URBIO 2014

The 4th International Conference of
Urban Biodiversity and Design

October 9-12 2014, Incheon, Korea

Cities and Water

Conservation, Restoration and Biodiversity

● 본 URBIO2014는 (사)한국환경복원기술학회 추계학술대회/임시총회와 공동진행됨.

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Proceedings of the 4th international conference of urban biodiversity and design (URBIO 2014)

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1. WELCOME ADDRESS

Welcome to URBIO 2014

It is with pleasure and honor, on behalf of the URBIO 2014 organizing committee, to open the 4th Conference on Urban Biodiversity and Design this year in Korea.

Urban frontiers in South-Korea have been influenced by a rapid urbanization process alongside with its industrialization, which now has to undergo certain problem-solving stage toward diminishing biodiversity and climate-induced disasters that have threatened our livelihoods and quality of life.

In parallel to the twelfth meeting of Conference of the Parties to the Convention on Biological Diversity (CBD COP12) and the Biodiversity Summit for Cities & Subnational Governments 2014 by ICLEI, URBIO2014 will play a significant role in enhancing the international academic, professional network to deal with urban environmental problems, also promoting the global-scaled awareness on conserving the urban biodiversity.

This year's topic, "Cities and Water: Conservation, Restoration and Biodiversity" will discuss of 3 sub-themes and 12 sessions with other parallels. We are all looking forward to this successful conference with excellent keynotes, interesting sessions, and many networking opportunities. I wish you all a very fruitful URBIO 2014.

Thank you.

Organizer of 2014 URBIO Korea

Namchoon, Kim

Welcome Address

Dear delegates,

As the president of the Korea Society of Environmental Restoration Technology, I would like to warmly welcome you to our URBIO 2014 conference. Since 19th century, drastic growth in human population, industrialization and urbanization have caused over exploitation and excessive consumption of biological and mineral resources. As a result, natural ecosystem has been devastated and various ecosystem services provided by nature has decreased. These problems are very important issues to us with climate change, biodiversity conservation, and sustainability.

In 2014, urban population accounted for 54% of total global population, increased from 34% in 1960 and continues to grow. In this circumstance, urban ecosystem can make a better life environment and improve human well-being through providing ecosystem services such as absorbing contaminants, reducing energy use for heating and cooling, buffering against flooding and conserving urban biodiversity. Therefore, we should effort together in order to restore structures and functions of urban ecosystems and conserve urban biodiversity.

Especially, 90% of human population in South Korea concentrate in cities, therefore, I think, it is very meaningful to hold "The 4th International Conference of Urban Biodiversity and Design – Cities and Water: Conservation, Restoration and Biodiversity" in Korea. And I hope that at this conference we will have the chance to enhance our understanding about urban ecology and research direction for sustainable urban management though knowledge-sharing and discussion about results of academic researches and technology development.

Finally, I wish that people around the world will enjoy ecosystem services provided by rich biodiversity in consequence of our efforts

Thank you.

President Woo-Shin Lee
the Korea Society of Environmental Restoration Technology

Welcome Address from the President of URBIO
– International Network for Urban Biodiversity and Design

Honorable guests
Dear colleagues

I am honoured and greatly pleased to welcome all of you to the 4th URBIO Conference "Cities and Water – Conservation, Restoration and Biodiversity" in Incheon City, which is being held as a scientific site event to the 12th Conference of the Parties (COP 12) currently running in Pyeongchang.

Since the founding of our URBIO scientific network during COP 9 in Germany, our community has grown to over 1000 members representing scientists from over 60 countries. URBIO conferences – running parallel to the COP meetings – are important events for discussing the challenges and opportunities related to urbanization, ecosystem services and biodiversity. I am grateful and proud that many of our scientists have contributed to the initiatives and programs within the CBD Mayor Group "Global Partnership on Local and Subnational Action for Biodiversity", the "Singapore Index" and the recently published "Cities and Biodiversity Outlook" and its scientific foundation.

I am convinced that this URBIO conference, with the main theme "Cities and Water", will make an important contribution to the "Global Partnership on Local and Subnational Action for Biodiversity" and knowledge of how to manage and design urban ecosystems in a sustainable way.

I am grateful to the Secretariat of the CBD and ICLEI and its Cities Biodiversity Center for their continuously fruitful cooperation with URBIO since 2007 and especially for giving our network the opportunity to present our results during the "Biodiversity Summits" – the largest and arguably most high-profile events in parallel with the COP meetings. I am hopeful that our recently started discussion "Towards a Global Research Agenda for Urban Biodiversity, Ecosystem Services and Design" will rise to be another important program within the "Global Partnership on Local and Subnational Action for Biodiversity".

I want to congratulate and thank the URBIO 2014 organizer Prof. Dr. Namchoon Kim and the Advisory and Organizing Board for the wonderful and exciting program they have organised. I would like to express my deep appreciation to all those who have worked very hard in preparing the conference. My special thanks go to all the Societies, Associations and Sponsors that supported this conference. Without their generous promotion and engagement this URBIO conference would not have been possible.

Last and not least I want to express my warmest acknowledgements to all colleagues and participants who came to this conference – I am looking forward to fruitful discussions with you.

Prof. Dr. Norbert Müller
University of Applied Sciences Erfurt (GERMANY)

1. WELCOME ADDRESS

Distinguished Participants and Colleagues

It is indeed an honour and a great pleasure to warmly welcome you all to the fourth Urban Biodiversity Conference. It is a great pleasure to see many of you again and also some new participants and I hope that you will have exciting four days. The conference theme "Cities and water – conservation, restoration and Biodiversity" is important in view of the fact that 70% of the future population would residing in cities in future are especially vulnerable due to water stress. Water Management would be the most critical and challenging task for all the researchers and city planners in future. The climate change would worsen the woes of the cities and its dwellers if we are unprepared.

I am happy that all of you have chosen URBIO 2014 as an international platform to exchange your ideas and experiences to debate and exchange information on various aspects involved in the conservation, protection and sustainable development of water resources in the context of the cities. Towards the end of the conference, I hope that you will further strengthen your networks and continue developing the ideas brainstormed and complement the research and policy makers.

I congratulate the conference organising team and the conference chair Prof. Dr. Namchoon Kim for inviting good keynote speakers and selecting good technical papers. I express my deep appreciation for all the conference team, advisory board for working hard in putting together a wonderful and exciting program ahead. My special thanks are also to ICLEI, CBD, and all the sponsors of this conference without whose generosity and support to the conference would not have been possible.

I would thank all the speakers, participants and colleagues for participating in this conference and I hope that you would take back a fruitful discussion, long lasting ties and interesting ideas. I wish everyone a very exciting and productive conference ahead.

As the secretary general of URBIO network, I cordially invite you to the conference.

Warm Regards

Haripriya Gundimeda

Secretary General URBIO

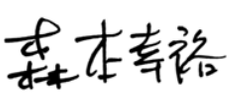
Welcome Address from the Presidentof ICLEE
- International Consortium of Landscape and Ecological Engineering

Distinguished guests,
Dear URBIO 2014 participants,

On behalf of the ICLEE (International Consortium of Landscape and Ecological Engineering),I am honored to welcome all of you to the URBIO 2014 conference in Incheon,Korea. The ICLEE, an academic sponsor of this conference, is the publishing organization for "*Landscape and Ecological Engineering*", the international SCI-listed journal. The journal has been publishingsome of the important results of the URBIO conferences since the URBIO 2010 in Nagoya, Japan.Currently, the journal is supported by the academic societies related to Landscape Ecology, Landscape Architecture and Ecological Restoration in Asian countries, however, it covers the worldwide topics closely related to the goal of the Convention on Biological Diversity. I would like to draw your attention to publish your excellent scientific findings on "*Cities and Water – Conservation, Restoration and Biodiversity*", *the* main theme of this conference. The journal "*Landscape and Ecological Engineering*" is waiting for the submission.

And, I wish to celebrate the URBIO 2014 conference also as a co-chair of the URBIO 2010.I can imagine the difficulties that could be covered only by sincere efforts of the people involved. I would like to thank all of the people and organizations that have contributed to hold thissignificant conference, especially Korean colleagues, including Prof.Dr.Namchoon Kim.And again, let me express my sincere acknowledgements to all participants. I am excited to meet you and discuss on the issue of urban design based on biodiversity and ecosystem services for the sustainable environment.

President of ICLEE



Prof. Dr. Yukihiro Morimoto

Congratulatory Message

Congratulations to holding the 4thInternational Conference of Urban Biodiversity and Design. Since the first URBIO Conference in Erfurt, Germany in 2009, this annual conference has been dealing with high-level discussions on biodiversity in urban areas. So as the president of Korea Association of Environmental Planning & Landscape Architecture, I feel greatly honored that Korea Society of Environmental Restoration Technology hosts this year's conference here in Songdo with the assistance of the Ministry of Environment, Incheon Metropolitan City, POSCO E&C and ICLEI. I would like to thank Prof. Namchoon Kim, the organizer of this event and Prof. Woo-Sin Lee, the president of Korea Society of Environmental Restoration Technology. And my special thanks go to all people who make great efforts to protect and restore the environment of our country.

The main theme of this conference is "Cities and Water: Conservation, Restoration, and Biodiversity" which has been highly studied and practiced by many environmental researchers and professionals nowadays. Started from several professors' recognizing the importance of ecological restoration in 1990's, the professional certification, such as the licenses for Natural Environment Management Engineers and Ecological Restoration Engineers, was established in 2004 and 2005. Since then, the environmental profession of Korea continues to grow every year by training professionals and carrying out lots of government tasks. In the beginning, most of the projects were limited to the restoration for forest, road cut-slope, and riversides, but these days it is not hard to see successful completion of environmental restoration tasks around our daily life.

Every year, the numbers of projects, technical solutions, and professionals are increased. In spite of these numerical increases, we still need to expend a great deal of time and effort to develop this industry and academia of Korea. Beyond environmental restoration and rehabilitation, we also need to provide ecosystem services to support human welfare. More people want to achieve better quality of life and they want to have nature closer to their daily life. Therefore, I believe that this professional field of environmental restoration should continue to grow robustly for the future generations of our countries. And Korean Association of Environmental Planning & Landscape Architecture will make every endeavor to support this movement as well.

I hope that all share of knowledge and ideas on each topic of 2014 URBIO and CBD is informative and meaningful enough to lead to future prosperity of this field. And I was impressed by the outcomes of ICLEI's "Cities for Life" summit, and I trust that biodiversity is a key factor in making cities sustainable, safe, and happy. Again, congratulations to opening of 2014 URBIO. And I wish all participants of this event a pleasant stay and a meaningful time in Korea ,both personal and professional.

Thank you.

Kyung-Jun Shin
Chairman of
Korea Association of Environmental Planning & Landscape Architecture

2. URBIO2014 ORGENIZATION

Organization Overview

Organizer

Kim Namchoon (Organizer, Dankook Univ., Korean Society of Environmental Restoration Technology)

Advisory Board

Norbert Müller URBIO President (University of Applied Sciences Erfurt, Germany)
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2. URBIO2014 ORGENIZATION

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Choi Hyesun (Korea Environment Institute)
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Cho Sehwan (Hanyang University)
Kim Sungkyun (Seoul National University)

Main Sponsors

Ministry of Environment (Republic of Korea)
Incheon Metropolitan City
CBD COP 12
ICLEI Korea
Incheon Development & Tourism Corporation
POSCO E&C
Korea Tourism Organization

Organizing Societies

Korean Society of Environmental Restoration Technology

Co-organizing Societies

Korean Institute of Landscape Architecture
Korean Society of Environmental Impact Assessment
ICLEE (International Consortium of Landscape and Ecological Engineering)

Supporting Societies

International Union for Conservation of Nature
German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety
German Federal Agency for Nature Conservation
Korea Society of Environment and Ecology
Ecological Society of Korea
Restoration Ecological Society of Korea
Korea Society of Ecology and Infrastructure Engineering
Korea Environment Institute
Korea Institute of Civil Engineering and Building Technology
Korea Environmental Industry & Technology Institute
Korea Association of Environmental Planning & Landscape Architecture
Korea Society of Landscape Architecture
Korea Green Roof & Infrastructure Association

Korea Speciality Contractors Association Landscape Gardening and Facilities Setting Works Council

National Nature Trust

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ECO&BIO. Co., Ltd.
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Group HAN. Co., Ltd.
Global Ecoculture Forum
Journal of Landscape Architecture Korea
Korea Landscape Architecture Newspaper Co., Ltd.
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Korea Social Network Association

3. PROGRAM AT A GLANCE

URBIO

URBIO is an open worldwide scientific network for education and research with the aim to promote urban biodiversity and design through a continuing dialogue with the United Nations Convention on Biological Diversity (CBD). Within the CBD programs URBIO is the scientific initiative of the Major Group "Local Authorities". The network was founded in 2008 during the first URBIO conference, since then the URBIO network Headquarters have been in Erfurt, Germany. In order to foster the scientific exchange between researchers, practitioners and stakeholders the network holds contact with various international networks, organize international scientific conferences and workshops prior to the COP meetings (Conference of the parties to the CBD). Since its foundation, the URBIO network has held three conferences: URBIO2008 during May 2008 in Erfurt/Germany, URBIO2010 during May 2010 in Nagoya/Japan, and URBIO2012 during October 2012 in Mumbai/India.

Venue

POSCO Global R&D Center
POSCO Global R&D Center, Songdogwahak-ro 100, Yeonsu-gu, Incheon

Organized by

Korean Society of Environmental Restoration Technology

Sponsored by

Ministry of Environment (Republic of Korea)
Incheon Metropolitan City
CBD COP 12
ICLEI Korea
Incheon Development & Tourism Corporation
POSCO E&C
Korea Tourism Organization

Contacts

- Conference Secretariat : urbio2014korea@gmail.com
- Website of URBIO2014 : www.urbio2014.kr

Program at a glance

Time	DAY 1 Oct 9 (Thu.)		
9:00	Pre-excursion		
10:00			
11:00		Registration	
12:00			
13:00			Opening Remark & Plenary Session
14:00			Coffee Break & Poster Presentation
15:00			
16:00			Oral Session / Invited Session (in Korean)
17:00			
18:00	Welcome Reception		
19:00			
20:00			

Time	DAY 2 Oct 10 (Fri.)				
9:00	Registration	Side Meeting	Welcome Address		Tour for Companions
10:00			Plenary Session		
11:00			Coffee Break		
12:00			Plenary Session		
13:00			Lunch & Poster Presentation	KOSERT Fall-meeting	
14:00			Oral Session	Invited Session (in Korean)	
15:00			Coffee Break		
16:00			Oral Session	Invited Session (in Korean)	
17:00					
18:00	Conference Dinner				
19:00					
20:00					

Time	DAY 3 Oct 11 (Sat.)			
9:00	Registration	Side Meeting	Welcome Address	Tour for Companions
10:00			Plenary Session	
11:00			Coffee Break	
12:00			Plenary Session	
13:00			Lunch & Poster Presentation	
14:00			Oral Session	
15:00			Coffee Break	
16:00			Oral Session	
17:00				
18:00	Closing Remark & Farewell Party			
19:00				
20:00				

Time	DAY 4 Oct 12 (Sun.)
9:00	Post-excursion
10:00	
11:00	
12:00	Move to Pyeongchang (Biodiversity Summit for Cities & Subnational Governments 2014)
13:00	
14:00	
15:00	
16:00	
17:00	
18:00	
19:00	
20:00	

4. CONFERENCE SCHEDULE

DAY 1 (Oct. 9, Thu.)

13:00 – 14:30	Opening remark	• Prof. Kim Namchoon (URBIO2014 Organizer)	Rm.201
		• Prof. Norbert Müller (URBIO President)	
	Keynote lecture	• Prof. Steven Handel • Dr. Tang Hsien Po • Prof. Lee Eun Heui	Rm.201
14:30 – 15:30	Poster presentation and Coffee break		Lobby
15:30 – 17:30	Oral session	• Policy and law for urban biodiversity	Rm.101
		• The Urban Biodiversity Research Coordination Network (UrBioNet)	Rm.102
	Invited session	• Eco-Innovation technology for climate change adaptation (in Korean with English translation)	Rm.202
18:00 – 19:30		Welcome reception	Restaurant (B1)

DAY 2 (Oct. 10, Fri.)

09:00 – 10:00	Welcome address	• Prof. Lee Wooshin(President of KOSERT) • Dr. Braulio F. de Souza Dias (CBD Executive Secretary) • Jeong Yeon-Man (Vice Minister of Environment) • Yoo Jeong-bok (Mayor of Incheon)	Event hall
10:00 – 10:30	Keynote lecture	• Prof. Jürgen Breuste	Event hall
10:30 – 11:00	Coffee break		
11:00 – 12:00	Keynote lecture	• Dr. Woo Hyoseop • Prof. Mark Hostetler	Event hall
12:00 – 14:00	Lunch and Poster presentation Restaurant(B1), Lobby		
12:30 – 14:00	Side meeting	• URBIO board meeting	Rm.102
13:00 – 14:00	Side meeting	• KOSERT fall-meeting	Rm.201
14:00 – 15:30	Oral session	• Participation and collaborative work for urban biodiversity	Rm.101
		• Urban wetlands for smart adaptation to climate change	Rm.202
		• Water, green infrastructure, and ecosystem service	Rm.306
	Invited session	• KOSERT session (in Korean)	Rm.102
		• Urban biodiversity forum organized by MOE / part 1 (in Korean)	Rm.307
15:30 – 16:00	Coffee break		
16:00 – 17:30	Oral session	• Business and the urban environment	Rm.101
		• Evaluation of biodiversity in historical cities	Rm.102
		• Urban stream restoration	Rm.202
		• The environmental drivers of urban resilience	Rm.306
	Invited session	• Urban biodiversity forum organized by MOE / part 2 (in Korean)	Rm.307
18:00 – 20:00	Conference dinner		Event hall

4. CONFERENCE SCHEDULE

DAY 3 (Oct. 11, Sat.)

09:00 – 09:30	Welcome address	• David Cadman (ICLEI Secretary General) • Park Yeonhee(ICLEI Director of Korea office)	Event hall
09:30 – 10:30	Keynote lecture	• Dr. ChunJaekyong • Prof. Shozo Shibata	Event hall
10:30 – 11:00	Coffee break		
11:00 – 12:00	Keynote lecture	• Dr. Je Jong Geel • Prof. Norbert Müller	Event hall
12:00 – 14:00	Lunch and Poster presentation Restaurant(B1), Lobby		
12:30 – 14:00	Side meeting	• ICLEE board meeting	Rm.102
14:00 – 15:30	Oral session	• Research agenda on urban biodiversity, ecosystem services and design	Rm.101
		• The effect of mega cities on nearby suburban ecosystem	Rm.102
		• Landscape design and management practices	Rm.202
		• Flora and fauna of cities	Rm.306
15:30 – 16:00	Coffee break		
16:00 – 17:30	Oral session	• Panel discussion on the Research agenda on urban biodiversity, ecosystem services and design (with ICLEI)	Rm.101
		• Methods of investigation and monitoring on ecosystems	Rm.102
		• Human welfare as an ecosystem service	Rm.306
18:00 – 20:00	Closing remark and Farewell party		Event hall

DAY 4 (Oct. 12, Sun.)

09:00 – 18:00 Post-excursion

CBD COP12 Move to the venue of Pyeongchang CBD COP12

Biodiversity Summit for Cities & Subnational Governments 2014 (Oct. 12 to 14)

- URBIO report, LAB-Korea, Pyeongchang / Gangwon Declaration (Oct. 13)

Topics of URBIO 2014

The main theme of URBIO 2014 will be "Cities and Water: Conservation, Restoration and Biodiversity." Water is the key resource for the survival and habitats of species. However, our cities have put water ecosystems under severe development pressure, which now requires profound academic study toward the enhancement of biodiversity and managing our urban water bodies. Our discussion will include the following 3 sub-themes including 12 sessions with other proposed parallel sessions.

