7	125
	P7-11	185
	P9-4	192
Akihiro Sakatoku	P6-8	161
Akihiro Takata	P1-11	129
Akihiro Tuji	P9-7	195
Akiko YOKOYAMA	P10-2	199
	P7-11	185
Akira Umehara	P9-5	193
Alexey A. Kotov	P6-6	159
Anna Seo	O3-2	43
Antonio Quesada	P9-7	195
Aota Yasuaki	P13-7	229
Atsushi Masaki	O1-3	34
Auger Guillaume	P13-7	229
Aya Takasawa	P13-9	231

B

Baek, Seung Ho	O9-5	95
Baik-Ho Kim	P3-2	137
	P6-1	154
	P6-2	155
	P7-1	175
Bal Dev Bhattraï	P7-9	183
Bhattraï Bal Dev	P7-10	184
	P5-7	153
Bin Yin	P1-6	124
Bohyung Choi	O4-5	54
Bomchul Kim	P7-8	182
	O1-4	35
	P1-1	119
	P11-2	219
	P1-4	122
	P1-9	127
	P2-1	131
	P3-4	139
	P3-5	140
	P7-2	176

Bomchul Kim	Plenary	9
Bong-seok Jeon	P10-18	215
	P10-19	216
Boram Yang	P1-10	128
Bumchul Kim	O9-1	91
Byeong Mee Min	O3-2	43
Byeongyoung Kim	P5-6	152
Byoung-ki Choi	P6-5	158
Byun, Jeong-Hwan	P7-1	175
Byung-Joon Jung	P1-9	127
ByungKwan Jeong	P6-19	172

C

Cai Ping Xu	O8-5	87
Chae Hong Park	O7-5	79
	O8-4	86
	O9-6	96
	P9-8	196
	P9-9	197
Chae-Gyu Lee	O6-1	66
Chang Hwan Kim	O6-8	74
Chang Seok Lee	O6-8	74
Changwon Jang	P11-2	219
	P3-4	139
	P3-5	140
Chenglin Wu	P4-1	143
Chi Hong Lim	O6-8	74
Chieko Yoshida	P9-6	194
Chih-Yu Chiu	O1-5	36
Chikage Yoshimizu	O5-1	58
Chizuru Wada	P13-10	232
Choi Jun kil	P9-4	192
Chulgoo Kim	P7-2	176

D

Da Hye Lee	P6-19	172
Dae Hwa Kim	P1-5	123
Dae Ryul Kwon	P9-8	196
	P9-9	197
Daekyo Cheong	P13-17	239
Dahye Lee	P1-8	126
Daisuke Tanaka	P6-8	161
David P. Hamilton	O2-1	37
Dayi Zhang	O8-6	88

Dong Jun Han	O7-3	77	Gea-Jae Joo	O4-6	55
Dong Woo Yang	P6-20	173		O5-2	59
Dong-II Seo	O5-6	63		O5-8	65
	P3-6	141		O6-6	72
Dong-Kyun Kim	P13-1	223		O8-8	90
	P8-2	187		P13-12	234
Dongsub Kim	P10-1	198		P13-14	236
	P7-4	178		P3-6	141
	P10-4	201		P6-15	168
	P10-5	202	Geung-Hwan La	O3-4	45
	P10-6	203		O5-2	59
	P10-7	204		O5-8	65
	P10-8	205		P13-1	223
	P13-4	226		P8-2	187
	P7-3	177	Gi Young Ock	O4-4	53
Dongwoo Yang	P6-4	157	Gilson Hwang	P10-1	198
	Y1-3	17	Guangwei Zhu	O8-1	83
	O9-2	92		O8-7	89
Doug-Hee Rhew	P1-3	121	Gui-Sook Nam	O5-5	62
Dr. Md. Jahidul Islam	O7-7	81		P4-3	145

E

Etsuji Hamabata	P12-2	222
	P12-1	221
Eui-Haeng Lee	O5-5	62
Eung Roh Park	O7-5	79
	O8-4	86
	P9-8	196
Eunjoo Lee	P7-10	184
	Plenary	9
Eunkyu Lee	P6-15	168

F

Fumiko Kitano	P1-11	129
Funayama Kei	P9-6	194
Futaba Kazama	P6-9	162

G

Gao-Hua Ji	P7-7	181
Ga-Ram Hong	O6-1	66
Gea-Jae Joo	P8-2	187
	O3-5	46
	O3-7	48

	O6-8	74
Gwan Ho Bae	O6-8	74
Gwan Yeong Park	P1-5	123
Gwangsun Choi	P7-10	184
GyeongRak Lee	P6-11	164
Gyu Song Lee	O6-8	74
GyungBae Nam	O6-8	74
Gyung-soon Kim	O4-6	55

H

Hae Kyung Park	O4-5	54
Hae-Jin Lee	P1-3	121
	P6-5	158
Hae-Kyung Park	P6-5	158
Haengseop Song	P10-1	198
Hai Xu	O8-7	89
Hai-Jun Wang	O3-1	42
Hajime Obata	P1-7	125
Hak Young Lee	P13-1	223
	P6-19	172
	P8-1	186
	P8-3	188
Hak-Yang Kong	P5-3	149
Ha-Kyung Kim	P6-2	155
Hangsun You	P1-8	126
Han-Yong Um	P3-2	137
Heng Lyu	P1-6	124
Hengpeng Li	O8-1	83

Hiroaki Tsutsumi	P9-5	193
Hiroaki SUDA	P10-2	199
	P7-11	185
Hiroshi Fukuda	P6-16	169
Hiroyo Takee	P11-3	220
Hiroyuki Arai	Y1-1	15
Hiroyuki Mano	P9-2	190
Hiroyuki Takasu	O5-1	58
Hisayuki Azumi	P13-3	225
	P1-7	125
Hitoshi Tanaka	P6-8	161
Ho Bok Song	P6-3	156
Ho- Dong Park	P9-5	193
	P10-18	215
	P10-19	216
	P6-17	170
	P9-6	194
	P9-7	195
Hogyeum Joo	P13-13	235
Ho-Joon Kim	P10-5	202
	P10-6	203
	P13-4	226
Hong Shen	O5-4	61
Hong-Zhu Wang	O3-1	42
Hourui Fan	O9-4	94
Hui Lin	O8-6	88
Hui Lin Zhuang	P6-13	166
Hui Zhang	O7-1	75
Huiru Zhuang	O8-6	88
Huiyun Li	O8-1	83
Hwang Goo Lee	P6-7	160
Hwayoung Jung	O4-6	55
Hyeok Yeong Kwon	P6-10	163
	P6-12	165
Hyeon Jin Cho	P8-3	188
Hyeon jin Jo	P8-1	186
Hyeong jin Lee	P8-1	186
Hyun Je Cho	O6-8	74
Hyun Seo Ji	P1-5	123
Hyun Seon Shin	P1-7	125
Hyun Woo Kim	O3-4	45
Hyunbin Jo	P13-14	236
Hyun-Gi Jeong	O5-5	62
Hyungi Jeong	P6-5	158
Hyun-Gi Jeong	P6-6	159
Hyungjin Cho	P5-3	149
Hyunseon Shin	P13-3	225
Hyunsuk Cho	P5-3	149
Hyun-Woo Kim	O5-2	59

Hyun-Woo Kim	P8-2	187
	P13-1	223

I

Ichiro Tayasu	P5-1	147
Indranil Mukherjee	O4-8	58
	O5-3	60
In-Hwan Cho	P6-1	154
	P7-1	175
In-Seok Seo	P10-8	205
IRan-Young Im	P13-12	234

J

Jae An, Lee	O6-3	69
Jae Gyeong Lee	P10-20	217
	P5-4	150
Jae Hun Kim	P6-11	164
Jae Jeong Yu	P6-10	163
	P6-5	158
Jae Sung Eum	P7-8	182
Jae-An Lee	O6-1	66
	O6-7	73
	P1-3	121
Jaean Lee	P5-3	149
	P5-5	151
Jaeho Lee	O3-7	48
Jae-Ki Shin	P11-1	218
	P13-11	233
	P2-5	135
Jaesoo Lim	O9-2	92
Jaesung Eum	P1-1	119
	P1-4	122
	P7-2	176
	Plenary	9
Jaeyong Lee	P3-5	140
	Plenary	9
Jai-Ku Kim	P11-2	219
	P3-4	139
	P7-2	176
Jeasung Eum	P2-1	131
Jeffrey S. Owen	P3-4	139
	P3-5	140
Jeng Wei Tsai	P6-13	166
	O1-5	36
Jeong Eun Na	P8-1	186