Ⅰ. *Blue and green infrastructure for resilient cities*

Ⅰ- 1 Water,greeninfrastructure, and ecosystem services
Ⅰ- 2 The environmental drivers of urban resilience
Ⅰ- 3 Flora and fauna of cities
Ⅰ- 4 Human welfare as an ecosystem service

Ⅱ. *Landscape design and restoration*

Ⅱ- 1 Urban wetlands for smart adaptation to climate change
Ⅱ- 2 Urban stream restoration
Ⅱ- 3 Landscape design and management practices for urban biodiversity

Ⅲ. *Participation and collaboration*

Ⅲ- 1 Participationandcollaborativeworkforurbanbiodiversity
Ⅲ- 2 Businessandthe urban environment
Ⅲ- 3 Policy and law for urban biodiversity
Ⅲ- 4 Research agenda on urban biodiversity, ecosystem services and design
Ⅲ- 5 Panel discussion on the Research agenda on urban biodiversity, ecosystem services and design

Ⅳ. *Evaluation and monitoring*

Ⅳ- 1 Evaluation of biodiversity in historical cities
Ⅳ- 2 The urban biodiversity research coordination network
Ⅳ- 3 The effect of mega cities on nearby suburban ecosystem
Ⅳ- 4 Methods of investigation and monitoring on ecosystems

5. SESSIONS

Presentation Identifiers

Example :	10	-	OR	2.1	-	01
Meaning:	Day	Separator	Presentation Type	Session ID	Separator	Sequence

Day

09·····October 9, Thursday
10·····October10, Friday
11·····October 11, Saturday

Presentation Type

PL·····Keynote lecture in thePlenary Session
OR·····Oral presentation
PO·····Poster presentation

Session ID and Oral session schedules

Category	Session ID	Session Title	Date	Time Block	Room	Chairs	
Ⅰ. Blue and green infrastructure for resilient cities	1.1	Water, green infrastructure, and ecosystem services	Oct 10 (Fri.)	14:00-15:30	306	Maria Ignatieva	Dong Yeob Kim
	1.2	The environmental drivers of urban resilience	Oct 10 (Fri.)	16:00-17:30	306	Glenn Stewart	Mahito Kamada
	1.3	Flora and fauna of cities	Oct 11 (Sat.)	14:00-15:30	306	Charles Nilon	Peter Werner
	1.4	Human welfare as an ecosystem service	Oct 11 (Sat.)	16:00-17:30	306	Haripriya Gundimeda	Choong-hyeon Oh
Ⅱ. Landscape design and restoration	2.1	Urban wetlands for smart adaptation to climate change	Oct 10 (Fri.)	14:00-15:30	202	Yukihiro Morimoto	Bonhak Koo
	2.2	Urban stream restoration	Oct 10 (Fri.)	16:00-17:30	202	Takashi Asaeda	Chan-Woo Byeon
	2.3	Landscape design and management practices	Oct 11 (Sat.)	14:00-15:30	202	Mark Hostetler	Chun-Yen Chang
Ⅲ. Participation and collaboration	3.1	Participation and collaborative work for urban biodiversity	Oct 10 (Fri.)	14:00-15:30	101	Keitaro Ito	Mahito Kamada
	3.2	Business and the urban environment	Oct 10 (Fri.)	16:00-17:30	101	Nicholas Williams	Seok-Ki Moon
	3.3	Policy and law for urban biodiversity	Oct 09 (Thu.)	15:30-17:30	101	Steven Handel	Sang-Ryul Shim
	3.4	Research agenda on urban biodiversity, ecosystem services and design	Oct 11 (Sat.)	14:00-15:30	101	Norbert Müller	Shela Patrickson
	3.5	Panel discussion on the Research agenda on urban biodiversity, ecosystem services and design	Oct 11 (Sat.)	16:00-17:30	101	David Maddox	Norbert Müller
Ⅳ. Evaluation and monitoring	4.1	Evaluation of biodiversity in historical cities	Oct 10 (Fri.)	16:00-17:30	102	Shozo Shibata	Yoshihiko Iida
	4.2	The Urban Biodiversity Research Coordination Network	Oct 09 (Thu.)	15:30-17:30	102	Charles H. Nilon	Myla F.J. Aronson
	4.3	The effect of mega cities on nearby suburban ecosystem	Oct 11 (Sat.)	14:00-15:30	102	Meehye Lee	Hyun Seok Kim
	4.4	Methods of investigation and monitoring on ecosystems	Oct 11 (Sat.)	16:00-17:30	102	Pierre Jutras	Junichi Imanishi

5. SESSIONS

Category	Session ID	Session Title	Date	Time Block	Room	Chairs	
Invited Session	V.1	Eco-Innovation technology for climate change adaptation (in Korean with English translation)	Oct 09 (Thu.)	15:30-17:30	202	Namchoon Kim	
	V.2	KOSERT (in Korean)	Oct 10 (Fri.)	14:00-15:30	102	Sangjun Im	Dongok Im
	V.3(1)	Urban biodiversity forum organized by MOE / part 1 (in Korean)	Oct 10 (Fri.)	14:00-15:30	307	Wooshin Lee	
	V.3(2)	Urban biodiversity forum organized by MOE / part 2 (in Korean)	Oct 10 (Fri.)	16:00-17:30	307	Namchoon Kim	

6. ORAL AND POSTER PRESENTATIONS

Oct 09 (Thu.)

Keynote lecture 13:00-14:30

Event Hall

Oral presentation 15:30-17:30

Rm.101 — 3.3 Policy and law for urban biodiversity

Rm.102 — 4.2 The Urban Biodiversity Research Coordination Network

Rm.202 — V.1 Eco-Innovation technology for climate change adaptation (in Korean with English translation)

Poster presentation 13:00-18:00 (Core time : 14:30-15:30)

Session Hall Lobby

Oct 10 (Fri.)

Keynote lecture 10:00-12:00

Event Hall

Oral presentation 14:00-15:30

Rm.306 ——— 1.1 Water, green infrastructure, and ecosystem services

Oral presentation 16:00-17:30

Poster presentation 10:00-18:00 (Core time : 13:00-14:00)

Event Hall Lobby

Oct 11 (Sat.)

Keynote lecture 09:30-12:00

Event Hall

Oral presentation 14:00-15:30

Rm.306 — **1.3 Flora and fauna of cities**

Oral presentation 16:00-17:30

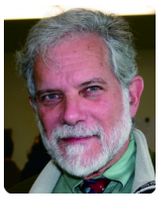
Poster presentation 10:00-18:00 (Core time : 13:00-14:00)

Event Hall Lobby

Keynote Lectures

- *Towards a Research Agenda on Urban Biodiversity, Ecosystem Services and Design*
  - **Prof. Norbert Müller** 81p URBIO President, Department of Landscape Management and Restoration Ecology, University of AppliedSciencesErfurt, Germany

- *Restoring Urban Waterfronts to Increase Ecological Services: a Rising Tide*
  - **Prof. Steven Handel** 29p Director, Center for Urban Restoration Ecology, Rutgers University, USA

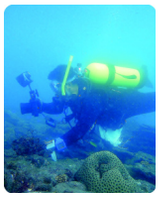


- *Urban Waters; Ecosystem Services, Design and People's Perception*
  - **Prof. Jürgen Breuste** 47p President of the Society for Urban Ecology (SURE), Paris-Lodron University Salzburg, Austria

- *Respect of the Urban Green and the Techniques to Connect Green*
  - **Prof. Shozo Shibata** 77p President of the Japanese Society of Revegetation Technology, Kyoto University, Japan

- *The Power of Doing: The Case for Creating Local Examples of Green Practices in Cities*
  - **Prof. Mark Hostetler** 63p Department of Wildlife Ecology & Conservation, University of Florida, USA

- *Always Keep a Window in Life*
  - **Dr. Tang Hsien Po** 33p Community-based landscape planner, Director of Tarzan Natural Education Society, Taiwan



- *Restoration of Urban Waterways as a Green Infra*
  - **Dr. Woo Hyoseop** 57p Korean Society of Ecology and Infrastructure Engineering, Korea(Former President of Korea Institute of Civil Engineering and Building Technology)

- *Green Buildings for Sustainable Urban Environment*
  - **Prof. Lee Eun Heui** 37p Dept. of Horticultural Science and Landscape Architecture Seoul Women's University, Korea(Former President of Korea Green Roof & Infrastructure Association)

Keynote Lectures

- *Building Urban Biodiversity for Local Economy*
  - **Dr. Je Jong Geel** Mayor of Ansan, City and Nature Institute, Korea (Chair of Korea Protected Area Forum and Ecotourism Korea, Member of the 17th National Assembly)

- *Urban Biodiversity in the Environmental Law System*
  - **Dr. Chun Jaekyong** 67p CEO of National Nature Trust (in Korea), CEO of Social Capital Institute, Adjunct Professor of Seoul National University, Korea

Keynote Abstract

09-PL-01

Restoring urban waterfronts to increase ecological services: a rising tide

Steven N. Handel

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The value of urban waterfronts

A modern understanding of the value urban waterfronts includes much more than a listing of industries which can be sitedalong river edges and marine ports. The new interest in ecological services is exploring the many valuable ways in which habitats nearwaterfronts can advance the health and sustainability of our cities for residents. There are regulating ecological services by which waterfront habitats improve the quality of life. Air quality can be improved as trees and other vegetation trap noxious chemicals and other pollutants that are generated in the city. Riverine habitats can clean storm water before it entersocean habitats, lessening the need for expensive infrastructure. During storms, waterfront habitats can absorb storm surges and protect adjacent commercial and residential zones from damage. These habitats can also bind and improve soils, slowing siltation and degradation of waterways. Even small scale urban habitats along rivers serve as habitats for migratory wildlife and became links in the landscape ecology of a region.

There are also cultural services that waterfront habitats give our citizens, and these have gotten much attention in the past. As venues for exercise, community interactions, artistic inspiration, and a sense of place, waterfronts help define our cities' personality in important ways and add to the joy of everyday life. In a modern world, quiet habitats along waterways are also a place to improve mental health, lessening tension and stress while allowing people to have a place for reflection and spiritual experiences.

In these several ways, consideration of an ecological structure and complexity near our waterways adds value to urban living, and can even decrease the amount of tax money needed to make our cities function as civic spaces. Recognizing and teaching the real value that ecological design can add to waterfronts is part of a complete discussion of urban planning at a time when cities worldwide are rapidly growing. Most humans live in cities today and the percentage is growing rapidly. How can we make new cities and growing older cities more sustainable?

Ecological character of urban waterfronts

Urban waterfronts almost always have a long history of past land-uses which have degraded their ecological character. New uses along old waterfronts do not rest on pristine lands or national parks. We must recognize the difficult role that an ecological designer has to add back value for our urban citizens. Waterfronts often have poor soil with chemical and physical damage from past industrial use. Hydrocarbons or heavy metals along the waterfronts are remnants from the industrial past. Even when commercial shipping and industrial uses are gone, the soil holds sad memories of ecological misuse. Many waterfront areas are also very small parcels, not connected to expansive areas which can support many of our plant and animal species. Planning for ecologically healthy waterfronts must consider the roles of scale and geometry in constraining an ecologically improved future. Cities are also relatively hot, caused by pavement and enormous energy emissions, which make citiesseveral degrees warmer than the surrounding countryside. This too strains the kind of species that can be introduced into our urban waterfronts and their ability to reproduce and persist. In a time of rapid climate change around the world, this heat island effect will be magnified.

There are also biotic problems in urban waterfronts that are challenging to ecological planners. Of course cities have lost native species as people have used the land for many decades. The loss of species has changed trophic interactions and life history dynamics. Similarly, many species of plants require animal interventions

in their lifecycle. For example, pollinators are needed to make seeds and vertebrates often are needed to move seeds about the landscape. These links have lessened and weakened in crowded cities. These changes limit the ecological introductions that we can successfully make to improve urban environments. Cities are also the center of introduction for many invasive plants and insects which move in from other continents. These invasive species can overwhelm many habitats, lessening biodiversity. This too can challenge the sustainability of our urban waterfront parks, meaning that more management and more public funds are needed to keep these areas healthy and useful.

Although these many problems are real and have been studied throughout the world, there are ways where low value waterfronts can be improved to add back the ecological services upon which we all depend. There are a series of case studies which our laboratory has contributed to which illustrate ways that ecological thinking can improve water resources and waterfront habitats for urban dwellers.

Restoring a derelict commercial zone

Along the East River in Brooklyn, New York City, an old commercial zone had become abandoned because it was too small to be commercially viable in an age of container ships and bulk cargoes. The local government has created an ecologically themed Brooklyn Bridge Park on this thin, 2 km long waterfront in my nation's largest city (see www.brooklynbridgepark.org). Here, many habitat types were introduced to advance sustainability. Small zones of vegetation vary from salt marsh grasses to coastal, salt tolerant shrubs and trees, to varied planting areas which rely on fresh water. Threaded through these ecological zones are many public amenities, including sports, education, and artistic spaces. Brooklyn Bridge Park is quickly become incredibly popular with over 100,000 people using it in a typical summer week. The park has introduced New York City residents to their waterfront history and the reality that the city's financial and cultural riches rest on New York's character as a great port. After the 300 years that this waterfront was only a commercial zone, with these cultural, ecological, and educational features, new civic values have taken their place and added a new destination for residents and tourists alike.

Restoring a landfill using ecological links

Almost all cities have landfills where over decades, tons of garbage have been dumped, the repositories of the waste of our frantic urban lives. Often, these landfills are near waterways as those lands were considered less suitable for residential or business areas: too muggy; too impacted by storms; too unstable; too full of mosquitoes and other biting insects. With the closure of the old landfills, we have new opportunities to use these ugly open spaces to improve urban life. At the Fresh Kills landfill in New York City, the largest landfill in the Americas, about 1000 ha are being redesigned into a vast public park. The structure of this new FreshkillsPark will include many habitat types from woodlands to meadows to salt marsh(see www.nycgovparks.org/park-features/freshkills-park). Even though the soil layer above the cap is thin, 0.5 – 1.0 m, studies have shown that this is adequate to support much sustainable vegetation.However, the site is too large to be formally planted like a garden with tens of thousands of plants in precise locations. Rather, the park designers are using ecological principles to re-create a useful, long-lasting habitat complex at relatively low cost. Experimental studies by our lab have shown that birds, even in my nation's largest city, can still play an important role in introducing thousands of seeds of many species to this degraded site. This process of seed dispersal and population initiation is playing a major role in transforming this waste site into an interesting and useful public space that introduces new ecological services on once derelict land.

New challenges during climate change: a rising tide demands new solutions

Past degradation of urban waterfronts is almost universal. However, new stresses are now appearing worldwide, driven by rapid climate change and the direct consequence of rising sea levels. So many commercial and residential zones are near our waterways. They are all being challenged by the higher ocean levels and more frequent storm surges. Almost every study by climate scientists is showing that this threat is quickening. All coastal cities must rapidly develop plans to maintain their viability, and improve the quality of life for the millions of people in our coastal cities. New approaches are needed to parry climate change threats with useful public spaces using the charm and functioning of the best urban designs. Recently, the federal government of the United States conducted a design competition to directly deal with this problem. The "Rebuild By Design"

program (see www.rebuildbydesign. org)meshed ecologists with architects, landscape architects, planners, and engineers to change how waterfront construction can be modified to address new coastal problems. Innovative solutions were sought for bothsmall coastal communities and major coastal metropolises. These design ideas can be models for how other waterfront areas may mesh economic and social viability with ecological health in our changing world.

A Habitat Engine for securing marine resources

Along the Atlantic Ocean coast in the State of New Jersey, billions of dollars of property were lost when Hurricane Sandy swept through this region in 2012. Many small, poor coastal communities were devastated. The ocean is expected to rise at least 1 m in the next 50 years here, and with increasing storm frequency. These towns face a frightening future. One scheme that has been developed is to create new areas to where marine natural resources can migrate as the ocean rises (see www.rebuildby design.org/teams/sasaki-rutgers-arup/). With sea level rise, we will lose our coastal salt marshes which are habitats for marine fisheries, shorebirds, and invertebrates as these plant communities are inundated. By carving out new habitat areas for the future, at slightly higher elevations than are present today, we can make space for saltwater to rise, migrate inland, and re-create these critical habitats. Soil that is removed for the creation of these new coastal zones can be used to create higher berms around existing human communities to shield them from storm surges. We call this approach the Habitat Engine, in the sense that the new areas for future marine natural resources can pull in plant and animal species that need saltwater, just as an engine pulls cars on a train full of ecological supplies. These new areas are also Habitat Engines in the community sense, as they can bring in social and commercial value when currently existing coastal areas are lost under the sea. By mapping appropriate locations where migration of habitats is possible and then creating restoration zones adjacent to areas which most probably will be underwater this century, we can ensure that coastal community life persists.

A "Big U" for the people and industry of Manhattan

In our biggest cities, they can be little movement of habitats or people away from the current heavily used edge. Cities such as New York, Tokyo, and Seoul have so much invested in the current landscape infrastructure that no one wants to move away from the edge. What can be done to secure the most valuable coastal property from the reality of future sea level rise and increased storm intensity? For Manhattan, a series of remedies have been proposed, which are called the Big U. This design, led by the Danish architectural firm BIG (see www.big.dk), takes the vulnerable existing waterfront roadways and walkways and transforms them into more valuable and safer civic spaces with a strong ecological expression (see www.rebuildbydesign.org/teams/big-team/). Meshed with the new uses are also a clever series of protections to stop saltwater from devastating lower Manhattan. Losses here during the 2012 hurricane blacked out lower Manhattan and caused enormous social and financial loss. The new scheme combines storm protection with social amenities and ecological structures to give a triple improvement to land which will not be abandoned by the city government. We have added bioswales to control and clean storm water, coastal meadows and shrublands, bird and butterfly habitats, intertidal habitat interventions, and urban agriculture areas to complement traditional playgrounds, sports fields, and meeting places. These are all imbedded in a high vegetated berm that protects the inland buildings or by moveable gates which descend from elevated roadways when there are storm warnings. New land for nature and culture is created while public safety is advanced. People will be able to interact more intimately and safely with the New York harboredge.

These new ideas will improve and protect our urban waterfronts in the future. People can learn that ecological zones are not simply something to be enjoyed on a holiday in a national park, but can be something to improve our daily urban life, where we live and work. The idea that stewardship of our resources is part of citizenship can be advanced in our city centers to give us a better economic future and a more enjoyable, healthier civic life as our world becomes more urban.

09-PL-02

Always Keep a Window in Life.

TANG, Hsien Po

Director of Tarzan Natural Education Society, Taiwan

Abstract

A story from 1981, A New Doctor went to MingSeng Community in Taipei city and promote greening. "Green Little Genii"(綠色小精靈) was established for kids to love green plants and take care of them in the beginning. Play in this group was very important, so we developed "community green detective", "Green Treasure Map", "Plant ID" and so on. We found kids love this kind of activity, even though the games always happened at the community park. That was a window for them to see the place they live in different way. This group kept 12 years, from parks to generally school, the guide of activity was from student of university to the kid's present.

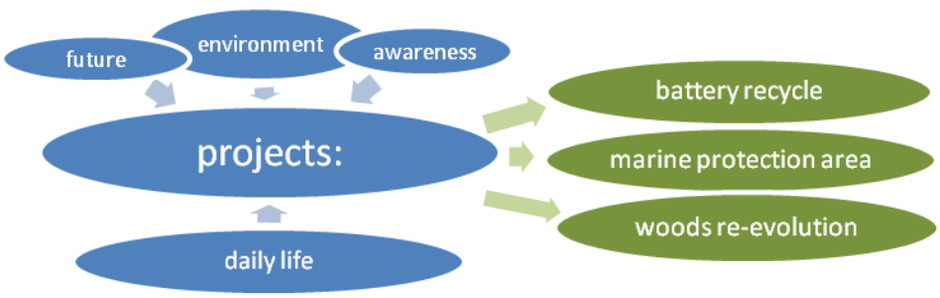


In 2003, we leaded 23 kids to WuLai Mountain area in Northern Taiwan for 21 days Camps, Called "Little Tarzan"(小泰山). This camp, in 2004, extended to 29 days and 30 kids, and 36 kids in 2005. Because we let kids play all the things happen in real world, but no such standard, as wash clothes, kids can try every kind of method to clean them and wear them, No matter they were real clean or not. And there were lots of "Work Stations"(工作站). Kids choice several ones to do, and they love it. That was a window for them to live in different way.


In 2007, we went to Penghu Islands, and stayed at the southern island alled QiMei(七美), Stared to connect the Marine Fishing Village, a life with nature time table. The great difference between WuLai and QiMei is not environment but people who real live at the place. At WuLai, there is no neighbor, But at QiMei, we live in a Abalone culture zone, we had run our life with others in this island. We participated the cultural activity and learned the local things, tried to get the life knowledge, about whether, farm, fishing and history. That also pushed our kids go in the community then A dialogue between life was happened, the window of life was created.

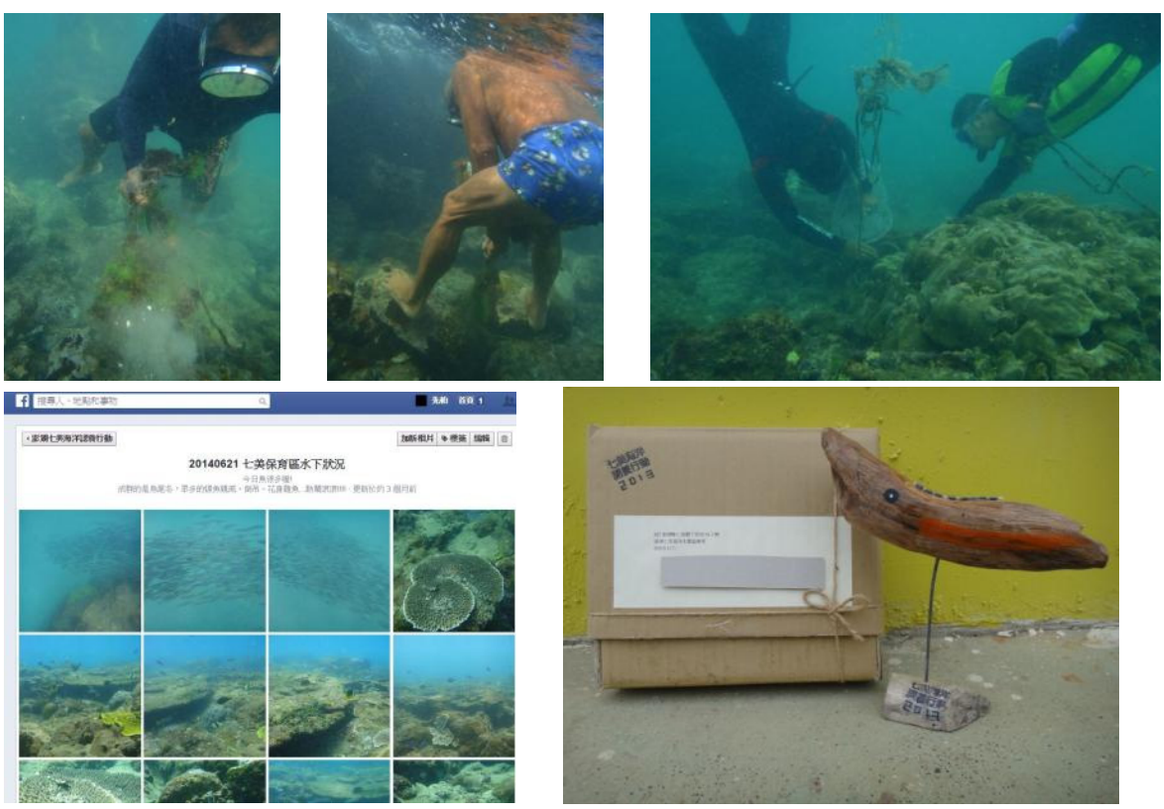
Through 5 years participation, we began connecting the community in Taipei and at QiMei with issues of life, such as marine protection(jobs) and sea food demand(money offer), seedling nursery(jobs) and working travel or company donation(money offer). We call these projects **Life Window**. Through them, the communication between life can really go on.