Jeong Eun Na	P8-3	188	Jong Ku Gal	O4-5	54
Jeong Hui Kim	P13-16	238		O4-8	57
	O6-7	73	Jong-Hak Yun	O3-5	46
	O9-5	95	Jonghwan Choi	P5-7	153
	P13-15	237	Jong-Min Oh	P4-3	145
	P3-6	141	Jong-yeon Hwang	O4-2	51
Jeong-Soo Gim	O3-7	48	Jong-Yun Choi	O5-2	59
	P13-14	236		O5-6	63
Ji Hyeon Kim	P13-16	238		O5-8	65
Ji Yoon Kim	O3-5	46		P3-6	141
	O6-6	72		P6-15	168
	O8-8	90	Joonwoo Noh	P10-10	207
	P13-12	234		P10-11	208
	P13-13	235		P10-12	209
Jianming Deng	O8-1	83		P10-13	210
Jiashou Liu	O7-4	78		P10-17	214
	O9-4	94		P10-3	200
	P5-2	148		P13-8	230
Jie Bai	P4-1	143	Jordan A. Read	O2-1	37
Ji-Hyeon Kim	P13-15	237	Ju Duk Yoon	P13-16	238
Ji-Hyung Park	P1-10	128		O3-7	48
	P1-9	127		O6-7	73
Jin Cheul Kim	P13-17	239		P13-15	237
	O9-2	92		P3-6	141
Jin Hur	O4-7	56		P4-4	146
jin Woong Lee	O6-7	73	Jun Chen	O5-4	61
Jing Yuan	O7-4	78	Jun Kil Choi	P1-7	125
	O9-4	94	Jung Ha Yun	P8-3	188
	P5-2	148		P8-3	188
Jin-Oh Hyun	O3-2	43	Jung Hwan Park	O6-3	69
Jinwon Seo	O7-8	82		O7-5	79
Jin-Woong Lee	P4-4	146		O9-6	96
Jin-Yong Ha	O3-6	47	Jungho Park	P10-1	198
	P9-2	190	Jun-Kil Choi	P13-3	225
	P9-3	191		P6-7	160
Jin-Yong Lee	O9-2	92	Jun-Oh Min	O4-5	54
Jin-Young Lee	P13-17	239		P3-3	138
Jisun Han	P10-18	215	Jun-ya Shibata	P5-1	147
	P10-19	216	Ju-Yong Kim	O9-2	92
Jo, Hyunbin	O3-7	48			
Jo-Hee Yoon	O9-5	95			
John Jones	P11-2	219	K		
Jong Eun Lee	P6-10	163	Kang-Hyun Cho	O3-2	43
	P6-11	164		P13-4	226
	P6-12	165		P5-3	149
Jong Gu Gal	O4-4	53	Katrin Teubner	O8-5	87
Jong Hwan Park	O3-4	45	Katsutoshi Takahashi	P1-11	129
	P13-1	223		P1-12	130
	P8-1	186			

Kazuhide Hayakawa	O5-1	58	Kyoko Fujita	P13-2	224
	P1-11	129	Kyongsu Lee	P13-8	230
	P1-12	130	Kyoung-A You	O9-6	96
	P13-10	232	Kyoungphile Nam	P10-20	217
Kazuki Takahashi	P6-8	161		P5-4	150
Kazuya Yoshizawa	P6-9	162		P5-5	151
KeeDae Kim	O6-8	74	Kyu Song Lee	O3-2	43
Keerthi Sri Senarathna Atapaththu	O7-6	80		O7-3	77
Keisuke Koba	O1-3	34	Kyung Hoon Shin	O4-5	54
Kenzi Takamura	P6-18	171	Kyung Hun Shin	O4-4	53
Kenzo Maki	P1-12	130	Kyung-A You	P10-14	211
Keon-Young Jeong	O5-2	59		P1-3	121
Kim Dong-Kyun	O3-6	47	Kyungeun Lee	O3-2	43
Kim Keon Hee	O9-6	96		P5-6	152
Kimio Hirabayashi	P6-9	162	Kyung-Hoon Shin	O4-7	56
Kimio Hirabayshi	P6-18	171		O4-8	57
Kiyong Kim	O1-4	35		P3-1	136
Knorr, Klaus-Holger Knorr	O1-4	35		P3-2	137
Ko Hosoda	O9-3	93		P3-3	138
Kohsuke Ota	O2-5	41		P3-7	142
Koji TOJO	P6-17	170		Y1-5	19
Kongtae Ra	O4-2	51		O4-2	51
Koya NAKAMURA	P6-17	170	Kyunghyun Kim	P5-5	151
Kui Mei Qian	O8-5	87	Kyung-Lak Lee	P6-5	158
Kumagai Michio	P13-7	229	Kyung-tae Kim	O4-2	51
Kun Shan	Plenary	11	Kyung-Yoon Chung	O6-1	66
Kunio Kohata	P6-8	161			
Kwang Yeong Joo	O3-2	43			
Kwang-Guk An	P3-2	137			
Kwang-Hyeon Chang	O3-6	47			
	O5-5	62			
	O5-6	63			
	P3-6	141			
	P4-3	145			
	P4-4	146			
Kwang-Seuk Jeong	O3-6	47			
	O5-2	59			
	P4-3	145			
	P6-15	168			
Kwangsoon Choi	P10-16	213			
	P10-7	204			
	P10-8	205			
	P13-4	226			
	P7-3	177			
	P7-4	178			
	P10-4	201			
	P10-5	202			
	P10-6	203			
Kwon Dae Ryul	O8-4	86			

L					
Larisa Prozorova	O7-2	76			
Lee, Eun Joo	O7-3	77			
Lee, Jin woong	P13-15	237			
Li Xu	P7-7	181			
Lin Li	Plenary	11			
Li-Qing	Wang P7-7	181			
Lirong Song	Plenary	11			

M					
Maki Oyagi	P10-2	199			
	P13-3	225			
	P1-7	125			
	P7-11	185			
	P9-4	192			
Makoto Ichikawa	P6-18	171			
Man Sik Choi	P3-1	136			
Man-Ha Hwang KwangsoonChoi	P10-4	201			

Mariana O. Sharyi-ool	P6-21	174	Myeong Seop Byeon	P6-3	156
Maruo Masahiro	P1-7	125		P10-14	211
Masaaki Takeda	P6-18	171		P7-1	175
Masahiro Maruo	P13-3	225	Myoung-Chul Kim	O5-2	59
Masahiro MARUO	P9-4	192	Myounghee Kang	O7-1	75
Masahiro Ogino	P13-9	231	Myoung-Sun Shin	P11-2	219
Masahito Sugiyama	O9-3	93		P2-1	131
Masaki Nishio	P6-8	161		Plenary	9
Masaki Sakamoto	P9-2	190	Myung Hwa Jung	P8-3	188
	P9-3	191	Myung Hwan Park	O7-5	79
Masashi Kamo	P9-3	191		P9-8	196
Mathew G. Allan	O2-1	37		O8-4	86
Matthew Hipsey	O2-1	37		P7-1	175
Maurice Lineman	P13-12	234		P9-9	197
Md Harun Rashid	O2-5	41	Myung-Soo Han	P6-1	154
	O3-8	49		P6-2	155
Megumi NOBORI	P10-2	199	Myungsun Shin	P1-4	122
	P7-11	185			
Megumu Fujibayashi	P13-9	231	<hr/>		
	P6-8	161	N		
Meiyan Jin	P4-3	145	Nagafuchi Osamu	P13-2	224
Mengyuan	O8-7	89	Nakajima Jun	O8-2	84
Mengyuan Zhu	O8-1	83	Namil Chung	P6-4	157
Mi Jin Lee	P6-10	163	Nam-Il Won	O4-1	50
	P6-12	165	Nan-Young Kim	O6-2	68
Mi-Ae Song	P1-3	121		O6-5	71
Micah Lourdes A. Felix	P10-3	200	Naoko Hishida	P13-2	224
Michio Kumagai	Plenary	12	Noboru Okuda	O4-3	52
Mi-Jung Bae	O2-2	38		P13-2	224
	P10-14	211		P5-1	147
Mi-Kyung Kim	P6-14	167	Nobuhide Fujitake	P1-11	129
Min Ho Jang	P13-16	238		P1-12	130
	O3-7	48		P13-10	232
	O5-6	63	Nobuyuki Tanaka	P13-9	231
	O6-7	73	Norihiko Yoshida	P6-9	162
	O9-5	95	Noriko FUTATSUGI	P6-17	170
	P13-15	237	Noriko Ishida	P13-3	225
	P3-6	141		P1-7	125
	P4-4	146		P9-4	192
Min-Kyung Kim	P6-14	167	Nozomi Amahashi	P1-7	125
Minoru, Takenaka	P12-1	221			
Min-Seob Kim	O4-2	51	<hr/>		
	P3-2	137	O		
	P3-3	138	OdaShoko	P9-7	195
Mitsuhiko Koyama	P11-3	220	Osamu Mitamura	P13-3	225
Miyako Hara	P1-11	129		P1-7	125
Mochizuki, Akihito	O9-3	93		P9-4	192
Morimaru Kida	P1-12	130			
Muneoki Yoh	O1-3	34			