The icon of Qimei project is based on restudying the daily life on the island. If we could do something on this island, It should got three point: good for future life, good for environment, and enhance the Community Awareness.



The Battery recycle project, called "QiMei FishMen"(七美海男人), was started from a celebration dinner for we got the first prize of "LET'S COLOR, TAIWAN". There was a neighbor who also owed a fishing boat, and he told us, the "D" size batteries were used in a very large quantity and with discretion, they throw these batteries to water. He fear these batteries will pollute the ocean. Then all of participant of the game were agree to use half of the prize to promote recycle project.

The Marine protection area project, called "QiMei Marine Adoption"(七美海洋認養), was initiated at a chat with several elder fishermen, who caught fish in the same area, west side of Island. they talked about the amount of fish was less and less year by year and the price of some fish was cheaper in Qimei than the other bigger city. We asked the community in city, and there were 38 and 42 persons participating in the first and following year. and there are 24 persons join this program two years.



Keynote Abstract

The Woods Re-evolution project, called "QiMei Ecological planting"(七美生態植栽), was begun earlier this year. When we found lots of trees die every winter, we try to figure out what's going on. even though we could not precisely point the reasons, but Nature showed us a process, evolution. We contact a foundation belonging to a computer company, and prepare this program for at least 10 years.

From a community greener to a landscape architect, to a teacher, to a community issue promoter, living in community to be one of them, through the tea time chat, dinner party, and observation, connecting any possibility is what i doing now. It let the two people in different communities meet through the **Life Window** program. It let fish purchase not just buying but supporting fishermen protect the ocean. It let trees planting not just labor work but ecological process. More expectance will be happen when we let these WINDOWs open.

09-PL-03

Green Buildings for Sustainable Urban Environment

Lee, Eun-Heui

Professor, Department of Horticulture, Life Science and Landscape architecture of Seoul Women's University,

1. Introduction

Since the Earth Summit of 1992 in Rio de Janeiro the term “sustainable development” became of central interest even though the concept of sustainable developmentgoes back to the energy crisis and environmental pollution concerns of the 1960s and 1970s. Most nations seem to be in agreement for protecting the integrity of the global environmental and developmental systems. Especially in urban areas, it is important to recognize the integral and interdependent nature of the earth; however, the situation in urban areas is always conflicted between natural and built up areas. In this coherence, the green buildings, especially with green roofs, could be a compromise in the conflict between development and the protection of nature.

In this speech green roofs will be introducedas one of the component factors of green buildings. In the climate change period, green roofs contribute not only to reduce greenhouse gases but also to increase in green areas, the construction of which has steadily decreased. The green roofs can partially substitute real green areas on the ground, but they also contribute to the effects of green areas such as absorbing rainwater, creating a habitat for wildlife and micro climate, increasing amenity by providing a more aesthetically improved townscape and roofs landscape, and mitigate the heat island effect with lower air temperature.

2. Green roof system and effects of green roofs in urban areas

Rapid industrialization and urbanization have brought about serious ecological problems. Above all, is the ongoing reduction in green spaces and increase in non-porous surfaces in urban areas modified from the natural hydrological cycle. These problems caused such conditions as heat island effects, urban desertification and urban floods, in addition to others. Since environmental problems are becoming more and more serious, there are some new efforts to limit paving and to improve the urban environment by changing dead asphalt and concrete for live surfaces; for example, permeable paving, infiltration and green roofs. The green roofs will help manage surface water, provide for wildlife and provide for recreation for human beings, etc. In Seoul, flat roofs, present in 70% of built up areas, approximately 36% of flat roof areas (55km^2) are assumed as a potential area for green roofs. In other words, such rooftop areas can be transformed into rain water reservoirs and parks.

2.1. Green roofs system

Green roofs are divided into three different types, depending on use, maintenance and construction as follows: intensive greening system, simple intensive greening system or compound system, and extensive greening system(FLL e.V., 2002)

a) Extensive green roofs in Dongdaemum design plaza (left) and Seoul Women’s University (right)

b) Intensive green roofs in Shinsaegae (left) and Lotte department store in Busan (right)

Figure1. Pictures of different types of green roofs

Table1. Comparison of different types of green roofs system

Type	Contents	Extensive system	Simple intensive system	Intensive system
Maintenance	Low maintenance	●	○	
	Maintenance		●	●
Target of Application	New building	●	●	●
	Existing building	●	○	○
Depth of Soil	Below 20 cm	●		
	Over 20 cm		●	●
Planting	Grass		○	●
	Sedum	●	●	●
	Ground covering plant	●	●	●
	Shrub, Bush		●	●
	Tall tree		○	●

The intensive green roof system, with a deep depth of soil, can support a wider variety of plants but requires more maintenance and expense. In extensive roofs, which are shallow, lighter than intensive green roofs, and require minimal maintenance, dry resident vegetation has been imported.

2.2. Effects on the storm water circulation

Approximately two-thirds of rainfall is kept in the soil, rivers, and plants before its eventual evaporation. This temporary storage of water has a significant influence on local and global climate changes. Due to increasing ground pavement with non-filterable materials, soil surfaces have been disappearing, which have, in turn, disturbed the natural water circulation function and caused ecological problems in urban areas, such as urban flooding. An extensive roof planting system was proposed as a solution to this problem. Green roofs store rainwater in the plants and growing media and allow for evaporation of water into the atmosphere. The amount of water that is stored on green roofs and the evaporate is dependent on the growing medium, its depth and the type of plants used.

Green roofs reduce the amount of storm water runoff and also delay the time at which runoff occurs, resulting in decreased stress on sewer systems at peak flow periods(table2, figure2).

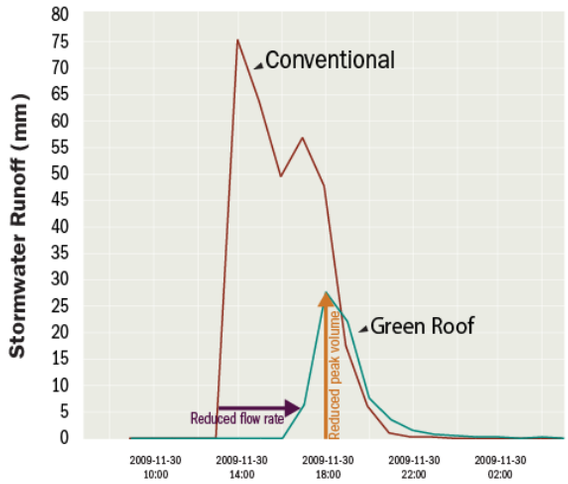


Figure2. Storm water runoff in compare with conventional and green roofs (Source, Eileen Zerba, 2010 in http://princeton.edu/reports/2010)

Table2. Runoff coefficient by surface materials

Type of surface material	Runoff coefficient
Roof of slope over a 15°	1
Roof of slope below a 15°	0.8
Green roof	0.3
Paving with asphalt	0.85～0.9
Park, natural ground	0～0.1

2.3. Improvement of Biodiversity

Green roofs with special vegetation improve habitats forfaunaand flora. For example, the dry biotope is the smallest portion of all in Seoul, because it contains suitable sites for residential housing or other uses. Improving biodiversity can be help with providing special sites and vegetation. For example, the endangered butterfly -Parnassius bremeri-disappeared because of lost dry biotope with some species of sedums. Therefore the enlargement of green roofs areas can also contribute to creating different types of a landscape and biodiversity.

The number of species of spiders and beetles on green roofs in Basel, with structured and unstructured design, surveyed over a three-year period increased (Stephan Brenneisen, 2006). In addition 60% of the roof tops covered in green roofs had more species of spiders and beetles, as well as endangered insects, etc.It means green roofs could contribute to improve biodiversity.

2.4. Greenhouse gases' reduction

Greenhouse gases are produced mainly through the combustion of fossil fuels and the various economic activities of humans. The amount of CO_2 in the air has increased significantly since the industrial revolution. This increase is considered one of the most important causes of global warming. Green roofs help to reduce CO_2 in the air, and subsequently global warming. Photosynthesis in plants removes CO_2 from the atmosphere and stores carbon in plant biomass, a process commonly referred to as terrestrial carbon sequestration. Recently, many studies have been conducted to demonstratethe positive effects of green roofs on the reduction of CO_2, which can help improve ecological functions in cities and mitigation of climate change. When some of the studies were combined, they revealed that some green roof plants, such as *Hosta longipes* and *Sedum kamtschaticum*, are more effective in reducing CO_2 in the air. The CO_2 level in these plants was measured about 100 ppm lower than the ambient CO_2 concentration.

Urban spaces are hotter during the summer than suburban and rural areas because their paved surface and

clustered buildings hold and slowly release solar radiation, which is known as the urban heat island effect. Managing this phenomenon is a matter not just of comfort but of public health. Installing green roofs and cool roofs across urban landscapes can play a significant role in reducing the urban heat island effect. Green roofs are cooler owing to evaporation/ transpiration along with the shading effects.

Table3. Reduced ambient CO_2 concentration by each plant species

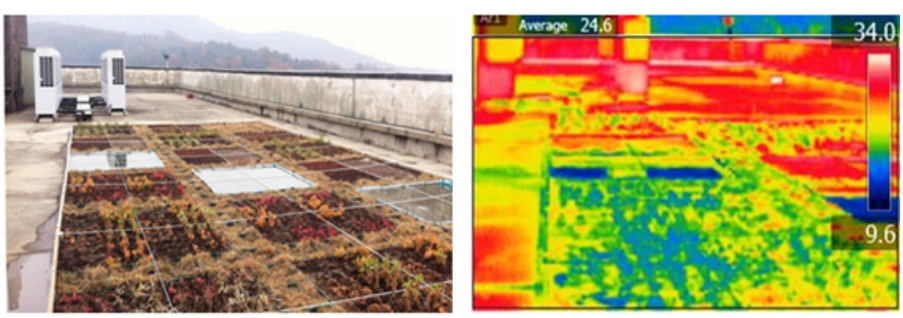
Plant	reduction(ppm)	plant	reduction(ppm)
Sedum kamtschaticum	143.7±2.8	*Saxifraga stolonifera*	71.4±3.4
Lysimachia nummularia	105.0±4.2	*Sedum sarmentosum*	96.9±2.5
Zoysia japonica	98.6±7.2	*Liriopeplatyphylla*	63.1±3.7
Hosta longipes	98.3±5.8	*Ophiopogonjaponicus*	56.1±5.8
Pachysandra terminalis	87.9±4.0	*Hedera helix*	38.1±2.6

(National Institute of Horticultural & Science, 2013; Ahn, 2010)

Consequently, roofs provide a unique opportunity to sequester carbon. If the land areas of rooftops in the metropolitan areas were covered with vegetation in some design, roofs of all urban areas would become enormous carbon sinks.

2.5. Micro-climate

The urban heat island effect has been registered in many cities in other countries. The concrete surfaces on roofs and façades and asphalted streets absorb the daily radiation. The mass of buildings and streets store this heat input. Plants could have two important effects: on the one hand, an umbrella effect; on the other hand, evaporation from the growth medium can influence the surface temperature. A comparable effect results from a cover of green plants and water, as in the followed figures.



a) The experimental site at Seoul women's university, taken June,2013
b) Green roof with a pond by Han Lilli(2012)
Figure3. Infrared photos of green roofs

3. Factors affectinggreen roofs in Korea

Green roofs are easier to implement than other programs because they just reuse the rooftops. The built up area of Seoul is 364km^2,which is 60% of the entire city of 605km^2. Within the built up areas, the roof area is 166km^2, corresponding to 36%. The potential green roof is assumed to be 55km^2. Some factors contribute to the expansion of roof greening.

3.1 "Biotope Area Factor" as one of the ecological solutions

Modern cities have many ecological problems to be solved, as stated above. Since environmental problems are more and more serious, there are some new efforts to limit paving and improve the urban environment by changing dead asphalt and concrete with live surfaces, such as permeable paving, infiltration and green roofs.

The biotope area factor is the unified planning indicator that can make full use of these techniques, such as green roofs, permeable paving, and infiltration facilities. This originated from, the "Biotope Area Factor"

(BAF) in Germany, and is a unified planning indicator comprehensively leading to improved ecological environmental functions at the three dimensional space planning level. It was fundamentally developed to resolve urban ecological problems. Its definition is the ratio of total planning area to the unpaved soil area with natural circulation functions. The Seoul Metropolitan Government applied an environment estimation indicator in the district unit planning and redevelopment project deliberation. The application of this indicator makes green roofs rev-up more, because green roofs are estimated as high as 0.5~0.6 weight rate (Table 4).

Table4. Weight by space type in Biotope Area Factor

	Space type	Weight/m²		Space type	Weight/m²
1	Greens on the natural ground	1.0	8	Paving in parts	0.5
2	Water zone(permeable)	1.0	9	Planted wall	0.4
3	Water zone(waterproof)	0.7	10	Porous Paving	0.3
4	Greens on the artificial ground 〉90㎝	0.7	11	Crevices paving	0.2
5	Green Roof 〉20㎝	0.6	12	Rain-infiltration roof	0.2
6	Greens on the artificial ground 〈90㎝	0.5	13	Paving	0.0
7	Green Roof〈20㎝	0.5			

(Source: Seoul metropolitan government, manual of biotope area factor in urban planning, 2005)

In this way, green roofs have the following potential benefits: reducing the urban heat island effect, increasing wildlife habitat in built-up areas, filtering pollutants and CO2 out of the air, reducing storm water runoff, and filtering pollutants and heavy metals out of rainwater. For the resident, there are private benefits of providing amenity space for building users, reducing heating and cooling loads on a building, increasing building life span, and the soil and plants on green roofs help to insulate buildings for sound. However, the most important point of these benefits may be the green roof capacity of water retention and runoff in the urban environment with sealed pavements.

3.2 Green Building Certification Criteria (GBCC)

In Korea the GBCC was adopted from 2002 and revised in 2013. It is divided into the eight parts including the eco- environmental part. The latter equals from 12 - 18 points from 100 points total and contents consisting of ecological functions of outdoor spaces including façades and rooftops of buildings. The Biotope Area Factor (BAF),which is a revised version of the adopted GBCC, belongs to the latter and this item is obligatory to evaluate. The artificial ground greening including green roofs is a one factor of BAF (see table 3), even though the portion of green roofs and façade greening is not so high.The government encourages various works, making the green roofs, ecological pond and façade greening, through the political support such as Green Building Certification System.

Table5. Eco-environmental part in GBCC for example apartment housing estate

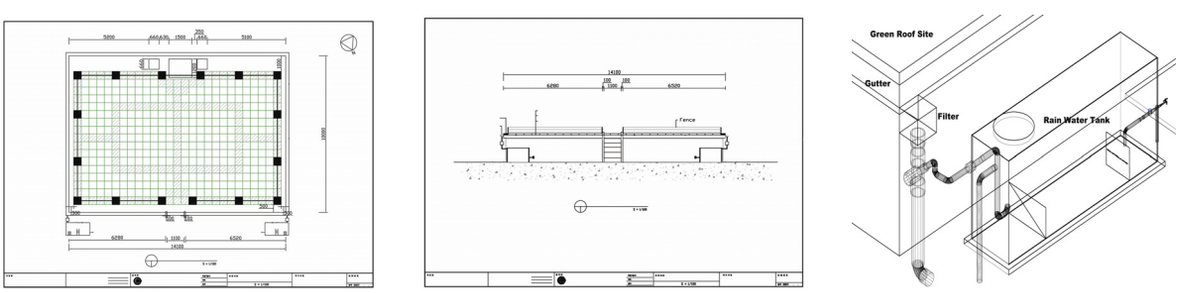
Part	Subject	Item	Evaluation	Points
Eco-environment	Creation of green areas in site	Networking of Green areas to the existing green axis	Evaluable item	**2**
		Ratio of green areas on the natural ground	Evaluable item	**2**
	Ecological functions of outdoor spaces including façade and rooftops of buildings	Biotope area factors	Obligatory item	**10**
	Creating habitat of flora and fauna	Creating biotope	Evaluable item	**4**

4. Case study of green roofs effects

4.1 Effects of retention and runoff delay of rain water

As impermeable surfaces like buildings and pavement replace open space and vegetation, green roofs can play an increasingly important role in storm water management. During rainstorms, green roofs act as a sponge, absorbing much of the water that would otherwise run off. To investigate the rain water retention capacity of existing green roofs accurately, a rain water storage system was constructed with a green roof system on the administration building at Seoul Women's University in Seoul, Korea.

The materials and methods are as follows. The green roof study was established in June 2007. The reference roof has no slope and the area is 140 m^2. This type is an extensive green roof system with 10 cm substrate depth. One hundred percent coverage was achieved in the green roof site before the data collection. Plant species used in this study included Korean native plants (*Caryopteris incana, Hemerocallis dumortieri*, etc.) and some sedum species (*Sedum kamtschaticum, Sedum sarmentosum*, etc.).



a) plan b) elevation c) tank system with filter

Figure4. The experimental site and systems at the Seoul Women's University

Figure5. Green roofs at Seoul Women's University

The rain water storage system was established with the green roof system to investigate rain water retention potential and runoff time after initial rainfall. Two tanks and an open-type gutter along the edge of the roof were installed to store rain water which passed through the substrate, and a flow meter tank was set up inside. It measured volume of rain water into substrate over time. The photo voltaic system was established to use

rainwater stored in tanks semi-permanently and water pumps were installed in each tank.

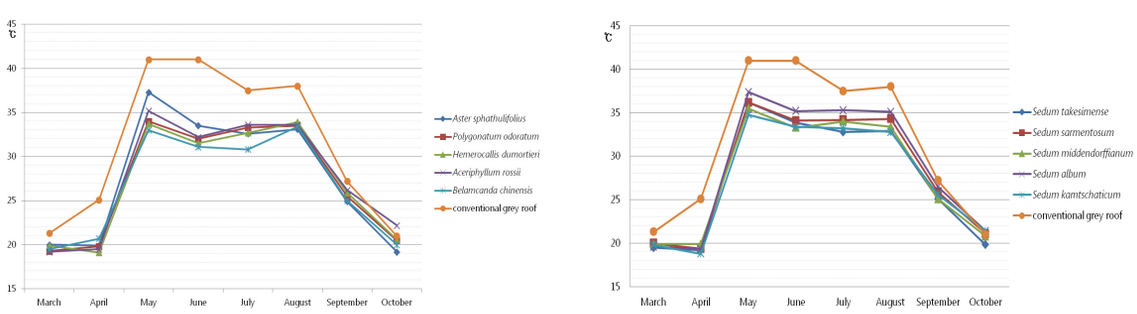
The investigated green roof effectively retained rainfall, and the mean percent rainfall retention was 87.8%, ranging from 79.4% to 99.3%. Also table6 shows that the green roof can delay the runoff by about 2 hours. Twelve rain events selected from the monitoring period are as follows:

Table6. Measured rain events and delay time of runoff on green roofs from September 2007 to August 2008

Num	Precipitation Period	Time(h)	amount of precipitation(mm)	amount of retention per ㎡ (mm)	Percentage of retention(%)	Delay time(h)
1	2007.9.1 07:00~18:30	10.5	15.89	12.7	80.0	2.3
2	2007.9.6 04:10~17:20	13.2	11.56	9.2	79.4	2.5
3	2007.9.27 05:00~07:10	2.2	4.57	4.0	87.5	0.8
4	2007.10.19 09:20~12:20	1.7	4.82	4.2	87.8	0.7
5	2007.10.25 19:10~10.26 01:50	6.7	5.75	4.9	85.8	2
6	2007.10.21 09:10~13:50	4.7	5.28	4.8	90.0	4.7
7	2008.6.28 22:30~6.29 06:20	7.8	11.61	10.2	87.8	0.7
8	2008.7.2 08:30~16:20	7.8	6.33	6.0	95.3	2.5
9	2008.7.5 15:20~17:50	2.5	2.01	2.0	99.3	2.5
10	2008.7.12 05:00~08:00	3	3.79	3.7	97.0	0.4
11	2008.7.16 01:30~17:40	7.2	10.13	8.2	81.4	2.8
12	2008.8.1 22:50~8.2 07:30	8.7	8.85	7.3	82.1	1.8
Mean		6.3	7.5	6.4	87.8	2.1

4.2 Effects of green roofs on temperature

To suggest the most effective vegetation model of green roofs for heat island mitigation, the thermal capacity of each plant was monitored and analyzed from March to August, 2013. The experimental site is on green roof of library building at Seoul Woman's University in Seoul, Korea. Photos was taken with thermo-graphic camera (Model: FLIR T 200) targeting 10 plant species that are mainly applied to green roofs. The result is as follows: From April to September, the surface temperature of plants was lower than the concrete temperature, whereas, in the cold season, October to November, it was founded that the surface temperature of plants was higher than the concrete temperature. Namely, a green roof works as a cooling layer in hot summer, and acts as an insulation layer in the winter. The surface temperature of *Belamcanda chinensis* was 31.1 ℃ and 30.8 ℃ with the lowest surface temperature measurement in June and July respectively. According to the result of another study on the thermal capacity of green roofs, the surface temperature of grass was 2.37℃ lower than that of the concrete. And the surface temperature of Sedum was 3.57℃ lower than that of the concrete in September. In the case of green walls, the surface temperature of grass was 4.78℃ lower than that of the concrete and the surface of temperature of ivy was 2.55℃ lower than that of the concrete in September. The mitigation effect of the plant evaporation/transpiration at the lower temperature was also noted in green roofs and green wall surfaces. *Aster sphathulifolius* was especially actively growing from July to September to compare the other plants (Figure8).



a) different herbaceous b) different sedum arts

Figure8. The comparison of the temperature between different plants

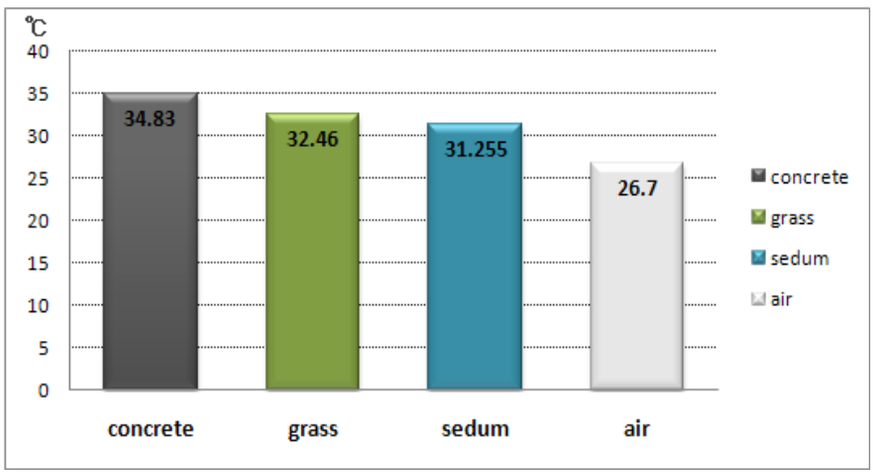


Figure9. The comparison of the temperature between different media on the rooftops

5. Conclusion

This result shows that the retention and run off delay effects of extensive green roofs can contribute to the improvement of urban water circulation. And the evaporation and oxygen-producing effect of green roofs can improve the micro-climate of urban areas. So it may be concluded that green roofs can mitigate the urban heat island effect and help with prevention of urban flooding.