Osamu Nishimura	13-9	231
	P6-8	161

P

Park Jayong	P9-4	192
Paul C. Hanson	O2-1	37
Pengling Shi	O5-4	61
Phil-Goo Kang	P1-9	127
Ping Xie	O5-4	61
Pyung-Rae Kim	O9-1	91

Q

QIAN Quimei	O3-3	44
Qidong Wang	O7-4	78
	P5-2	148
Qiwei Wei	O7-1	75
Quan Zhou	Plenary	11
Quilyo Wu	P13-2	224

R

Raehyuk Jeong	P6-5	158
	P6-6	159
Ran-Young Im	P13-13	235
Rei Somiya	P1-7	125
	P13-3	225
	P9-4	192
Reiji Kojima	P1-11	129
	P13-10	232
Rie Mabuchi	P9-5	193
Rie SAITO	P6-17	170
Rika Utsumi	P1-11	129
	P1-12	130
	P13-10	232
Rongping Gao	O8-1	83
Rui-Lei Zhang	P7-7	181

S

S. Geoffrey Schladow	O2-3	39
Sang Hyeon Park	P13-16	238
Sang Kyu Park	P6-20	173

Sang Uk Lee	P1-2	120
Sang-Hoon Kim	O6-1	66
	O6-2	68
	P5-5	151
	P6-14	167
	P6-1	154
	P6-2	155
Sang-Hun Kim	O6-5	71
Sang-Hyeon Park	P13-15	237
	P4-4	146
Sangjin Lee	P10-3	200
Sang-Kyu Park	P3-2	137
	P6-4	157
	Y1-3	17
Sanguk Lee	P10-10	207
	P10-11	208
	P11-1	218
	P13-5	227
	P2-2	132
	P2-3	133
	P2-4	134
	P2-5	135
Sang-Woo Lee	O6-4	70
Satoshi Chiba	O7-2	76
	P6-16	169
Sayaka Nakamura	P13-3	225
Se Uk Cheon	P6-5	158
Se Woong Chung	O2-3	39
	O2-4	40
	P1-5	123
Sea-Won Kim	P10-12	209
	P10-5	202
	P10-6	203
	P10-7	204
	P10-9	206
	P11-1	218
	P13-11	233
	P13-5	227
	P2-3	133
	P2-4	134
	P7-3	177
	P7-4	178
	P7-5	179
Sei Sun Hong	P13-17	239
	O9-2	92
	P13-6	228
Semi Kim	P5-3	149
Seo Wan Bum	O8-4	86
	P9-9	197

Seon Ah Jeong	P6-20	173	Soo-Jin Kang	P3-3	138
SeongHee Jeong	O6-8	74	Soon-Jin Hwang	O6-1	66
Seong-Ho Baek	O6-7	73		O6-2	68
Seongjin Hong	P3-2	137		O6-3	69
Seong-Ki Kim	O5-2	59		O6-5	71
	O5-8	65		O7-5	79
	P6-15	168		O8-4	86
	P8-2	187		P10-14	211
Seung Hyun Lee	P6-7	160		P3-2	137
Seung Won Jung	P6-19	172		P3-3	138
Seung-Ho Baek	O5-6	63		P6-14	167
	P13-15	237		P7-1	175
	P3-6	141		P9-8	196
Seung-Hyun Joung	P1-3	121		P9-9	197
Seungwon Shin	P13-17	239	Stefan Peiffer	O1-4	35
Seungyoon Lee	P10-16	213	Su Hyeon Lee	P13-16	238
	P10-9	206	Suk-Hee Yoon	P3-1	136
	P11-1	218	Sun-A Chong	P10-9	206
	P13-5	227		P13-11	233
	P2-2	132		P13-5	227
	P2-3	133		P2-2	132
Seungyun Lee	P2-5	135		P2-3	133
Shigeko Sakai-Kimura	P11-3	220		P2-4	134
	Y1-2	16		P2-5	135
Shigeo Yachi	P5-1	147		P7-5	179
Shigeyuki Arai	P13-9	231	Sun-Ah Hwang	O6-4	70
Shi-Kai Wu	O3-1	42	Sung Wan Yoon	P1-5	123
Shin Hyun Seon	P9-4	192	Sunghwan Kim	P3-7	142
Shin Jae-Ki	P10-9	206	Sungjin Kwak	P5-7	153
Shin Jae-Ki	P7-5	179		P7-10	184
Shin Uk Kang	P1-2	120		P7-9	183
Shin Uk Kang	P2-2	132	Sungmin Jung	P1-1	119
Shin-ichi Nakano	O5-1	58		P1-4	122
	O5-3	60		P2-1	131
	O5-7	64		P7-2	176
	P5-1	147		Plenary	9
Shinuk Kang	P10-10	207	Sungwon Hong	O-6	55
	P10-11	208		P13-14	236
Shinya Maruno	P12-2	222	Sun-Hye Kim	P1-9	127
Sho Nakano	O5-6	63	Sun-Mi Go	P4-4	146
	P3-6	141	Syuhei Ban	P11-3	220
Shogo Nakamura	P6-8	161		P13-2	224
Shogo Sugahara	P1-7	125			
	P9-4	192			
	P13-3	225			
Shogo Tukiayama	P12-2	222			
Shohei Fujinaga	O5-7	64			
Shoji D. Thottathil	O5-1	58	Tae Seok Ahn	P4-2	144
Song Eunsook	P1-8	126	Tae-Young Heo	P10-20	217
				P5-4	150

T

Takahiro Hirano	O7-2	76
	P6-16	169
Takamaru Nagata	P9-2	190
Takashi Asaeda	O2-5	41
	O3-8	49
	O7-6	80
Takashi Yoshida	Y1-2	16
Takayuki Hanazato	O3-6	47
	P6-17	170
Takayuki Shiraiwa	O1-3	34
Takehiko Fukushima	Y1-1	15
Takeo Onishi	O1-3	34
Takumi Saito	P6-16	169
Tanglin Zhang	O7-4	78
	O9-4	94
Taro Izumi	O1-1	32
Tatsuki Toda	P11-3	220
Tetsu Kumagai	P1-11	129
	P1-12	130
	P13-10	232
Tetsuji Akatsuka	P13-3	225
	P1-7	125
	P9-4	192
Thuan Cong Nguyen	O1-1	32
Tohru Takahashi	P9-5	193
Tomohiro Takeyama	P5-1	147
Toyo Takahashi	P6-8	161

U

Uhran Song	P9-1	189
------------	------	-----

V

Victor V. Bogatov	O1-2	33
-------------------	------	----

W

Wan Bum Seo	P9-8	196
Wanping Zhou	O8-1	83
Wei Chen	Plenary	11
Wei Zhang	O8-7	89
Weijun Tian	P4-1	143
Weimin Chen	O8-1	83
Wells John C	P13-7	229
Wenjing Wang	O5-4	61