Green roofs as substitutions of green areas are the best alternative plan in downtown areas like Seoul where land prices are ridiculously high. Incentives will be needed to be introduced so that citizens can participate in creating green roofs spontaneously and to increase active support about construction of such for sustainable urban environment. For example, in Seoul, flat roofs, which can be used possibly for making green roofs, constitute 70% of built up areas. In other words, in 70% of built up areas, the gray areas can be transformed into reservoirs of rain water and parks. The built urban landscape of most cities includes a huge amount of flat roof areas – more than 55km^2 in Seoul Metro City, which could, in many cases, be easily retrofitted to accommodate extensive green roof systems, which is not so dependent on the construction of existing building. Green roofs, if widely implemented, could have a significant impact on the urban heat island effect and CO_2 emission, improving the healthy urban environment.

Hereafter, studies on the impact of green roofs on the structure of existing buildings and the various administrative support and policies will be needed. In conclusion, green roofs may contribute greatly to an expansion of green areas and thus improvement of ecological functions cities.

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Urban Waters - Ecosystem Services, Restoration and People's Perception

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1 Urban Rivers and streams under pressure and in change

Town waters are (urban), flows and standing waters which is subject to characteristic influences of the towns (commercial use, flood protection, aesthetic design, pollution eutrophication etc.) (Shoemaker 1998). You show thus considerable changes compared with waters of the same type outside towns. The standing waters are natural created small body of waters, ponds, seas, but also park waters and storm water holding bank. Flowing waters are rivers, brooks, channels and drainage ditches (Gunkel 1991). They are important habitats with them marginal areas for plants and animals. (Gilbert 1989)

Changed are particularly at municipal flowing waters:

- Hydrology and hydraulics (drain donation/-dynamics, velocity of flow),
- Waters structure (breadth, run, profile, bank),
- Type spectrum of the plants and animals, abundance,
- Waters near use (e.g. leisure and relaxation use) and
- Water condition (Endlicher 2012, p. 87).

Municipal flowing waters can take over functions in the town with that:

- Habitats for flora and fauna (ecological potential),
- Town climate improvement (climatic potential),
- Industrial and commercial use (use potential),
- Photo of sewages (disposal potential),
- Embellishment of the human habitats town (relaxation and aesthetic potential.) (Endlicher 2012, S. 89) and
- Socio-cultural, economic and ecological functions (DVWK 1996).

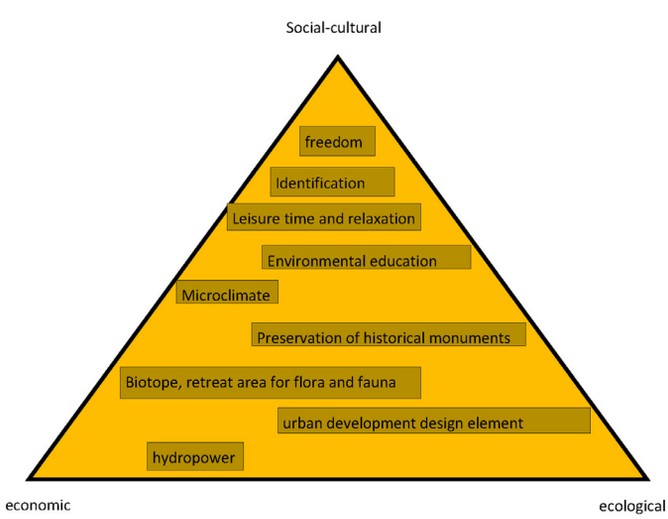

Fig. 1 Functions of municipal waters (DVWK 1996)

Table 1 shows the changes of urban waters in central European cities by anthropogenic utilization and perception. The urban rivers and streams are now most important for recreation and nature experience.

Tab. 1 Change of the functions of stretch of water and waters in Central European interior towns by anthropogenic use and perception (Kaiser 2005, S. 22)

	before 1750	1750 -1850	1850 -1915	1915 -1950	1950 -1980	starting 1980
protective function	●	•	–	–	–	–
Food, fisheries, watering	●	●	•	•	–	–
transport route	●	●	•	•	•	•
energy supplier	●	●	●	•	•	●
drinking water supply	●	●	•	●	●	●
Industrial water supply	●	●	●	●	●	●
disposal	●	●	●	●	●	●
recreational – and relaxation use	–	–	–	•	•	●
Upgrading living environment	–	–	–	–	–	●
Habitats for plants and animals	–	–	–	–	–	●

● big importance • Average importance • Lower importance – Carry no weight

The water quality is the most important indicator of the waters condition. Loads of municipal flowing waters due to substance entries are declining in Central Europe but in many other countries also in Argentina still available. Rivers are abused as sewers. There are other functions and with that the use for the residents at the rivers are disregarded with that or even destroyed. Substance entries cannot be tolerated therefore. They must be reduced and avoided at the sources (Kausch 1991).

A lowering of the oxygen salary which partly with technical means should be counteracted often occurs through the frequent discontinuation of the filter function of ecosystems in the waters sphere. A constant monitoring of the water quality is necessary to recognize and prevent loads early. A large part of the precipitation water does not come to the seepage through big municipal sealing areas. .It is brought by the sewage system or aboveground to the nearby flowing waters. This causes additional risks at high water there and lowers the ground-water level in the surroundings.

The technical control structure of the flowing waters leads to the isolation of habitats. The new urban

physical, chemical and biological conditions reduce vegetable and animal specialists in the damp area and promote ubiquity (diminution of the type spectrum this causes additional risks at high water there and lowers the ground-water level in the surroundings.

The technical control structure of the flowing waters leads to the isolation of habitats. The new urban physical, chemical and biological conditions reduce vegetable and animal specialists in the damp area and promote ubiquity (diminution of the type spectrum).

The often far advanced technical development of the flowing waters up to the sewage system for the reduction of the high water risk has destroyed many waters-related habitats in urban landscapes or impaired in her habitat functions considerably as a consequence. Particularly the river meadows in urban rooms as natural retention space hardly fulfill her ecological functions by river straightening and bank reinforcements and by groundwater lowering. The disturbance marked habitats meadow has often disappeared largely (Schuhmacher u. Thiesmeier 1991, Schuhmacher 1998)

2 How can people benefit from urban ecosystems – in particular from urban waters?

Ecosystem Services include all functions and processes of ecosystems people and society benefit from in economic terms or for their quality of life (Costanza et al. 1997; DeGroot et al. 2002). These ecosystem services are also provided in urban areas and cities and can be defined there as urban ecosystem services (Boland and Hunhammar, 1999). Ecosystem functions humans benefits in cities from range from water and climate regulation functions over biodiversity and pollination to aesthetic and recreational services. Since the first theoretically founded reflections about ecosystem services in the 1990ies (Daily et al. 1997; Costanza et al. 1997; DeGroot et al., 2002) but at least with the publication of the Millennium Ecosystem Assessment (MEA, 2005) it became clear that people depend on nature and ecosystems, their functions and the variety of processes and fluxes. Most of them we use without associating any (economic, social) value (Norberg 1999). In particular in urban regions and cities where the majority of people is living (United Nations, 2008) nature and ecosystems are intensively used and appear to be more and more degraded and devastated. They develop into a state where no longer being able to provide any service (MEA, 2005). According to McDonald (2009) urban ecosystem services are provided at different scales within an urban landscape: at the local (e.g. temperature regulation by tree shade, water and pollutant filtration at a single soil plot or timber production in a specific tree estate), at the regional or landscape scale (recreation, climate regulation, biodiversity) and at the global level (carbon mitigation, contribution to the continental or worldwide gene pool and biodiversity as such). Urban ecosystem services are in urban landscapes provided by vegetation area (urban green) and urban waters (urban blue). The sealed and impervious surfaces (urban grey) doesn't provide ecosystem services, it reduces them (Breuste et al. 2013).

As far as the urban dwellers should profit from urban ecosystem services the services must be provided where the people live and benefit from in their urban residential surroundings.

According to the Millennium Ecosystem Assessment (2005) and Costanza et al. (1997) four categories of urban ecosystem services (Table 2) can be defined (Breuste et al. 2013):

- Provisioning services (food and timber production, water supply, the provision of genetic resources),
- Regulating services (regulation of climate extremes such as heavy rainfall and heat waves, floods and diseases, regulation of water flows, treatment and handling of waste),
- Cultural services (recreation and tourism, provision of aesthetic features, spiritual requirements) and, finally,
- Supporting services (soil formation and processes, pollination or energy, matter and nutrient fluxes).

Urban ecosystem services can be related to the partially complementary concept of urban Quality of Life (Santos and Martins 2007) which also covers the different dimensions of sustainability from an anthropocentric point of view (Schetke et al. 2010). Table 2 lists and compares both concepts of urban ecosystem services UES and quality of life following the three dimensions of sustainability (Breuste et al. 2013).

Table 2 Services and indicators of quality of life related to the dimensions of sustainability (Breuste, et al. 2013 according to Millennium Ecosystem Assessment, 2005 and Santos and Martins, 2007).

Sustainability dimension	Urban Ecosystem Service	Quality of life indicator
Ecology	Air filtration Climateregulation Noisereduction Rainwaterdrainage Watersupply Wastewatertreatment Foodproduction	Health (clean air, protection against respiratory diseases, protection against heat and cold death) Safety Drinkingwater Food
Social sphere	Landscape Recreation Culturalvalues Senseofidentity	Beauty of the environment Recreationandstressreduction Intellectualendowment Communication Placetolive
Economy	Provision of land for economic and commercial activities and housing	Accessibility Income

3 Ecological restoration of urban rivers, streams and flood plains – international experiences

Rivers and brooks in urban landscapes are last nature elements in the urban landscape with her littoral zone. A more or less natural fauna and flora can get themselves here and remain connected by the waters under each other in a corridor differently than into parks and gardens. It is prerequisite for it, though, that the flowing waters as valuable connection rooms are recognized and treated. They are not valuable only as habitats for plants and animals but also as relaxation areas for the people and as areas in which the urbanites can re-establish the contact to nature already lost long ago. Intact flowing waters in towns are part of an intact urban landscape with that and put a particularly valuable potential, virtually the network of a green infrastructure in her. Her management aiming at it concerns a variety of possible and necessary measures. The improvement on the water quality is often the prerequisite for the re-use of the flowing waters. They must be often fetched again to the surface at single ways from the underground. The status of expansion of her banks must often be built back to make her accessible for the urbanites again. The safe accessible making makes first the perception of the municipal flowing waters possible. This concerns technical and property legal regulations. If this is possible, the restoration can be striven and realized in suitable sections of the flowing waters. Be aimed it usually cannot be which corresponds to it to strive for a condition before there has been human influences. It is all about at restoration measures to determine an aim condition which has as many features as possible of natural flowing waters therefore an as close to nature as possible to form condition and for which self-design of the river create a clearance new habitats arise from it for plants and animals in the area of waters, wetland and littoral zone which should be accessible to the urbanites as relaxation and nature experience rooms.

The urbanites already early alienated from nature must largely already be tied into these measures and them acceptance for this should be won; very good design successes are then possible. This means that reservations must get because of risks (natural and social), flagged opposite "unkemptness" and unfamiliarity and a new ratio of the town-dwellers to her waters must built upthis has already worldwide been realized successfully in projects in many towns. Flowing waters have become a new, integral part of the urban habitats there. They are straps of important ecosystem services and enrich the quality of life of the town population. Projects carried out successfully show the great potentials of the urban flowing waters for a new lasting design of the town landscapes and for the improvement on the quality of life in towns.

By waters restoration the functions at least partly and into certain often only little areas having been lost shall be established again. The original state usually cannot be the reference aim. Instead a "condition close to nature" is defined newly and by at first technical measures support. The improvement on the water quality by cleaning of the started water is at first place.

The rise of the low water drain and the connection of the flood protection with restoration measures are

current challenges in the urban waters management (DVWK 2000).

Also conservation and nature development on the one hand and on the other hand relaxation use can go together to create be able to be taken at the example of urban waters as very attractive relaxation rooms in towns again together.

Examples in Europe and Latin America show strengthen for restoration of urban streams and rivers and the integration of them into the urban landscapes.

4 Restoration of river Isar in Munich (2000 – 2011)

The river Isar flood plain is an attractive recreation area for whole Munich with its islands, gravel benches, meadows, riparian forest and parks and special for the almost 200.000 people who live near to the Isar districts. Suns, crickets, cycle, go for a walk, jog, games, and sometimes is even cross-country skiing in winter are possible. Freeing endeavors, the river Isar from fastened shores in the municipal area in some sections from her corset and there already was middle of the eighties restore to its natural state. Since June 2011 the river Isar has been between Großhessloher Wehr and the German Museum in her new natural variety experienced now.

With the project of the river Isar restoration in Munich three aims were pursued:

- Better flood protection
- More room and nature proximity for the riverside
- Improvement in the leisure and relaxation function of the urban river landscape.

Within the 1980s years the reputation got louder and louder to an Isar river closer to nature with higher relaxation quality in the city.

The river Isar plan, a restoration project which was developed by citizens, associations and political committees under participation in the context of the planning since 1995, was made in 1988.

The exemplary River Isar Restoration started in Munich in February 2000. The riverbed was enlarged and the high water dykes were repaired.

Flat, partial terrace, usable bank arose.

Gravel areas and natural bank formations with relaxation possibilities and new, interesting view relations to the river are part of the project.

Sufficient water leadership and water quality support the habitats close to nature developing of fauna and flora.

The river will design his riverbed wider in the course of the time itself.

Within eleven years the River Isar Restoration Plan was carried out on a length of eight kilometers to 2011. The reached water quality of the restored river Isar in the city of Munich was unique in Europe!

The first DWA (German union for water-supply and distribution, sewage and waste e. V.) water development price for measures carried out exemplarily for the preservation, design and development close to nature of waters in the urban area went to the water management office Munich and the country capital Munich for the project River Isar Restoration Plan in 2007.

The widening of the riverbed improved the high water flow. Today, low riverside, offshore gravel banks, gravel islands and flat ramps of big stone blocks with basins between this ("dissolved soling ramps") make the river Isar a river close to nature in the city again.

The habitat variety improved by the typical of river Isar animal and plants. Nature development, town and relaxation use can go together. The costs for the project (flood protection and restorationmeasures) amounted, to approximately 35 Mio. Euros which were carried to 55% of the Federal State of Bavaria and to 45% of the city of Munich (Wasserwirtschaftsamt München 2011).

Fig. 2 The section of the restoredriver Isar in Munich. Photo: A. Voigt 2013

5 Restoration and environmental sanitation of municipal watersheds in Belo Horizonte, Brazil (The Baleares creek restoration project 2003 – 2009)

Baleares creek restoration project was part of the SWITCH Project (Sustainable Water Management Improves Tomorrow's Cities' Health), which is coordinated by UNESCO and constitutes of a 32 institutions working net leaded by the Belo Horizonte Government (PBH) and Universidad Federal de Minas Gerais (UFMG). One of the interventions conducted by PBH was the Demurs Program that aimed at the restoration and environmental sanitation of municipal watersheds. Revisiting the river's original form, in many cases, is impossible and it is most commonly drawn to small watershed areas (Brown, 2000, Wade et al. 1998) like the ones investigated in Belo Horizonte, as a recent approach of study in Brazil. The thalweg of the first reach (s. Fig. 5) was deflected because a construction of a lateral street .The new thalweg was covered by a rock structure, it gave stability to thalweg and banks and provided roughness and permeability. The banks were recomposed with grass, bushes and young trees. Additionally a sewage network was constructed. In the second reach the creek was maintained in its original position, however, it was covered by a rock structure too. The left bank was with geotextiles and bushes. Streets and sewage network were implanted too. The reach three belongs to Baleares park area where the thalweg and floodplain were maintained in natural state, and riparian vegetation was restored. In both sides of the bank full width were constructed stream bank connections. Inside the park, the riparian vegetation was restored. The fourth reach is a small tributary of Baleares creek. It was all covered by a street with sewage network. There was no eco-morphological or landscaping intervention. The last one (reach five) is headwater areas outside the Baleares park and it is closed to public visitation. The riparian vegetation was restored and the area is still permeable. In relation to the survey, 179 structured questionnaires were applied along the Baleares creek catchment and were applied in October 2008, on the post-restoration period. It could be shown how important the assessment of the stream restoration interventions in urban neighborhoods is. The monitoring of the water quality (pre-restoration, September 2003-November 2006 and post-restoration February 2008- February 2009) results revealed a significant improvement in all assessed physical and chemical parameters. The survey indicated that the results of the intervention were well accepted by the population. This gave good perspectives in relation to the deployment of similar projects in other urban watersheds of the city. However, the preference for a "sanitary avenue" is clearly visible in relation to a more natural status of the river (Macedo and Magalhães Jr 2010).

Fig. 3 Five Reaches of Baleares Creek Restoration Project, Belo Horizonte, Brazil (Macedo and Magalhães Jr 2010)

Tab. 3 Survey results of Baleares Creek Restoration Reaches, Belo Horizonte, Brazil (Macedo and Magalhães Jr. 2010)

Questions	Responses		
You have been informed about the restoration program?	Yes: 76% (132/172)	No: 24% (40/172)	
How was it informed?	Neighbors: 46% (80/172) Goverment functionary: 7% (12/172)		Media and flyers: 23% (40/172) Planning assemble: 7% (12/40)
Once informed, you were asked to planning of the restoration?	Yes: 31% (41/132)	No: 69% (91/132)	
Do you go to or want to attend the park?	Yes: 61% (106/172)	No: 29% (65/172)	
Would you rather the total cover of creek?	Yes: 50% (86/172)	No: 50% (86/172)	
Why?	Car access improve: 44% (38/86) Protect the creek of the pollution: 14% (12/86) Cover the creek: 8% (7/86) Flood Control: 4% (3/86)		Reduce sickness vectors: 19% (17/86) It more aesthetic attractive: 10% (9/86) Knew only the canalization: 8% (7/86) The park will be dangerous: 4% (3/86)
The restoration exceeded your expectations?	Yes: 78% (135/172)	No: 32% (37/172)	
Why?	Water quality improve: 55% (74/135) Reduce sickness vectors: 29% (39/135) Car access improve: 19% (26/135) Flood control: 5% (7/135)		Aesthetics improve: 49% (66/135) Create the park: 25% (34/135) Remove the slum: 14% (19/135) The restoration is finish: 3% (4/135)

6 Investigation on socio-ecological restoration of river Matanza-Riachuelo in Buenos Aires, Argentina

The Matanza is a less long river (80km), caudal (8m^3/s) and hill slope (0,35 %) that crosses over the Planicie Pampeana, a smoothly wavy landscape with fluvial modeling. Traverse the south of the metropolitan area of Buenos Aires and ends in the Río de la Plata. The contribution of numerous streams - 232 curses- receives waters above, though only three streams: Rodríguez, Morals and Cañuelas are maina basin of irregular shape of 204.768ha constitutes, with a maximum width of 40km that shelters the 12% of the Argentinian population.

The 22.14% of that area of this basin is urban, 54. 55% is rural.

Tab. 4 Land use of Riachuelo-Matanzas catchment, Buenos Aires, Argentina

Land use	Area (ha)	Area (%)
Urban	45.305	22,14
Peri-urban	18.901	9,24
Suburban	14.476	7,07
Rural	111.631	54,55
Afforestation	5.828	2,85
Bathing water	7.815	3,82
Water body	700	0,34
Total	**204.656**	**100,00**

In the superior stretch the river is not too much deep (0, 3-0,5m) and runs without bigger problems, although some canals exist to ensure the drainage. When entering to the short plain, the riverbed loses his natural feature. When entering to the short plain, the riverbed loses his natural feature. The inferior course of the river is channeled and corrected and denominates Riachuelo in his last 15 km of his exit in the Río de la Plata estuary, reaching his biggest depth there(7 m).

The river Matanza-Riachuelo is the most contaminated of Argentina and he has a long history of negative environmental impacts. Buenos Aires second city founding took place in 1580 on the banks of its exit impacting the natural landscape and water quality. Governments have implemented programs by far breath; to the same time that civil society continues lathe programs to the participation, the city control and diffusion of the environmental problematic of the basin. The contamination situation that aggravated one in the 19th century by the installation of meat factories (saladeros) in his borders goes back to colonial period. During the 20th century the predominant contamination went by production agricultural rancher in the superior course or by effluent industrial and domestic who were put its waters in the inferior and middling/half courses.

Measurements made between 1998-2001 revealed critical conditions in the contents of dissolved oxygen, high leaden values and chromo that impacted life in the river. For the contamination by effluent the joined numerous rubbish dumps opencast and illegal occupancy of his banks. Such urgent environmental situation sensitized the civil society.

The Foundation City (La Fundación Ciudad) made between 2002 and 2003 discussion forums in the three sectors of the basin calling multiple actors in searching of consensual solutions that were high in her authorities.

Although several environmental improvement attempts existed, the situation starts to improve from 2006 with the creation of the Authority of the catchmentMatanza-Riachuelo (Autoridad de Cuenca Matanza-Riachuelo, ACUMAR). His operating dynamited one in 2008, in replaced to the intimation from the Supreme Court (Corte Supreme de Justice de la Nation de Argentina) as a result of a judicial case presented in 2004 by a group of lower basin neighbors. Although punctual contamination foci persist still, generally, water quality has started to improve by decrease and control of effluents illegals. In the river banks they took measurements to extract the barrels from abandoned boats, re-localize people who lived in poor way on the brooks, completed the towpath, eliminated garbage dumps and was a plan of cleaning and afforestation implemented in some sectors. The river covers a slow but contestant path towards his recovery. Governments have implemented programs by far breath; to the same time that civil society continues lathe programs to the participation, the city control and diffusion of the environmental problematic of the basin.

In the management and special in programs of rehabilitation/restoring of space of the banks the environmental perception that has the community is useful to identify problems and discover potentialities and synergies. To worldwide level there is you are seen of which the opinions and attitudes that people has environmental quality towards the river and his brooks is related narrowly to the landscape and depends on proximity to the water courses. To long of the basin 2012-2013 brings in one

Domiciled until 1 brook km. User a poll that explored the experiences and memories associated with the river, made activities, his aesthetic value, and the perception on water quality residua, human impacts and risks.

Also asked about which possibilities of changes discerned and which could be the individual commitment in the environmental quality improvement searching.

The neighbor opinions reveal that most considers that the banks landscape is ugly (33%) or very ugly (49%) because of the water contamination and to the garbage (80 %.) , 63% considers to quality of the water as bad and a 27% as very bad basing on the color and on the perceived smell. For a 90% of the polled the river does not offer any possibilities of recreation.

More than half of the high and half basin neighbors' show have negative experiences with the bank environment because of the floods or reek, meanwhile that 57% of the residents of the lower basin do not have relation to the river. The insecurity as disturbing feature was mentioned by a 48% of lower basin people and 28% in the middle.

Around 75% parts of the upper and middle basin polled are provided to collaborate with the municipality in the cleaning, maintenance and bank environment control. This predisposition is smaller in the lower basin (59 %.)

Although the space of the bank is not used, the residents state that it could be a place where their children could play at present (66% in the upper, 75% in the lower and only 39% in the middle basin).

The close residents to the riverine edge say having a negative relation with the river because of the flood danger and the reigning environmental conditions, whereas the more moved away they show not have any relation and they complain about the insecurity, but they think that the river has certain potentiality of being used to the recreation.

The predisposition to collaborate on the cleaning, maintenance and control is bigger in the neighbors domiciled until 500 m of the brooks (84% <100 m and 76% between 100-500 m) and reduces to 51% for the most distant.The resident women until 500 m of the brooks were significantly more inclined to give help than the men.

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10-PL-02

RESTORATION OF URBAN WATERWAYS AS A GREEN INFRA

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ABSTRACT

Since the dawn of human civilization, the built environment has changed the natural environment surrounding human settlements to varying extents. Urbanization, particularly when developing regions in the world started to accelerate their urban expansion, has dramatically changed the ways that humans and nature interact, degradingthe quality of human life and biodiversity in the urban areas. This articlepresents a state-of-the-art review, in Korea, of how the degraded urban waterways have been restored, as a green infra, and thus have helpedincrease the biodiversity and improve the aesthetics of urban areas.

Ⅰ. INTRODUCTION

Green Infrastructure (or simply GI in this article) is a concept that originated in the USA in the mid-1990s that highlights the importance of the natural environment in decisions about land-use planning. It is also called the blue-green infrastructure or green-blue urban grids, and usually refers to the patchwork of natural areas that provide habitat, flood protection, and cleaner water. More specifically, USEPA (2014)refers to GI in reference to water conservation and waterways restoration, such as rainwater harvesting, bio-swales, permeable pavements, green streets and alleys, and land conservation of riparian areas and wetlands.

On the other hand, GIis more broadly defined in EU as a strategically planned network of high quality natural and semi-natural areas with other environmental features, which is designed and managed to deliver a wide range of ecosystem services and protect biodiversity in both rural and urban settings (EU Commission, 2013). Similarly, GI is defined as a network of high-quality green and blue spaces and other environmental features, including parks, open spaces, playing fields, woodlands, wetlands, grasslands, river and canal corridors allotments and private gardens (Natural England, 2014).

This article is focused on the restoration of urban waterways such as streams and rivers that have been degraded by urban settings and human activities. They may be an essential element among a variety of green infra tools to foster a better quality of urban life and improve biodiversity in urban areas. Recently, Korea has carried out various stream restoration works,particularly in densely populated urban areas, and similar projects are still being undertaken in many cities as a way of promoting a blue-green infrastructure for improving the ecological networks as well as quality of life.

This article provides some basic statistics onthe urban streams and rivers in Korea, the initiation of urban stream restoration works, and somepending issues related to the presentrestoration practice.

Ⅱ. STATISTICS OF URBAN STREAMS IN KOREA

As of 2012, thetotal length of all the streams and rivers managed by law is about 65, 000km with a stream length density of about 0.65 km/km^2. Among these, a total length of about 30,000km of mid- and large-scale rivers and streams are called “National/Regional Rivers” that are managed by the “River Act”.The remaining small-scale streams are called “Small Streams” that are managed by the “Small Stream Improvement Act”.Among the streams and rivers managed under the River Act, the length of urban streams is about 3,000km, with a stream length density of about 0.33km/km^2. Currently, more than 90% of the total population in Korea dwells in the urban areas, which indicates the importance of the urban streams as a green infra to provide a better quality of life in the urban areas.

Since the 1960's, accelerated industrialization and urbanization have greatly altered the natural river ecosystems in Korea, particularly in the urban areas. About 80% of the total lengths of the streams and rivers that need levees or other protections for flood control have been totally channelized, while the urban river basins have been fully or partially covered impermeably with houses and streets.

Ⅲ. INITIATION OF RIVER RESTORATION WORKS

Since the progress of urbanization in the 1960s,the streams and rivers in Korea have been changed in four or five distinct stages (Woo, 2010). Before then, most streams and rivers remained in their natural conditions, with few artificial structures such as dams (including irrigation weirs) and levees. During this period, the ecological functions of rivers were well preserved. A typical example of such rivers is shown in Fig. 1(a).

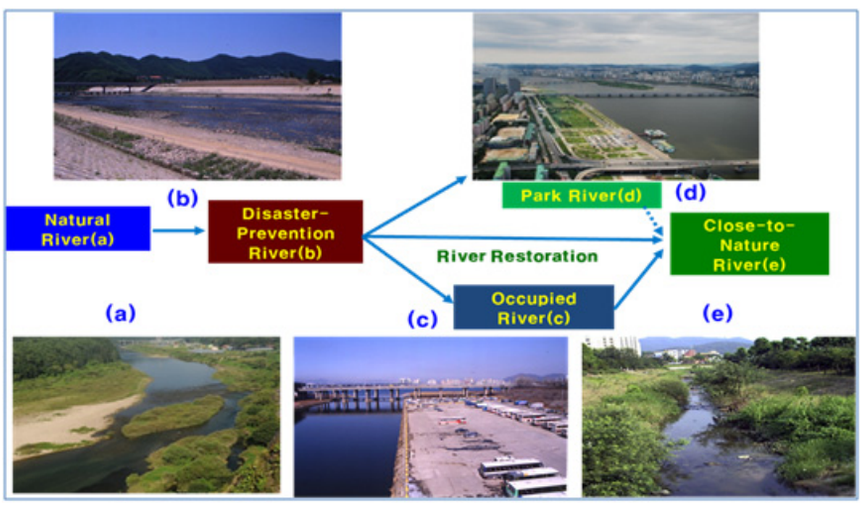

Fig. 1 Changes in river management practice in terms of channelization and restoration(Woo, 2010)

Since the mid-1960s, however, rapid urbanization, industrialization and reclamation of cultivated lands caused the overall environments of many streams and rivers to continuously deteriorate. Major causes during those years were single-purpose channel works for flood control, reclamation and the readjustment of riparian cultivated lands, i.e., so-called channelization. This type of river is called a "Disaster-prevention River" because in such rivers, flood control is considered first, while in most cases the ecological function of the river is neglected. A typical example of such rivers is shown in Fig. 2(b). As result, many rivers and streams have lost their precious natural functions including ecological habitats, self-purification of river water, and riparian scenery.

Since the 1970s, another pattern of river work practices began mostly on the urban streams; that is, to occupy the floodplains of the streams for purposes other than those belonging authentically to the streams, such as roadways, parking lots, and even covering the streams. This can be referred to as "*occupied river*" - A typical view of such streams is shown in Fig. 1(c).

In the early 1990s, the necessity of the restoration of those channelized and/or occupied rivers particularly in the urban areas emerged with a social mood of social development and environmental concern. Attention was paid in particular to the channelized urban streams with concrete-covered revetments, and clear-off corridors. City managers have converted these into pleasant-looking "river parks" for the public. Such rivers can be referred to as "*Park River*" - in which the aesthetic value of the river is restored. This trend of the conversion of channelized rivers into *Park Rivers* continues in Korea today. A typical view of such rivers is shown in Fig. 1(d), which was first made in 1986.

Stream restoration or river restoration, including the restoration of the natural functions of the rivers, had only begun in Korea in the late 1990s, initially as some demonstration projects under government-supported

research projects. Such river reach regenerated by restoration works can be called a “Close-to-nature River” as their natural functions are significantly enhanced. A typical view of such rivers is shown in Fig. 1(e).

Examples of Urban Stream RestorationWorks

The Yangaje-cheon (stream) Demonstrative Stream Restoration Project (Woo, 2010) was a part of the National R&D Project (1996-2001) funded by the Ministry of Environment (KICT/MOE, 1998). The test reaches are located in a small urban stream, the Yangjae-cheon, originating in a hilly and mountainous region, located southwest of Metropolitan Seoul, and eventually merging into the Han River. The stream had been thoroughly modified for its maximum flood conveyance in the 1970s (Fig. 1a). Fig.2b shows the same reach after topographic and vegetative restorations. More species have been found in the stream reach after restoration.

(a) Before Restoration Work (1996) (b) Three-years after Restoration Work

Fig.2A Demonstrative Stream Restoration Project(The Yangjae-cheon)

The success of this research project stimulatedthe implementation of similar projects in the urban streams nationwide from the late 1990s. They are, however, still in the *park river* stage, because they have focused mainly on improvingthe stream water quality and enhancing the riparian aesthetic value rather than on restoring the river ecosystem, which may be inevitable in such highly urbanized areas. One such case is the Cheonggye-cheon Restoration Project in Seoul, a well-known urban stream restoration project in Korea, which was completed in 2005. It is now one of the most popular tourists’ spots as well as one of the best walking and resting places for citizens in Seoul.

Fig.3 Comparative pictures before and after the Cheoggye-cheon project
(Left: a highway-decked street, right: a revived stream)
(Photoscourtesy of the Seoul Metropolitan Government)

Ⅳ. ISSUES AROUNDURBAN STREAM RESTORATION

In Korea, there are two distinct views on stream or river restoration works, sometimes collidingwith each other because of the different perspectives of groups concerned. One group, which we could call "upper perspective" group, usually includes ecologistsand environmentalists, and considers the present level of stream restoration practice in Korea being at the "*park river*" level. They sometimes look downon it as another artificial type of river works, far from restoringthe river's natural or environmental functions. On the other hand, another group, the "lowerperspective" group, usuallyincludeslocal residents and river managers, and considers restoration of river's natural functions, such as close-to-nature river in Fig. 1(e), to interfere their living environment because of the hindrance presented by the naturally-looking riparian condition to recreational activities such as walking, roller-skating, and fishing in the stream. In addition, they are afraid of the flood conveyance of the stream being reduced due to the thick vegetation grown in the channel. As such,they re-changed the re-naturalized stream reach in Fig. 2(b) to Fig. 4!

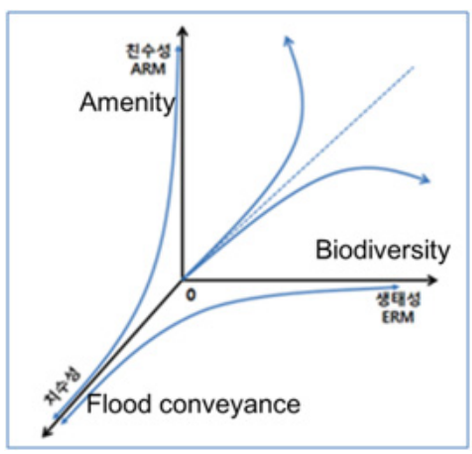

Fig. 4Re-work of a demonstrated streamrestora-Fig. 5 Relation of the three functionswork tion(Personal photo by the author, 2009)(biodiversity/amenity/flood conveyance)

These conflicting views may be attributed to the conflicting functions of streams, i.e., flood conveyance and ecological habitat expressed in biodiversity as shown in Fig. 5. In addition, a stream has aesthetic value, which is usually proportional to its capacity to provideecological habitat (biodiversity) in the beginning. The flood conveyance function, however, is usually in conflictboth with amenity and biodiversity.In most cases in Korea, urban stream restoration practices do not consider river widening because of the high land price in the urban areas. Amenity, expressed in the aesthetic value, may increase as biodiversity increases, such as in the *close-to-nature*type of stream, but their relationshipeventually becomes divergent.

In order to consider both of these two different views on the present practice of stream or river restoration in Korea, two types of river restoration models, different from but interrelated to each other, have been suggested, theAmenity Restoration Model and the Ecosystem Restoration Model(Woo and Kim, 2006). Fig. 6 shows the schematic diagram of the characteristics of the two models.

The Amenity Restoration Model (ARM) focuses mainly on the restoration of the aesthetic values of river. Here, aesthetic values mean amenity, accessibility, recreation, and historical/cultural values. It is a human-orientedmodel that results mostly in the"*park-rivers*" shown in Fig.1 (d) or Fig. 3(right). This model may be more plausible forrestoring highly urbanized watersheds and highly developed river corridors, where any efforts for ecosystem restoration may be limited due to socio-physical conditions surrounding the river.

On the other hand, the Ecosystem Restoration Model (ERM) focuses mainly on the restoration of the ecological system of a river; i.e.,the self-sustainability of the physical and ecological dynamics of a river. It is nature-oriented. This model may be more plausible for restoring sparsely urbanized watersheds and less developed river corridors. Ecosystem in the rivers restored under this concept should be self-sustained. Good examples of this model are still rare in Korea.

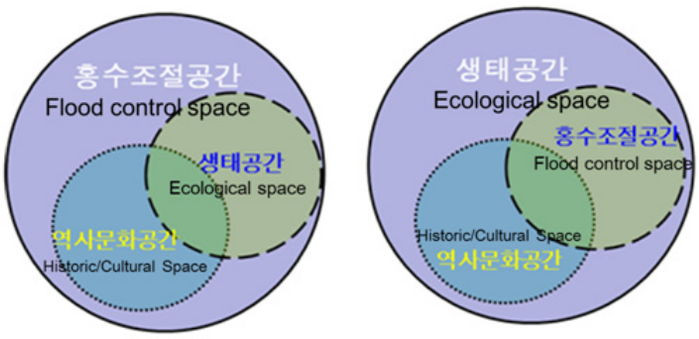

Fig. 6 Schematic diagram of ARM (left) and ERM (right)

In the design process, the allocations of river corridor space for these two models, ARM and ERM, should be different. In ARM, the space for flood control mostly encompasses spaces for ecological habitat and historical/cultural spaces (Fig. 6 left). On the other hand, in ERM the space for the ecosystem needs not be limited to within thespace for flood control. It can be larger than the space for flood control, and interconnected with neighboring terrestrial habitats (Fig. 6 right).

The reference for each model is also different. For ARM, it is usually hard to delineate the 'original' river because of a long time-span as well as urbanization and channelization. ARM, therefore, focuses naturally on the landscape architecture and sometimes the restoration of historical places. On the other hand, for ERM time-span is usually short, and a proper reference can relatively easily be obtained from the old maps, pictures and data of the relevant river.

Ⅴ. SUMMARY

The EU Commission (2013) clearly indicatesthe various benefits provided by Green Infrastructure, such as environmental, social, climate change adaption and mitigation, and biodiversity benefits. Restoration of urban waterways in particular provides with clean water, better human well-being, enhanced tourism and recreational opportunities, strengthened ecosystem resilience, improved habitats for aquatic wildlife, and ecological riparian corridors.Among these benefits, present approaches to urban stream restoration in Korea obviously enhance tourism and recreational opportunities, improve habitats for aquatic wildlife to a certain degree, and increase property values along the restored stream in many cases. However, floodingfrom the urban streams, which is one of the most critical factors in urban region management, could be rather increased with the current stream restoration practice in Korea due mostly to re-vegetation in the stream. However, this can be mitigated using typical green infra tools such as rainwater harvesting, permeable pavements, green streets and alleys, and land conservation of riparian areas and wetlands.

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10-PL-03

The Power of Doing: The Case for Creating Local Examples of Green Practices in Cities

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Mark Hostetler is a Professor, Department of Wildlife Ecology & Conservation, University of Florida. With over twenty years of experience in urban wildlife and green development issues, Hostetler conducts research and outreach on how urban landscapes could be designed and managed, from small to large scales, to conserve biodiversity. He has extensive experience in working with homeowners, developers, and policy makers on ways to manage and design residential developments for biodiversity. Hostetler co-founded University of Florida's Program for Resource Efficient Communities and collaborates with an interdisciplinary team of scientists and graduate students. Hostetler works with policy makers, developers, and homeowners to establish natural resource conservation strategies in communities that are billed as "green" developments. In particular, he conducts a national continuing education course on conserving biodiversity in subdivision development, and he has recently published a book titled, *The Green Leap: Conserving Biodiversity in Subdivision Development*.

Built environment professionals and the public are reluctant to adopt new conservation practices that benefit urban biodiversity. Conventional inertia, perceptions, economics, and policies stifle innovation, making it difficult to gain a foothold in cities and neighborhoods. Academics, environmentalists, and built environment professionals alike are adverse to promoting and trying new solutions. Academics have had successes in defining the urban biodiversity problem through monitoring the decline of plant and animal species, but we are reluctant to jump into the "real world"and push for solutions. Academics get bogged down in the nuances and "what if" scenarios. Built environment professionals, citizens, and city planners, waiting for that maverick to step forward,are unable to make that first step themselves.Fear of failure often cuts down implementation of innovative designs or management practices. People want to have the perfect solution that is tried and true, and often this entails waiting many yearswhileopportunities passby. Embracing uncertainty is not in the vernacular of most urban decision makers. How can new paths be forged? What steps are critical to foster innovation and implementation within metropolitan areas?

Over the past 10 years, I have been involved with an interdisciplinary group at the University of Florida, the Program for Resource Efficient Communities (http://www.buildgreen.ufl.edu); we partner with cities and built environment professionals to explore and implement novel urban design and management practices. We have had failures and successes, and in this talk, I will outline lessons learned and commonalities of successes that we have had. Over the years, I have become convinced that nothing speaks louder than a local example of a conservation practice that benefits urban biodiversity. Implementation could be in a yard, a neighborhood, or a public space. Built environment professionals and citizens have a chance to see, touch, and discuss a local design or management action. This pays huge dividends in terms of community acceptance for innovative practices that benefit local flora and fauna. But how can environmentalists and academics alike get the ball rolling?

Using several case studies, I will demonstrate and discuss U.S. and international examples where local initiatives have spurned new ways of doing business. Examples span the gambit of low-impact development (that address stormwater issues and biodiversity) to targeted open space conservation that balances human and wildlife needs. The devil is in the details and each example has specific solutions that are transferable to any situation around the world. For example, working with developers in Florida, we helped the developers of the Town of Harmony and Madera (http://www.wec.ufl.edu/extension/gc/) to implement novel design and management practices that had biodiversity benefits. One novel approach adopted in Harmony was the installation of a "Wildside Walk" that consisted of educational kiosks that educated residents about natural resource conservation

and how to minimize impacts stemming from the built space, keeping nearby conserved areas healthy (http://www.wec.ufl.edu/extension/gc/harmony/documents/wildsidewalk.pdf).