Woncheol Park	P13-8	230
Wonchoel Lee	P6-6	159
Won-seok, Lee	O4-2	51
Woo Myoung Heo	O7-3	77
Woo Tchul Lee	O3-2	43
Wook-Hyun Nahm	P13-6	228
WoomyoungHeo	P7-4	178
Woomyung Heo	P10-1	198
	P5-7	153
	P7-10	184
	P7-9	183

X

Xia Liu	O3-3	44
	O8-5	87
Xiao-Jie Dai	P7-7	181
Xiaomin Gong	P4-1	143
Xiao-Min Liang	O3-1	42
Xiaoxia Han	O8-1	83
Xue Du	O7-4	78
Xuejing You	O8-6	88

Y

Yang Cui	O8-1	83
Yangguo Zhao	P4-1	143
Yasushi Seike	P13-3	225
	P1-7	125
	P9-4	192
Yeonjung Lee	O4-5	54
	O4-7	56
	P3-2	137
	P3-3	138
	P3-7	142
	Y1-5	19
Yeonsook Choung	O3-2	43
	P5-6	152
Yeo-Rang Lee	P6-4	157
Yoichiro Sakai	O4-3	52
	P5-1	147
Yong Jae Kim	P6-19	172
Yong SikShin	P6-19	172
Yonghak Lee	P5-6	152
Yonghee Park	P13-17	239
Yong-Jae Kim	O5-6	63
Yongmei Wang	P4-1	143

Yongsik Sin	P3-7	142	Yuichi Kameda	P6-16	169
Yong-Soo Kwon	P6-1	154	Yuichi MIYABARA	P6-17	170
	P6-2	155	Yuja Wang, Yan Xue	O8-3	85
Yong-Su Kwon	O6-5	71	Yuki Kobayashi	O5-1	58
	P6-4	157	Yuki Nakayama	P6-18	171
	Y1-4	18	Yuko Niyama	P9-7	195
Yoonhee Kim	P2-1	131	Yuko Sugiyama	P1-11	129
Yosang Lee	P10-15	212		P1-12	130
	P10-16	213		P13-10	232
	P10-8	205	Yukyong Jung	P3-4	139
Yoshihiko Sako	Y1-2	16	Yuna Shin	P10-20	217
Yoshihisa KATO	P10-2	199		P5-4	150
Yoshiko Iizumi	O1-1	32		P5-5	151
Yoshikuni Hodoki	O5-1	58	Yung-Chul Jun	O6-2	68
	O5-3	60	Yunyoung Lee	P11-2	219
Yoshito Chikaraishi	O4-8	57		P7-2	176
Youn-Bo Sim	P6-14	167	Yunlun Jia	Plenary	11
Young Hun Jin	O7-5	79	Yunmei Li	P1-6	124
	P6-3	156		P7-6	180
	P9-9	197	Yuno Do	O3-5	46
Young-Cheol Cho	O9-6	96		O6-6	72
Young-Chul Jun	P6-14	167		O8-8	90
Young-Ji Han	O9-1	91		P13-12	234
Young-Seuk Park	O6-5	71		P13-13	235
	O2-2	38	Yuping Su	O8-6	88
	P3-2	137	Yusuke Okazaki	O5-1	58
	P6-4	157	Yuta Morii	P6-16	169
	Y1-4	18	Yuwei Chen	O3-3	44
YoungSoon Choi	P1-1	119	Yuzhi Song	O8-3	85
	P1-4	122	Yuzuru Kimochi	P6-8	161
	Plenary	9	Yves Prairie	Plenary	10
Youngsung Kim	P10-10	207			
	P10-11	208			
	P10-12	209			
	P10-13	210			
	P10-17	214			
	P10-7	204	Zhongjie Li	O7-4	78
	P7-3	177		O9-4	94
	P7-5	179		P5-2	148
Youngteck Hur	P10-3	200	Zhongxing Wu	Plenary	11
	P13-8	230	Zhu	O8-7	89
Yu Wei Chen	O8-5	87	Zin' ichi Karube	P5-1	147
Yuan Weng	O8-6	88			

Z

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