In addition, I think that we need to integrate ecological data into design in such a way that visual outputs will allow city planners and developers to assess different scenarios and achieve results that provide optimal biodiversity solutions. Collectively, researchers over the past 60 years (or more) have collected a good deal of data on urban biodiversity and impacts on urban plants and animals. From urban gradient studies to patch dynamic studies, we have a plethora of empirical data that suggests how various urban designs would impact various species. However, these studies have not affected actual planning decisions in most cities (there are exceptions of course).

Often, to address biodiversity, urban decision makers do not use empirical studies because they are too detailed and/or they target particular taxa (i.e., urban bird studies dominate the scientific literature). Most planners and other urban decision makers rely on broad ecological theories to shape planning. Planners can manipulate three things that affect urban biodiversity: 1) the quality, amount, and patch size of conserved open space; 2) how open space and nearby built areas are managed; and 3) the degree of open space connectivity. Currently, to guide green infrastructure conservation, planners and landscape architects use island biogeography theory (MacArthur and Wilson 1967), using species-area curves and distance to source calculations, which translates into conserving large remnant patches (Linehan et al. 1995). They also create wildlife corridors and improve landscape connectivity, which stems from meta- population theory (Keymer et al. 2000). Overall, these ecological theories translate into clustering built areas, conserving some percentage of open space, and protecting lands for corridors (Arendt 1996). While conserving some connected patches is a good step, in reality, it is much more complicated to determine which species gain and/or lose from one design versus another.

In reality, suites of flora and fauna respond differently to sizes of connected patches, nearby land use impacts, and fragmentation/edge effects. A given corridor and patch arrangement has different effects on mammals, butterflies, herpetofauna, birds and the associated vegetation community. For example, scattered patches of habitat are more connected for birds and butterflies than for mammals and herpetofauna, because the built matrix impedes the movement of ground-dwelling animals (Hourdequin 2000). Size of the animals also matters as very small species, e.g., small beetles, hummingbirds, small lizards, and mice, operate at different scales than larger animals, e.g., large butterflies, raptors, alligators, and bears. Also, edge effects impact different species within a taxonomic group; for example, specialists are more vulnerable to fragmentation than generalists (Hilty et al. 2006). People may believe that only large patches are worth conserving but even fragmented landscapes, if done correctly, are capable of benefiting a whole suite of species (Dupre and Ehrlen, 2002; Bastin and Thomas 1999). Typically, we do not have the opportunity to evaluate the impacts on different species, and we just go with general principles in urban design.

Design is important, but both the conserved areas and the landscape matrix surrounding the conserved areas must be managed appropriately. Any green infrastructure can dramatically lose its biological integrity over time due to lack of appropriate management for both built and conserved lands (Hostetler 2012). For instance, invasive plants and animals may spread into conservation areas, requiring invasive exotic control within conserved habitat. Additionally, most urban natural areas are missing certain ecological processes and need some type of habitat management; examples include prescribed burns, roller chopping, restoration through native plantings, and other activities used to improve or maintain the habitat for native plants and animals. Even day-to-day human behaviors can impact green infrastructure (Hostetler 2010; Hostetler and Drake 2009): ATV vehicles running through conserved areas, infiltration of feral cats and dogs and other exotic pets, nutrient and chemical intrusion caused by improper use of fertilizer/herbicides/pesticides, and increased impacts from light and sound pollution (Longcore and Rich 2004). Thus, even with green infrastructure design, funded management plans are needed and residents in nearby built areas must be engaged so that their homes, yards, and neighborhoods enhance and rather than damage local biodiversity efforts.

With all these nuances, it is no wonder that planners and conservationists rely on broad theories to make decisions. Also, many of the urban studies are not understood (or heard about) in the planning world, and they are not incorporated into urban planning. To date, urban decision makers state that they do not have sufficient information to holistically address how alternative design and management practices can improve the biological integrity of cities (Ahern 2013). Tools have not been created that synthesize urban ecological data into a format that can be used by most city planners.

What to do? I suggest that we (ecologists) explore (more often) what urban planners actually use in the "real world" to make decisions. Typically, most city and county planning rely on land use maps and evaluate different designs by utilizing GIS software, such as ArcGIS Desktop software. One robust decision-support tool, called CommunityViz®, is an extension of the ArcGIS Desktop software that enables formula-driven alternative future scenarios, as well as, front-end web-based and digital presentation-driven information sharing. The software is flexible and facilitates, land use scenario planning, sketch building, time scale interval visualization, social-ecological impact assessment, urban growth modeling, and similar GIS related functions. CommunityViz® has been in use for over a decade with an extensive, and growing, track record of application to public and private sector urban land use planning processes (http://www.orton.org/tools/communityviz). By the way, this is not an endorsement as there are other similar tools available, it is just one that I am familiar with.

In other words, if we had flora and fauna biometric equations that would plug into CommunityViz®, planners would have a tool to evaluate different design and management options and their impacts on a suite of species, *simultaneously*. This planning tool permits biometric equations that run in the background and display various impacts from alternative planning design and management decisions. For example, planners can manipulate patch sizes and management practices for a 100 ha site, and the outputs would display impacts on birds, mammals, and insects simultaneously. I believe such an integration of ecological data with a visual planning tool will provide the three characteristics needed to make sustainable development decisions: *saliency* (relevance to decision making), *credibility* (scientific adequacy), and *legitimacy* (fair and unbiased information production that also respects stakeholders' values) (Cash et al. 2003).

Of course, we are currently missing these biometric equations. I propose getting a group of ecologists, planners, landscape architects, and other interested built environment professionals and tackle this problem. I have ideas about how to do this (e.g., meta-analyses) but we need various expertise involved to create usable and realistic equations for taxa big and small. Conserving green infrastructure and implementing management practices takes effort and money, and the use of these biometric fauna and flora equations will help cities to develop better planning strategies and be more confident that they are getting "bang for their buck!" Perhaps through a workshop, we will map out a strategy to generate biometric equations, ultimately helping urban decision makers to evaluate which species and groups lose or gain from different urban designs and management strategies.

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Urban Biodiversity in the Environmental Law System

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I. Urban Biodiversity

1. Background

Although cities occupy just 2 percent of the Earth's surface, their inhabitants use 75% of the planet's natural resources.[1] Cities draw on their surrounding ecosystems for goods and services, and their products and emissions can affect regional and even global ecosystems. Healthy ecosystems and biological diversity are vital for cities to function properly.[2] Urban Biodiversity(URBIO) is one of the main topics at the 2014 URBIO Conference concurring the CBD-COP 12 in Korea. As the cities are getting more and more developed, URBIO is also getting more important theme. The full implement of URBIO is not sufficient by way of doing programmes by some local governments or citizens who are concerned about biodiversity. For the purpose of sustainability of such programmes, URBIO need to be institutionalization and also to be supported by financing system under the law and regulation. Sometimes, the hard law system in terms of command and control should be changed into the soft law system for the voluntary participation by business firms and individuals. This presentation is going to deal with problems and issues on the environmental or levy laws and regulations relating to biodiversity and URBIO in respect of acceleration of URBIO. The subject of cooperation for URBIO between the central government and the local government which manages the city is also going to be dealt with in this presentation.

2. Basic Concept

"Biological diversity" means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.[3] In Korean legal system, the term "biological diversity (or biodiversity)" means diversity among living things originating from all sources, such as terrestrial and aquatic ecosystems (excluding marine ecosystems), and the ecological complexes of all these, and includes diversity within species, between species and of ecosystems.[4] The term "ecosystem" means the material world or functional world in which the community of living things in a particular region is intertwined with the inorganic environment by which the community is maintained.[5] Qualitative, quantitative, spatial and monetary approaches can assess the benefits that flow from ecosystem: provisioning services, regulating services and cultural & social services.

3. Strategic Plan for Biodiversity

In decision X/2, the tenth meeting of the Conference of the Parties, held from 18 to 29 October 2010, in Nagoya, Aichi Prefecture, Japan, adopted a revised and updated Strategic Plan for Biodiversity, including the Aichi Biodiversity Targets, for the 2011-2020 period.[6] This plan provides an overarching framework on biodiversity, not only for the biodiversity-related conventions, but for the entire United Nations system and all other partners engaged in biodiversity management and policy development.[7] Parties agreed to translate this

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1) http://www.unep.org/urban_environment/issues/biodiversity.asp (2014.8.31)
2) *Ibid*.
3) Article(§)2. Use of Terms, **Convention on Biological Diversity** which was opened for signature on 5 June 1992 at the United Nations Conference on Environment and Development (the Rio "Earth Summit")
4) Para 7 of §2, Natural Environment Conservation Act(2008) in Korea
5) Para 5 of §2, Natural Environment Conservation Act(2008) in Korea
6) http://www.cbd.int/sp (September 1, 2014)

overarching international framework into revised and updated national biodiversity strategies and action plans within two years.[8] Additionally, in decision X/10, the Conference of the Parties decided that the fifth national reports, due by 31 March 2014, should focus on the implementation of the 2011-2020 Strategic Plan and progress achieved towards the Aichi Biodiversity Targets.[9]

The mission of the new plan is to "take effective and urgent action to halt the loss of biodiversity in order to ensure that by 2020 ecosystems are resilient and continue to provide essential services, thereby securing the planet's variety of life, and contributing to human well-being, and poverty eradication. To ensure this, pressures on biodiversity are reduced, ecosystems are restored, biological resources are sustainably used and benefits arising out of utilization of genetic resources are shared in a fair and equitable manner; adequate financial resources are provided, capacities are enhanced, biodiversity issues and values mainstreamed, appropriate policies are effectively implemented, and decision-making is based on sound science and the precautionary approach."[10]

Enhancing the benefits to all from biodiversity and ecosystem services is "Strategic Goal D" of the Aichi Biodiversity Targets. Such Goal D is composed of three targets relating to the biodiversity and ecosystem services.[11] "By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable"(Target 14). "By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification"(Target 15). "By 2015, the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization is in force and operational, consistent with **national legislation**"(Target 16).

4. Methodology

1) Ecosystem Management Programme

UNEP's Ecosystem Management Programme works towards assisting countries and regions to integrate an ecosystem approach into development and planning processes, acquire and improve the capacity to use ecosystem management tools, realign the environmental programmes, and finance priority ecosystem service s.[12] Ecosystem services have no standardized definition but might broadly be called "the benefits of nature to households, communities, and economies"[13] or, more simply, "the good things nature does."[14] Using an ecosystem approach, natural resource managers can identify and analyse the drivers operating on an ecosystem and design appropriate actions. Generally speaking, the *integrated management* includes improving site management, regulation, land use planning, property rights, and improving the distribution of cost and benefits. Once this analysis is complete, implementation may begin. Using this framework, authorities at local, national and regional levels will be able to launch assessments of their ecosystems. Successful implementation should involve four steps[15]: (1)making the case; (2)generating knowledge; (3)turning knowledge to action; (4)monitoring, evaluation and feedback.

2) Bibliograph

The importance of urban biodiversity is debated by many in the conservation community. According to the result of study which was accomplished by Charles H. Nilon, Urban biodiversity and the importance of management and conservation, *Landscape and Ecological Engineering* Volume 7, Number 1 45-52 1860-1871 SCI(E), some researchers and managers focus on threats to biodiversity associated with

7) *Ibid.*
8) *Ibid.*
9) *Ibid.*
10) http://www.cbd.int/sp/elements/default.shtml (September 1, 2014)
11) http://www.cbd.int/sp/targets/default.shtml (September 1, 2014)
12) http://www.unep.org/ecosystemmanagement/Methodology/tabid/314/language/en-US/Default.aspx
13) James Boyd and Spencer Banzhaf, What Are Ecosystem Services? The Need for Standardized Environmental Accounting Units.
14) "Mother Nature's Sum". Psmag.com. 2008-09-24. Retrieved 2012-07-09.
15) http://www.unep.org/ecosystemmanagement/Methodology/tabid/314/language/en-US/Default.aspx

urbanization and land use change. In contrast to such approach, "people who live in, study, or care about cities - ecologists, wildlife managers, conservation biologists, planners, and local residents - have debated what biodiversity means in urban settings." "Recent literature on biodiversity in cities notes the range of ecological, social, and cultural meanings of urban biodiversity and stresses the importance of defining the setting and scales at which biodiversity is being assessed." Nilon's such approach to urban biodiversity has documented the importance of conservation of rare species and habitats but also the importance of managing the range of habitats in and around where people live, work, and play.

II. Policies in Environmental Law

Biodiversity - the diversity among living organisms - plays an essential role in ensuring the survival of life on earth. Clean water, foodstuffs, medicines and quality of life are just a few of the services which biodiversity offers to cities.[16] Recognizing the importance of biodiversity and healthy ecosystems for their survival, cities today undertake many initiatives to utilize and conserve their surroundings efficiently. These actions can reach far beyond the boundaries of the city, affecting biodiversity on a global scale.[17]

1. National Biodiversity Strategy

The Act for Preservation and Use of Biodiversity of 2011 in Korea introduced the system of National Biodiversity Strategy. §7(Establishment of National Biodiversity Strategy) thereof describes (1) the government shall establish the strategy for national biodiversity conservation and the sustainable use of its components (hereinafter referred to as "national biodiversity strategy") in every five years ; (2) the national biodiversity strategy shall contain the following matters :

1. The status, objectives and principal directions
2. The protection and management of components of biodiversity and biodiversity itself
3. The sustainable use of components of biodiversity
4. Response to the threats to biodiversity
5. Research, technical developments, education, public relations and international cooperation relating to biodiversity
6. Other matters necessary for the conservation and use of biodiversity

2. National Action Plan

The Act for Preservation and Use of Biodiversity in Korea introduced the National Biodiversity Strategy Action Plan. §8(Establishment and Implementation of National Biodiversity Strategy Action Plan) thereof describes (1) the head of related central administrative agencies shall establish and implement the national biodiversity action plan relating to its responsible areas according to the national biodiversity strategy (hereinafter referred to as "action plan") ; (2) the head of related central administrative agencies shall notify implementation outcomes of the previous year's action plan and the action plan of the current year to the Minister of Environment, which is prescribed by Presidential Decree ; (3) the necessary matters required to establishment, implementation, etc. of the action plan will be designated by Presidential Decree.

3. Cities, ecosystems and biodiversity

Studies of the ''ecological footprint'' of cities – the area of land needed to provide a city with the resources it requires to function and to remove its wastes – show that cities affect a geographic area vastly greater than their own surface area. A city's ecological footprint contributes significantly to biodiversity loss, both locally and at the global level.[18] Urban interests have had a detrimental effect on the ecosystems around the cities, damaging the biodiversity of the surrounding areas, and in turn threatening the viability of the cities themselves. While damaged ecosystems negatively affect urban residents, healthy ecosystems provide cities with a range

16) http://www.unep.org/urban_environment/issues/biodiversity.asp (2014.8.31)
17) *Ibid.*
18) *Ecosystems and Biodiversity*: The Role of Cities, published by UNEP and UN-HABITAT (2014.8.31). This brochure offers useful information on global initiatives and the support mechanisms available for cities to protect biodiversity.

of services which are essential for their economic, social and environmental sustainability.[19)]

4. Urban Solutions

Just as the ecological footprint of a city can have a negative impact far beyond the boundaries of the city, certain urban actions can also have a far-reaching positive impact. According to the UNEP, there are many solutions[20)] for such goal[21)]: (1)the **arrangement of green areas** in a city and their connection with the surrounding countryside are critical to sustainability; (2)small towns and big cities can make up **watersheds** – an area of land that catches precipitation and drains or seeps into a marsh, stream, river, lake or groundwater; (3)local authorities recognize that appropriate **ecosystem management** can save cities large sums of money, often avoiding the necessity for mechanical intervention in areas such as water quality; (4)urban **planning and building** regulations can prevent construction on vulnerable land such as wetlands; (5)urban measures to increase **energy efficiency** can also benefit biodiversity; (6)urban **parks**, green median strips and tree planting offer urban residents more pleasant surroundings, and provide a refuge for wildlife; (7)urban **protected areas**, such as parks, nature reserves and greenbelts, are often particularly important in urban settings for wildlife and for people; and (8)urban **agriculture** can contribute to soil conservation, urban hydrology, microclimate improvement and urban biodiversity.

Ⅲ. Institutionalization and Payment for Ecosystem Service

Changes in institutional and environmental governance frameworks are sometimes required to create the enabling conditions for effective management of ecosystems, while in other cases existing institutions could meet these needs but face significant barriers.[22)] Many existing institutions at both the global and the national level have the mandate to address the degradation of ecosystem services but face a variety of challenges in doing so related in part to the need for greater cooperation across sectors and the need for coordinated responses at multiple scales.[23)]

Payments for ecosystem services(PES), also known as payments for environmental services (or benefits), are incentives offered to farmers or landowners in exchange for managing their land to provide some sort of ecological service. They have been defined as "a transparent system for the additional provision of environmental services through conditional payments to voluntary providers."[24)] These programmes promote the conservation of natural resources in the marketplace.

Ecosystem services are the benefits people obtain from ecosystems. Ecosystems provide three main kinds of services to the city: provisioning of food, fibre and fuels; regulating through purification, detoxification and mitigation of droughts and floods; and enriching the spiritual, aesthetic and social life of urban dwellers.[25)] Many of the services listed here are highly interlinked(primary production, photosynthesis, nutrient cycling, and water cycling, for example, all involve different aspects of the same biological processes).[26)]

Some PES programs involve contracts between consumers of ecosystem services and the suppliers of these services. However, the majority of the PES programs are funded by governments and involve intermediaries, such as non-government organisations. The party supplying the environmental services normally holds the property rights over an environmental good that provides a flow of benefits to the demanding party in return for compensation.[27)]

In the case of private contracts, the beneficiaries of the ecosystem services are willing to pay a price that can be expected to be lower than their welfare gain due to the services. The providers of the ecosystem services can be expected to be willing to accept a payment that is greater than the cost of providing the services.[28)]

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19) *Ibid.*
20) For example, http://www.unep.org/urban_environment/events/Bonn-briefcase.asp
21) *Ecosystems and Biodiversity*: The Role of Cities, published by UNEP and UN-HABITAT (2014.8.31)
22) *Ibid*., p.20
23) *Ibid.*
24) Tacconi, L. (2012). Redefining payments for environmental services. Ecological Economics, 73(1): 29-36.
25) http://www.unep.org/urban_environment/issues/biodiversity.asp (2014.8.31)
26) Millennium Ecosystem Assessment, 2005. *Ecosystems and Human Well-being: Synthesis*. Island Press, Washington, DC., p.40
27) http://en.wikipedia.org/wiki/Payment_for_ecosystem_services (2014.8.31)

1. Hard Law System

1) Water-levy for Use: Water Use Charge

Korea enacted the Act for Purification and Assistance to the Residents in the Han-river Watershed of 1999. §19(Levying and Collection of Water Use Charges) thereof describes: (1) In order to raise funds for programs for supporting residents and water quality improvement projects, each waterworks business operator shall levy and collect a charge in proportion to water consumption (hereinafter referred to as "**water use charge**"), as prescribed by Presidential Decree, from each end user to whom raw water drawn from public waters specified by Presidential Decree is supplied as is or as purified and shall transfer the charge to the Han River Basin Management Fund under Article 20: *Provided*, That the foregoing shall not apply to any of the following cases: 1. Where an end user resides in a water-source management area; 2. Where such water is used for maintaining the water level of a river ;

(2) A person under any of the following subparagraphs shall, when he/she draws water from public waters specified by Presidential Decree, pay the water use charge directly to the Han River Basin Management Fund under Article 20 in proportion to the volume of raw water he/she draws, as prescribed by Presidential Decree: 1. A person who has exclusive waterworks installed pursuant to subparagraph 11 of Article 3 of the Water Supply and Waterworks Installation Act; 2. A person who uses water from a river under Article 50 (1) of the River Act ; (3) Notwithstanding paragraph (2) 2, a person falling under any of the following subparagraphs shall be exempted from the levying of the water use charge: 1. An electric source developer under Article 3 of the Electric Source Development Promotion Act who operates a dam for power generation; 2. A person who uses, for agriculture, water from a river ;

(4) Each waterworks business operator shall submit data necessary for the calculation and forecasting of the water use charge, such as intake volume, supplied volume, and loss rate, to the Committee for the Management of the Han River Basin under Article 24, as prescribed by Presidential Decree ; (5) Necessary matters concerning the methods for the calculation, levying, and collection of the water use charge and the payment procedure shall be prescribed by Presidential Decree ; (6) A person who uses water from a river under paragraph (2) 2 may have the water use charge abated or exempted, as prescribed by Presidential Decree ;

(7) If a person obligated to pay the water use charge fails to pay the water use charge, the competent waterworks business operator may collect the charge in the same manner as delinquent local taxes are collected. In such cases, if a waterworks business operator is not a local government, collection may be entrusted to the head of the local government having the jurisdiction over the area, as prescribed by Presidential Decree ; (8) If a person under any subparagraph of paragraph (2) fails to pay the water use charge to the Han River Basin Management Fund under Article 20, the Minister of Environment may collect the charge in the same manner as delinquent national taxes are collected ;

(9) The Minister of Environment shall transfer the water use charges collected pursuant to paragraph (8) to the Han River Basin Management Fund under Article 20 ; (10) As to the compulsory collection of water use charge under paragraph (7), Article 68 (2) and (3) of the Water Supply and Waterworks Installation Act shall apply mutatis mutandis ; (11) As to the areas subject to the levying and collection of water use charges, Articles 9, 10, and 11 of the Water Supply and Waterworks Installation Act shall not apply.

2) Management Contract for Biodiversity

Korea enacted the Act for Preservation and Use of Biodiversity of 2011. §16(Making a Management Contract for Biodiversity) thereof describes: (1) the Minister of Environment can make a contract(hereinafter referred to as "Management Contract for Biodiversity") or advise to the head of related central agencies or local governments for making such contract which aims for preservation of areas necessary to protect the endangered species, to enhance the biological diversity, or areas where the biodiversity is remarkable or excellent with the owners, occupier or manager about change of cultivation, mitigation of chemicals, fostering wetland, or management of land ; (2) where the Minister of Environment, the head of related central agencies or local governments makes a Management Contract for Biodiversity should pay for real expenses to the person whose income on the land from implementing such contract has been decreased, according to the criteria under the presidential decree.

28) *Ibid.*

3) Cap and Trade System of Carbon Emissions

Korea enacted The Framework Act on Low Carbon And Green Growth of 2011. §46(Introduction of Cap and Trade System) thereof describes: (1) The Government may operate a system for trading emissions of greenhouse gases by utilizing market functions in order to accomplish the State's target of reduction of greenhouse gases ; (2) The system under paragraph (1) shall include a system for setting a cap on emission of greenhouse gases and for trading emissions and other internationally recognized trading system ; (3) The Government shall, when it implements the systems under paragraph (2), consider international negotiations related to climate change and may take necessary measures in relation to controlled entities under Article 42 (5), if international competitiveness is likely to be degraded significantly ; (4) The method of allocation of the allowable quantity of emission, the methods of registration and management, and the establishment and operation of an exchange for implementing the system under paragraph (2) shall be provided by another Act separately. In Korea, according to §46 of the Framework Act on Low Carbon And Green Growth, the Act of Allocation and Trade of Greenhouse Gas Emissions of 2012 was enacted of which effective date is January 1, 2015.

2. Soft Law System

1) Voluntary Carbon Offset

In Korea, the Act for Maintenance and Enhance of Carbon Absorption Sources was enacted in 2013 for voluntary carbon offset. §19(Forest Carbon Offset) thereof describes (1) the Minister of the Korea Forest Service shall build an infrastructure for forest carbon offset in order to utilize forest carbon stock that is additionally secured by the heads of local governments or business entities through activities aimed at managing and improving carbon sinks under Articles 9, 10, 13, and 15 through 18, for the following purposes:

1. Forest carbon offset based on reductions[29]: Internationally accepted standards shall apply so that the heads of local governments or business entities, who are obligated to reduce greenhouse gas emissions under any other Act or regulation, can use forest carbon stock to offset their required greenhouse gas emissions reduction target;
2. Forest carbon offset based on social contributions[30]: Relaxed standards prescribed by Presidential Decree shall apply where the heads of local governments or business entities intend to manage and improve forest carbon sinks voluntarily to contribute to society ;

(2) The heads of local governments or business entities, who intend to implement forest carbon offset under paragraph (1), shall prepare a project design document, and other relevant documents specified by Ordinance of the Ministry of Agriculture, Food and Rural Affairs and shall submit them to the head of the Forest Carbon Center established under Article 23 (hereinafter referred to as the "head of the Forest Carbon Center"). (3) Where a project is found feasible after the head of the Forest Carbon Center examines a project design document, etc., he/she shall register the project in the forest carbon registry under Article 24 ; (4) Where a project registered pursuant to paragraph (3) falls under any of the following, the head of the Forest Carbon Center shall revoke such registration and shall, without delay, give notice to the head of local governments or business entities:

1. Where details of the project design document are falsely stated;
2. Where details of a monitoring report prepared by business entities in accordance with Article 20 are falsely stated;
3. Other cases where any registered project cannot be performed due to extenuating circumstances as prescribed by Presidential Decree.

2) National Trust

"The National Trust shall be established for the purpose of promoting the permanent preservation for the benefit of the nation of lands and tenements (including buildings) of beauty or historic interest and as regards

29) Such module is a so-called governmental model of carbon offsetting based on the duty of reduction. Korean Government is going to abolish this sub-article of §19, because of efficiency in the field of forest.

30) Such module is really a voluntary carbon offsetting.

lands for the preservation (so far as is practicable) of their natural aspect, features and animal and plant life."[31] In Korea, the term "national trust" means the voluntary preservation and management of cultural heritage and natural environment assets in the private sector, so as to improve the quality of the life of the current generation, as well as future generations, by the acquisition of cultural heritage and natural environment assets, which are worthy of being protected, by the national trust corporation under Article 3, with property and dues, which are contributed, donated or entrusted by nationals, companies and organizations, etc., and the preservation and management of such heritages, etc.[32]

Korea enacted the National Trust Act and introduced the national trust system under such Act in 2006, most of which was taking after the National Trust Act of 1907 in the UK. The purpose of this Act is to prescribe matters concerning the establishment and operation, etc. of a national trust of cultural heritage and the national trust of the national environment, and support for such matters by the State and local governments, thereby promoting the voluntary preservation and management of cultural heritage and the natural environment by the private sector(§1).

The National Nature Trust in Korea established in 2007 under the National Trust Act(§3) of 2006 has begun to manage natural and cultural heritage in trust, restore lost heritage through buying, and make a trust community. A trusted heritage becomes common property owned by the Trust and managed for the purpose of national interest and future generations. The first model by community system and the second model by trust system are two key legal bases compared with the government model in the conservation and use of natural heritage in Korea. The most characteristic aspect of trust model in management of natural heritage is spontaneity. The trust system contracted between land owners and non-governmental trust agency can mitigate conflicts among owners of lands comprising the ground of natural heritages.

§19 of the National Trust Act in Korea describes the **Preservation Contract** System among trustor, trustee and beneficiary. According to the para(1) of §19, the National Nature Trust may make a contract with owners or possessors of cultural heritage and natural environment assets or the agents thereof, provide necessary support to them to help them faithfully preserve and manage the relevant cultural heritage and natural environments assets and be directly engaged in activities to preserve them by borrowing the relevant cultural heritage and environment assets, for the efficient preservation and management of cultural heritage and natural environment assets. Necessary matters concerning the provisions of preservation contract or methods and procedures of concluding such contract shall be prescribed by the articles of the National Trust corporation(para 2 of §19).

The National Trust is in itself a charity trust and so may raise fund for nature preservation activities. According to the §22 of the Act, the National Trust corporation may raise funds by obtaining approval from the heads of the relevant central administrative agencies, when it is deemed necessary to purchase, preserve or manage cultural heritage and natural environment assets(para 1 of §22). The National Trust is not allowed to use contributions for purposes, other than the purposes of collecting contributions. When it ceases to or completes collecting contributions, it shall disclose the results thereof(para 2 of §22). Where the national trust corporation requests for approval under paragraph (1), necessary matters concerning necessary documents and procedures, etc., shall be prescribed by Presidential Decree(para 3 of §22).

31) Section 4.1 National Trust Act of 1907, the United Kingdom

32) Para 2 of Section 2, the Act on the National Trust of Cultural Heritages and National Environment Assets in Korea of which popular title is the **National Trust Act.**

Example of the Preservation Contract

Nature Preservation Contract[33)]

The Carthusian Monastery in South Korea (designated as "Carthusian" hereafter) and the National Nature Trust (designated as "NNT" hereafter) shall make a conservation contract under the section 19 of *the Act on the National Trust of Cultural Heritage and Natural Environment Assets* (Act No.7912, Mar.24, 2006) as followings：

Section 1 (**purpose**) This contract has a purpose to conserve and manage the forest at San(Mt.) 45-1 Ban-gye-ri, Mo-dong-myun, Sang-ju City, Gyong-buk Province, Korea (designated as "project site" hereafter) which is owned by *St. Benedict Waegwan Abbey* and occupied by *Carthusian*.

Section 2 (**contents of contract**) The contents of conservation and management prescribed by this contract are as followings：

1. The first project site as mentioned above shall be 10 ha at San(Mt.) 45-1, which might be designated by *Carthusian* in the attached map or drawing, and shall be conserved and managed by NNT without surrender of ownership, which areas (including second site) might be enlarged hereafter according to the agreement between contracting parties.
2. This contract shall continue in effect during 20 years after effective date and might be extended to or renewed hereafter according to the agreement between contracting parties.
3. *Carthusian* shall give NNT the right to use the land of mountain at the project site as mentioned above, and shall not change the inherited character of the project site and shall not make a development or a building encroaching on environment of the project site.
4. NNT shall conserve ecosystem and landscape at the project site, shall try to enhance the proper function of its soil and forest, and shall make activities relating to eco education, carbon offset and conservation of biodiversity at the project site.

Section 3 (Method of Management) ① NNT shall burden the cost of conservation and management including afforestation, renovation of trees or cultivation of forest at the project site ; might perform relevant programs ; might change of the character of land and establish facilities necessary for such conservation and management under the consent of *Carthusian*.

② *Carthusian* shall allow the establishment of land mark which explains the honour of member or donator of NNT who takes part in the conservation or management of the project site.

③ NNT shall report to and consult with *Carthusian* every 5 year about conservation and management of the project site.

Section 4 (operation of assets) ① The timbers produced from trees grown up before making this contract at the project site might be owned or used according to the intention or directive of Carthusian.

② The biomass except for timber according to the subsection 1, and the carbon-offsets produced at the project site might be owned or used according to the intention or directive of NNT.

③ When NNT is going to do forestry in the project site by its own investment, NNT shall consult with *Carthusian* relating to the disposal and calculation of products according to such forestry.

Section 5 (inevitable circumstances) ① When there will be inevitable circumstances including natural disaster, the contracting parties might revise some conditions of this contract according to the new agreement.

② This contract might be terminated by way of consultation between contracting parties, when the surrender of ownership for the project site or the change of situations will make the effective conservation or management of the project site impossible.

Section 6 (legal resources) The Act on the National Trust of Cultural Heritage and Natural Environment Assets, the Presidential-decree of such Act, the Articles of NNT and the bylaws of NNT shall be applied to the legal contexts in addition to this contract.

Supplementary Provision

Article 1 (effectuation) This contract shall be come into effect on the date of January 1, 2012.

Article 2 (attached documents) The letter of authorization by *St. Benedict Waegwan Abbey* and the map or drawing which defines the project site shall be the attached documents of this contract.

December 13, 2011

Owner: St. Benedict Waegwan Abbey

Wae-gwan-ri 134-1, Wae-gwan-eub, Chil-gog-county, Gyong-buk Province, Korea

Occupier: Carthusian Monastery in Korea

San(Mt.) 45-1 Ban-gye-ri, Mo-dong-myun, Sang-ju City, Gyong-buk Province, Korea
Chief Order, Galichet Jean Michel *under the authority of St. Benedict Waegwan Abbey*

Conservator: National Nature Trust in Korea

Acropalace #302, Gwanyang-dong 1594, Anyang City, Gyong-gi-do Province, Korea
CEO, Dr. Chun Jae-kyong

33) Registration No. NCC 20111201(A) on the Register 2011 of National Nature Trust in Korea

11-PL-02

Respect of the urban green and the techniques to connect green

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Abstract

Nature in urban areas isgenerally considered to be already destroyed. However in the urban areas it is not impossible to find the remnant nature kept for a long period of time. Itgenerally hasbeen remained as religious woodlands, riparian forests etc. Addition to such nature we create new green spaces according to the change of the city structure by new city plans. The elaborate considering of these plans make it possible to restore the deteriorated ecological network of urban green. To realize it incessantly developing techniques for re-vegetation are suitable.

Introduction

Generallynature of urban areas is considered to have already been destroyed. As is known, to find the primeval nature there is difficult, but the pieces of them are found especially in the historical cities.These cities have been developed in the long history naturally in some cases and by elaborate city plan in other cases. In eastern Asia traditional idea about the city planning considering the location of mountains, rivers and water bodieshad been adopted mainly under the influence of Chinese culture.

Moreover these cities also experienced the modernization later. In the process of modernization a lot of changes of the city structure are recognized. At the same time urban areas extended toward the urban fringe areas. This change usually means the loss of neighboring agricultural areas.

Within the downtown areas the pieces of the primeval nature are found mainly at sacred spaces like temples and shrines which have been protected by the religious reasons.In addition, in the modernized urban areas local governments construct the city planswith street trees, parks and green spaces. These plans are usually important and useful when we consider the improvement of the peculiar city climate.

When we plan to maintain these green spaces it is important to keep them in good condition and to create more spaces for green not only to keep the good environment but also to improve the quality of biodiversity. Furthermore the importance of the application of the techniques to keep/create the connectivity of fragmented and isolated green spaces in urban areas must be kept in mind.

Persistence of the historical urban green

Considering the green historically kept it is easy to image some spaces like sacred woodlands, river banks, etc. These greenspaces have been preservedby the understanding of importance of their existence. The vegetation of sacred spaces is easy to protect.

In Kyoto, Japan having long history as the capital of Japan for more than 1000 years, quite inverse two types of the change of trees can be found according to the Japanese animistic feeling to nature. During the trees young theyare usually treated like a kind of weed. These trees will be cut. But in some cases they survive by chance. If these trees luckily grow up large they are regarded as the animistic god of the local area. On the latter case Japanese people stretch the taboo-rope on the trunk and construct small shrine in front of the tree. The size and the location is important turning point for each tree.

On the other hand these religiously important trees and woodlands are decreasing by the change of feeling to nature. The change of feeling from traditional respect for nature to logically clear solution occurred drastically in these several decades.

Deterioration of green by modernization

Modernization of urban areas brings the deterioration of urban ecosystem because of the fragmentation and/or isolation of the remaining nature. Sakamoto(1988) reported the deterioration in downtown of Kyoto City of the 20th century. As a result, sacred woodlands had been protected for a long time. These woodlands are expected as the cores of the city green. But in the process of modernization these woodlands deteriorate, reduce the area and finally become very small woods consist of a few trees or an isolated tree. In some cases all trees will be cut down as the traffic obstructs in the city plan. Such a deterioration and disappearance of trees and woodlands causes the reduction of the network of vulnerable urban ecosystem. At present it is difficult to stop this kind of deterioration because of thechange of feeling to nature of citizens.Meanwhile, the possibility of appearance of new individuals after the natural death of an isolated tree will become ecologically difficult because of too long distance from mother trees.

However we need to evaluate again the importance of nature with long history. In UK some researchers found the ecological importance of woodlands with long history even in small woodlands. Peterken (1992) showed the high biodiversity in the coppiced woodlands with the history of continuity more than several hundred years. Concerning to the coppiced woodlands he said that "the coppice fauna and flora still includes many species associated with mature, stable woodland, which appear in the modern landscape as 'ancient woodland indicators' ". Even in the urban areas the similar tendency can be expected when the sacred spaces have been preserved for a long period of time.

Connectivity of the urban nature with the surrounding nature

Urban areas are usually surrounded by the secondary nature like farmlands, woodlands and so on and connecting with these nature by rivers and streams. In addition, cities had always been keeping woodlands or forests to gain the important resources like firewood, timber and so on around the urban fringe areas. This is popular landscape all around the world. Akasaka (1984) surveyed the transition of the forest of Eilenriede nearbythe old Hannover, Germany. This forest has long history as the financial sources of city economy and the recreation space for citizens and so on. In the long history urban areas of Hannover has been expanding and urbanized areas and Eilenriede are contact closely witheach other at present. However the role of this forest is constant and unchanged, and the management of this forest is still be kept for the same purposes by the excellent management.

Especially in the developing countries it is important to keep the forest resources in close places from urban areas. However the urbanization and the expansion of urban area sometimes destroy the superior relationship between downtown and woodlands around the urban fringe areas.These urban fringe areas are important when we consider the connectivity of ecosystems as the existence supplying the ecological sources. And rivers and streams function as the ecological corridor.

However, the expansion of urban areas changes urban fringe areas that have been functioned as buffer zone. In Japan most of the flat landshave been urbanized and the distance between natural/semi-natural areas and urban areas becomes too close. These changes cause the friction between wild animals and residential people. The loss of semi-natural urban fringe areas by urbanization causes the deterioration of connectivity of neighboring ecosystems. As urbanization of urban fringe areas is generally recognized as an indiscriminate development it is difficult to expect the preservation of the ecological connectivity.

Necessity to connect the deteriorated greenand ecosystem to consider the biodiversity

In urban areas fragmented and isolated woodlands will deteriorate by the occurrence of local extinction of species by the loss of the satisfactory network with circumjacent ecosystems. Isolated ecosystems are impossible to supply enough natural replacement of species.

When we plan to restore the deteriorated nature most important purpose is to stop the deterioration of important nature in urban areas as a core of network first of all. Next important purpose is to restore or to create the ecological corridors and networks. Even in the greenspacesregarded as important cores some extinct species are sometimes found and the niches of them are replaced by other invader species, means thatcareful construction plan is required. Theoretically the distribution of open spaces is discussed. But practically ecological consideration concerning to the invader species is important.

To realize above things we need to plan the construction of green networks effectively using remnant urban nature and the newly planned green. Not only about the distribution of them but also the management systems to keep the quality are required.

On occasion roof top planting and wall greening are recommended in urban areas because of the lack of enough spaces for plantation. But when we consider about the connectivity of the green more cautious planning is required. For instance small insects like butterfly will not be able to fly over the lined skyscrapers, means the roof top planting is not useful for them. It is similar for the wall greening.Most important is the enough discussion and practice with the viewpoint of ecological characteristics of target species.

Importance of techniques to keep and create connectivity of the urban green

At present we have a lot of techniques for greening and re-vegetation. However some techniques are not applied because of the high cost and ineffectiveness results. To restore the connectivity of the green in urban area most important matter is the elaborate planning based on the sufficient ecological data.

Historical greenspaces should be cores of urban ecosystem. And whenit deteriorates we need to apply the techniques to restore them. To realize it soil improvement by fertilizing, aeration etc. and progression of light condition by tree thinning etc. will be carried out expecting the natural regeneration of vegetation in future. High quality core vegetation will function well for the restoration of the green network.

Trials to revive or create the green network more densely are also required. This will be forced mainly by the initiatives of government. Street trees plantation, preparation of parks and green spaces and restoration of riparian spaces are considered as effective practices. Understandably these green should be managed well. We also have enough knowledge and techniques concerning to fertilizing, pruning and so on. For instance, even in the case that we can't find enough natural soil, we can prepare high quality artificial soilinstead of the degraded soil.

As is known river bank is also regarded as important component to keep the ecological networks. This space are generally maintained as recreation spaces for citizen. But some of them change to the huge gutter or ditch hardened by concrete without any ecological function. Restoration of natural water stream and natural vegetation should be encouraged using restoration techniques.

In some citieslocal governments encouragethe citizens to keep their private gardens in good condition by subsidy. Especially in the downtown areasprivate gardens with long history keeping higher quality have been found. These gardens are important parts of urban ecosystems. But the evaluation of these greens is not yet enough.

Estimation of the green and the application of techniques to restore the deteriorated green and ecosystem in urban areasare inseparable. Through the elaborate city planning these can be consistent. However when we consider about the ecologically superior urban green retaining the high biodiversity, thorough monitoring activity and persistent efforts to develop techniques are required.

Conclusion

Many citizens understand the importance of green and ecosystem with high biodiversity. However, conversely, we can't accept the wild animals and insects especially like mosquito, cockroach because they are not our pets in spite that they are also the member of ecosystems. Especially in tropical areas there are many harmful organisms. We also need to consider the steps to coexist with them using developing techniques.

At all urban areas in the world we can find the superior nature even in urban areas and we have nature-friendly techniques to solve the problems. We should not forget the respect for relationship with nature in the urban areas.

Reference

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Sakamoto K (1988) Remnant Forms of *Ulmaceae* Woods and Trees in Urban Areas, Bull. Re-vegetation Research Monograph No.2, Assoc. Re-vegetation Research in Kyoto, Japan

11-PL-04 2014-09-02 Paper Keynote Norbert Müller for URBIO 2014

Towards a Global Research Agenda on Urban Biodiversity, Ecosystem Services and Design

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1 The Urban Challenge

We have now entered the urban age. Over half of humanity lives in towns and cities and by 2050 almost 3 billion additional people will inhabit the world's cities.In all of human history the world will have undergone the largest and fastest period of urban expansion. Consequently, urban growth will impact the provision of many ecosystem services and the benefits humans derive from nature, and the demands of cities will reshape most rural landscapes in the coming decadesWithout adequate consideration of the coming urbanization, many of the goals of the Convention on Biological Diversity, as well as the Millennium Development Goals for providing clean water for consumption and sanitation and the UNFCC goals for mitigating and adapting to climate change, are unlikely to be met. A sustainable urbanization will be necessary for achieving goals of a more sustainable planet.

2 The consideration within the Convention on Biological Diversity

Until 2007 the opportunities cities and other local authorities offer in terms of implementation of the Convention on Biological Diversity (CBD)had received little consideration within the CBD.No thematic program, mayor group and cross cutting issues focused on this topic. In March of that year, howeverrepresentatives of host cities of CBD meetings and other cities showing leadership on biodiversity issues, met in Curitiba (Brazil) to lay the foundation for a "Global Partnership on Local and Subnational Action for Biodiversity".

At the 9thmeeting of the Parties to the CBD (COP 9)in Bonn(Germany) in May 2008, the Parties discussed the role of Local Authorities in the implementation of the Convention and, for the first time ever and adopted a decision on cities and biodiversity (Decision IX/28). This decision encourages the 194 Parties to the Convention to recognize the role of cities in national strategies and plans, and invites Parties to support and assist cities and other local authorities in implementing the Convention at local level.This event emerged in the establishmentof the Mayor Group "Local Authorities" within theCBDs programs.

At the 10th meeting of the Parties in October 2010 in Nagoya, Japan (COP 10) wherethe "Strategic PlanBiodiversity for Biodiversity 2011 – 2020" with the "Biodiversity Aichi Targets" (Decision X 2) were adopted the "Plan of Action on Subnational Governments, Cities and Other Local Authorities for Biodiversity 2011- 2020" (Decision X/22) was decided.The "Plan of Action" laid out options for national governments and their partners in supporting and promoting the subnational implementation of the Aichi Targets.

At the 12thmeeting of the Parties (COP 12) in October 2012 in Hyderabad, India "The Plan of Action" Decision X/22 was complemented with additional considerations (Decision XI/8). The Parties wereencouraged to develop with their local and subnational governments strategies and plans to implement the "Aichi Targets" at all levels.

3 The "Global Partnership on Local and Subnational Action for Biodiversity"

The journey towards a consideration of local authorities within the CBD and the foundation of the "Global Partnership on Local and Subnational Action for Biodiversity" (former "Global Partnership on Cities and Biodiversity") started in early 2006 at the General Assembly of ICLEI (International Council for Local Environmental Initiatives) in Cape Town, South Africa. Here more than 300 local authorities' member to ICLEI called for the establishment of a pilot project on Local Action for Biodiversity (LAB) where 21 cities

representing 52 million people have worked together with ICLEI and IUCN's Countdown 2010 initiative. At the initiative of the mayor of Curitiba (Brazil)and the Secretariat of the CBD, a meeting was held in Curitiba, on 26-27 March 2007. Over 34 mayors and representatives attended, and participants adopted the Curitiba Declaration on Cities and Biodiversity. The Declaration reaffirms the mayor's commitment to contribute actively to the implementation of the three objectives of the CBD and to the achievement of the 2010 biodiversity target. A task force was established with the Secretariat of the CBD, ICLEI, IUCN,UN-and Scientific organizations and the mayors of Curitiba, Bonn, Nagoya, Montreal and Singapore.

"The Global Partnership on Local and Subnational Action for Biodiversity" was launched during COP 9 in 2008 with the goal of bringing together all the relevant networks and initiatives involved, in implementing the Convention on Biological Diversity. Today it includes UN Agencies (UNESCCO, UNEP, UN-Habitat), international NGOs (ICLEI, IUCN), selected Parties and Scientific networks (Stockholm Resilience Centre, URBIO Urban Biodiversity &Design, WRF The World Resources Forum, Nature of Cities blog) and City governments (represented by the Advisory Committee on Cities) and Subnational governments (represented by the Advisory Committee on Subnational Governments).

http://www.cbd.int/en/subnational/partners-and-initiatives/global-partnership

Since 2008 each of the COP meetings has been complemented by parallel meetings of the "Global Partnership". URBIO organized scientific conferences prior the COP meetings and ICLEIorganized "Biodiversity Summits for Cities and Subnational Governments". At COP 10 and COP 11 these were the largest and arguably most high-profile events in parallel with the COP, attended by governors, ministers and the Executive Secretary of the CBD and helping to raise the profile of subnational implementation of the Convention.

4. Partners and instruments

In order to support local authorities the partners within the "Global Partnership" have developed several initiatives and instruments. Prominent examples are in chronological order:

4.1 ICLEI and IUCN program "Local Action for Biodiversity" (LAB)

This flagship biodiversity program is coordinated in partnership between ICLEI and IUCN. LAB's approach is action oriented and customized for local and regional authorities and their partners around the world, with the goal of improving biodiversity management at the local level. LAB is a key component of, and contributor to, the CBD's "Global Partnership on Local and Sub-national Action for Biodiversity". The program began in 2006 with a select group of 21 pioneering local and regional authorities from around the world, representing 54 million citizens. The initiative has since expanded to include many more cities and has branched into thematic streams, including LAB Pioneers, Climate Change and Biodiversity and Biodiversity and CEPA. The program focuses on implementation, and is comprised of a three-year, five-step peer learning process, a local biodiversity and ecosystem services assessment report, workshops, forums, a knowledge bank, networks and various strategic projects that address specific local and national needs. In 2010 emerged the manual "Local Action for Biodiversity Guidebook" (2010), documenting cities contributions to biodiversity conservation with guidelines for replication.

Since the foundation of the "Global Partnership", the driving force of the Major group "Local authorities" is ICLEIs Cities Biodiversity center and its"Biodiversity Summit for cities and subnational governments" organized on the COP meetings.

http://www.cbd.int/en/subnational/partners-and-initiatives/iclei

ICLEI (ed.) 2013: Local Biodiversity Strategy and Action Plan Guidelines: Biodiversity and Municipal Planning

Laros MT and Jones FE (Eds) 2010: ICLEI – Local Governments for Sustainability Local Action for Biodiversity Guidebook: Biodiversity Management for Local Governments.

4.2 URBIO platform and scientific conferences

URBIO is an open worldwide scientific network for education and research, which was founded during COP 9 with the aim to promote the work of the "Global Partnership".

Already in 2005 scientistsof the European "Competence Network Urban Ecology" requested to raise the implementation of the CBD in urban areas and to support this by an International conference during COP 9 in Germany. This was the foundation of the international scientific network URBIO.Its aimsareto foster scientific research related to urban biodiversity, ecosystem services and sustainable landscape design and the exchange with the other partners of the Global Partnership". As clearing mechanism a website is hold and a newsletter is distributed. Prior to the COP meetings scientific conferences are hold as side events and thematic workshops. The coordinating work of the headquarters in Erfurt (Germany) has been funded by the German Government from 2007 - 2014. The following thematic conferences were organized by URBIO:

Urban biodiversity and design – implementing the CBD in towns and cities (Germany2008)

Urban biodiversity in the ecological network (Japan2010)

Urban biodiversity and climate change – adaptation and mitigation (India 2012)

Cities and water – conservation, restoration and biodiversity(Korea 2014)

http://www.cbd.int/en/subnational/partners-and-initiatives/urbio

http://www.fh-erfurt.de/urbio

4.3 The "Singapore Index"

In 2008 - during COP 9 - Singapore proposed the development of the city biodiversity index – a self-assessment tool to evaluate biodiversity conservation efforts of cities. Within expert workshops of the Global Partnership a set of 23 indicators were developed and presented as "Singapore Index" during COP 10.

Until today over 60Cities have applied the Singapore Index as diagnostic and decision-making tool.

http://www.cbd.int/en/subnational/partners-and-initiatives/city-biodiversity-index

4.4 TEEB – "The Economics of Ecosystems and Biodiversity for Local and Regional Policy Makers"

The Economics of Ecosystems and Biodiversity(TEEB) is a global initiative focused on drawing attention to the economic benefits of biodiversity. Its objective is to highlight the growing cost of biodiversity loss and ecosystem degradation. TEEB presents an approach that can help decision-makers recognize, demonstrate and capture the values of ecosystems &biodiversity, including how to incorporate these values into decision-making. In 2010 a 200 page sourcebook "The Economics of Ecosystems and Biodiversity for Local and Regional Policy Makers" were published to support subnational and local authorities especially (TEEB 2010).

TEEB 2010: A Quick Guide to the Economics of Ecosystems and Biodiversity for Local and Regional Policy Makers 8 p.

4.5The "Cities and Biodiversity Outlook"

The "Cities and Biodiversity Outlook" (CBO) is a global assessment of the links between urbanization, biodiversity and ecosystem services prepared under leadership of the Secretary of the CBD and the Stockholm Resilience Centre and with contributions of over almost 200 scientists and practitioners.

Part I of the CBO – "Action and Policy" - provides the summary of the assessment drawing on contributions from more than 120 scientists and policy-makers from around the world. It presents 10 key messages for strengthening conservation and sustainable use of natural resources in an urban context and was launched during COP 11 in Hyderabad (2012).

http://www.cbd.int/en/subnational/partners-and-initiatives/cbo

Part II of the CBO – "Urbanization, Biodiversity, and Ecosystems – Challenges and Opportunities" is a more detailed scientific analysis and assessment of the links between urbanization, biodiversity and ecosystem services and was published in 2013. Besides 15 principle papers it provides 18 regional and local case study assessments (Elmqvist et al 2013).

Elmqvist, T. et al. (eds.) Urbanization, Biodiversity and Ecosystem Services: Challenges and Opportunities: A Global Assessment. Springer, New York open access

4.6 The "Nature of Cities" Forum

The "Nature of Cities" is a virtual magazine and discussion site on cities as ecosystems since 2012 on the web. It is a global collective of contributors, an essay and discussion site devoted to cities as social-ecological spaces, ecosystems of people, buildings, open spaces, and nature. City design with nature at the center is key

to urban resilience, sustainability, and livability.

http://www.thenatureofcities.com

4.7 Further partners and activities

UN-HABITAT and the CBD Secretariat worked together to develop in 2010the manual:

Supporting Local Action for Biodiversity: The Role of National Governments

http://www.cbd.int/en/subnational/partners-and-initiatives/un-habitat

The Network of Regional Governments for Sustainable Development (nrg4SD) is a non-profit international organization representing subnational governments and associations of subnational governments at global level.

http://www.cbd.int/en/subnational/partners-and-initiatives/nrg4sd

5 Global Research Agenda on Urban Biodiversity, Ecosystem Services and Design

Subsequently, in following up of the abovestatedwork of the "Global Partnership"the Scientific Network URBIO was invited by the SCBD to determine the necessary scientific fields and skills most needed by local governments to implement the "Plan of Action". This "Research Agenda on Urban Biodiversity, Ecosystem Services and Design" should be based on existing studies on urban biodiversity and the needs of local governments.An initiating workshop was organized at the URBIO Headquarters in Erfurt in July 2013 together with ICLEI and the SCBD.Here representatives from URBIO, ICLEI , the SCBD and contributors to the CBO attended and drafted a first roadmap. The driving questions of the workshop were:

- What information do decision makers &managers in governments and other sectors need to support biodiversity, expand ecosystem services &apply ecologically-sophisticated design?
- What knowledge is currently available in the cities &what are critical knowledge gaps?
- How can basic research support the specific need of cities?
- How can we communicate knowledge to decision-makers?
- What should next steps be to develop this agenda?

Following up this event an online survey was held to determine the most urgent research questions from the view of the URBIO community.

In twosubsequent sessions of the URBIO 2014 conference the dialogue between city representatives and researchers will continue and closed by panel discussion with the audience.

Withthe Incheon URBIO2014 Declaration the progress of the "Research Agenda" will be brought tothe "Biodiversity Summit for cities and subnational governments" a COP 12 in Pyeongchang.

6 Outlook

The "Global Research Agenda on Urban Biodiversity, Ecosystem Services and Design"is a further instrument within the "Global Partnership" to support local authorities. To face the urban challenge a better understanding what local authorities need, will be important for researcher as well as to produce applied research which can be implemented immediately will be essential for practitioners. Therefore collaborative forms of research (e. g. Ives &Lunch 2014) and new communication platforms like the "Cities of nature" forumwill be good toolswithin this instrument.

http://www.thenatureofcities.com/

Ives Ch., & Lynch Y. 2014: Untapping the Potential of Science-Government Partnerships to Benefit Urban Nature. Nature of Cities Blog http://www.thenatureofcities.com Posted on August 31, 2014

October 9

Keynote lecture

09-PL-01

Restoring urban waterfronts to increase ecological services: a rising tide

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The value of urban waterfronts

A modern understanding of the value urban waterfronts includes much more than a listing of industries which can be sitedalong river edges and marine ports. The new interest in ecological services is exploring the many valuable ways in which habitats nearwaterfronts can advance the health and sustainability of our cities for residents. There are regulating ecological services by which waterfront habitats improve the quality of life. Air quality can be improved as trees and other vegetation trap noxious chemicals and other pollutants that are generated in the city. Riverine habitats can clean storm water before it entersocean habitats, lessening the need for expensive infrastructure. During storms, waterfront habitats can absorb storm surges and protect adjacent commercial and residential zones from damage. These habitats can also bind and improve soils, slowing siltation and degradation of waterways. Even small scale urban habitats along rivers serve as habitats for migratory wildlife and became links in the landscape ecology of a region.

There are also cultural services that waterfront habitats give our citizens, and these have gotten much attention in the past. As venues for exercise, community interactions, artistic inspiration, and a sense of place, waterfronts help define our cities' personality in important ways and add to the joy of everyday life. In a modern world, quiet habitats along waterways are also a place to improve mental health, lessening tension and stress while allowing people to have a place for reflection and spiritual experiences.

In these several ways, consideration of an ecological structure and complexity near our waterways adds value to urban living, and can even decrease the amount of tax money needed to make our cities function as civic spaces. Recognizing and teaching the real value that ecological design can add to waterfronts is part of a complete discussion of urban planning at a time when cities worldwide are rapidly growing. Most humans live in cities today and the percentage is growing rapidly. How can we make new cities and growing older cities more sustainable?

Ecological character of urban waterfronts

Urban waterfronts almost always have a long history of past land-uses which have degraded their ecological character. New uses along old waterfronts do not rest on pristine lands or national parks. We must recognize the difficult role that an ecological designer has to add back value for our urban citizens. Waterfronts often have poor soil with chemical and physical damage from past industrial use. Hydrocarbons or heavy metals along the waterfronts are remnants from the industrial past. Even when commercial shipping and industrial uses are gone, the soil holds sad memories of ecological misuse. Many waterfront areas are also very small parcels, not connected to expansive areas which can support many of our plant and animal species. Planning for ecologically healthy waterfronts must consider the roles of scale and geometry in constraining an ecologically improved future. Cities are also relatively hot, caused by pavement and enormous energy emissions, which make citiesseveral degrees warmer than the surrounding countryside. This too strains the kind of species that can be introduced into our urban waterfronts and their ability to reproduce and persist. In a time of rapid climate change around the world, this heat island effect will be magnified.

There are also biotic problems in urban waterfronts that are challenging to ecological planners. Of course cities have lost native species as people have used the land for many decades. The loss of species has changed

trophic interactions and life history dynamics. Similarly, many species of plants require animal interventions in their lifecycle. For example, pollinators are needed to make seeds and vertebrates often are needed to move seeds about the landscape. These links have lessened and weakened in crowded cities. These changes limit the ecological introductions that we can successfully make to improve urban environments. Cities are also the center of introduction for many invasive plants and insects which move in from other continents. These invasive species can overwhelm many habitats, lessening biodiversity. This too can challenge the sustainability of our urban waterfront parks, meaning that more management and more public funds are needed to keep these areas healthy and useful.

Although these many problems are real and have been studied throughout the world, there are ways where low value waterfronts can be improved to add back the ecological services upon which we all depend. There are a series of case studies which our laboratory has contributed to which illustrate ways that ecological thinking can improve water resources and waterfront habitats for urban dwellers.

Restoring a derelict commercial zone

Along the East River in Brooklyn, New York City, an old commercial zone had become abandoned because it was too small to be commercially viable in an age of container ships and bulk cargoes. The local government has created an ecologically themed Brooklyn Bridge Park on this thin, 2 km long waterfront in my nation's largest city (see www.brooklynbridgepark.org). Here, many habitat types were introduced to advance sustainability. Small zones of vegetation vary from salt marsh grasses to coastal, salt tolerant shrubs and trees, to varied planting areas which rely on fresh water. Threaded through these ecological zones are many public amenities, including sports, education, and artistic spaces. Brooklyn Bridge Park is quickly become incredibly popular with over 100,000 people using it in a typical summer week. The park has introduced New York City residents to their waterfront history and the reality that the city's financial and cultural riches rest on New York's character as a great port. After the 300 years that this waterfront was only a commercial zone, with these cultural, ecological, and educational features, new civic values have taken their place and added a new destination for residents and tourists alike.

Restoring a landfill using ecological links

Almost all cities have landfills where over decades, tons of garbage have been dumped, the repositories of the waste of our frantic urban lives. Often, these landfills are near waterways as those lands were considered less suitable for residential or business areas: too muggy; too impacted by storms; too unstable; too full of mosquitoes and other biting insects. With the closure of the old landfills, we have new opportunities to use these ugly open spaces to improve urban life. At the Fresh Kills landfill in New York City, the largest landfill in the Americas, about 1000 ha are being redesigned into a vast public park. The structure of this new FreshkillsPark will include many habitat types from woodlands to meadows to salt marsh(see www.nycgovparks.org/park-features/freshkills-park). Even though the soil layer above the cap is thin, 0.5 – 1.0 m, studies have shown that this is adequate to support much sustainable vegetation.However, the site is too large to be formally planted like a garden with tens of thousands of plants in precise locations. Rather, the park designers are using ecological principles to re-create a useful, long-lasting habitat complex at relatively low cost. Experimental studies by our lab have shown that birds, even in my nation's largest city, can still play an important role in introducing thousands of seeds of many species to this degraded site. This process of seed dispersal and population initiation is playing a major role in transforming this waste site into an interesting and useful public space that introduces new ecological services on once derelict land.

New challenges during climate change: a rising tide demands new solutions

Past degradation of urban waterfronts is almost universal. However, new stresses are now appearing worldwide, driven by rapid climate change and the direct consequence of rising sea levels. So many commercial and residential zones are near our waterways. They are all being challenged by the higher ocean levels and more frequent storm surges. Almost every study by climate scientists is showing that this threat is quickening. All coastal cities must rapidly develop plans to maintain their viability, and improve the quality of life for the millions of people in our coastal cities. New approaches are needed to parry climate change threats with useful public spaces using the charm and functioning of the best urban designs. Recently, the federal government of

the United States conducted a design competition to directly deal with this problem. The "Rebuild By Design" program (see www.rebuildbydesign. org)meshed ecologists with architects, landscape architects, planners, and engineers to change how waterfront construction can be modified to address new coastal problems. Innovative solutions were sought for bothsmall coastal communities and major coastal metropolises. These design ideas can be models for how other waterfront areas may mesh economic and social viability with ecological health in our changing world.

A Habitat Engine for securing marine resources

Along the Atlantic Ocean coast in the State of New Jersey, billions of dollars of property were lost when Hurricane Sandy swept through this region in 2012. Many small, poor coastal communities were devastated. The ocean is expected to rise at least 1 m in the next 50 years here, and with increasing storm frequency. These towns face a frightening future. One scheme that has been developed is to create new areas to where marine natural resources can migrate as the ocean rises (see www.rebuildby design.org/teams/sasaki-rutgers-arup/). With sea level rise, we will lose our coastal salt marshes which are habitats for marine fisheries, shorebirds, and invertebrates as these plant communities are inundated. By carving out new habitat areas for the future, at slightly higher elevations than are present today, we can make space for saltwater to rise, migrate inland, and re-create these critical habitats. Soil that is removed for the creation of these new coastal zones can be used to create higher berms around existing human communities to shield them from storm surges. We call this approach the Habitat Engine, in the sense that the new areas for future marine natural resources can pull in plant and animal species that need saltwater, just as an engine pulls cars on a train full of ecological supplies. These new areas are also Habitat Engines in the community sense, as they can bring in social and commercial value when currently existing coastal areas are lost under the sea. By mapping appropriate locations where migration of habitats is possible and then creating restoration zones adjacent to areas which most probably will be underwater this century, we can ensure that coastal community life persists.

A "Big U" for the people and industry of Manhattan

In our biggest cities, they can be little movement of habitats or people away from the current heavily used edge. Cities such as New York, Tokyo, and Seoul have so much invested in the current landscape infrastructure that no one wants to move away from the edge. What can be done to secure the most valuable coastal property from the reality of future sea level rise and increased storm intensity? For Manhattan, a series of remedies have been proposed, which are called the Big U. This design, led by the Danish architectural firm BIG (see www.big.dk), takes the vulnerable existing waterfront roadways and walkways and transforms them into more valuable and safer civic spaces with a strong ecological expression (see www.rebuildbydesign.org/teams/big-team/). Meshed with the new uses are also a clever series of protections to stop saltwater from devastating lower Manhattan. Losses here during the 2012 hurricane blacked out lower Manhattan and caused enormous social and financial loss. The new scheme combines storm protection with social amenities and ecological structures to give a triple improvement to land which will not be abandoned by the city government. We have added bioswales to control and clean storm water, coastal meadows and shrublands, bird and butterfly habitats, intertidal habitat interventions, and urban agriculture areas to complement traditional playgrounds, sports fields, and meeting places. These are all imbedded in a high vegetated berm that protects the inland buildings or by moveable gates which descend from elevated roadways when there are storm warnings. New land for nature and culture is created while public safety is advanced. People will be able to interact more intimately and safely with the New York harboredge.

These new ideas will improve and protect our urban waterfronts in the future. People can learn that ecological zones are not simply something to be enjoyed on a holiday in a national park, but can be something to improve our daily urban life, where we live and work. The idea that stewardship of our resources is part of citizenship can be advanced in our city centers to give us a better economic future and a more enjoyable, healthier civic life as our world becomes more urban.

09-PL-02

Always Keep a Window in Life.

TANG, Hsien Po

Director of Tarzan Natural Education Society, Taiwan

Abstract

A story from 1981, A New Doctor went to MingSeng Community in Taipei city and promote greening. "Green Little Genii"(綠色小精靈) was established for kids to love green plants and take care of them in the beginning. Play in this group was very important, so we developed "community green detective", "Green Treasure Map", "Plant ID" and so on. We found kids love this kind of activity, even though the games always happened at the community park. That was a window for them to see the place they live in different way. This group kept 12 years, from parks to generally school, the guide of activity was from student of university to the kid's present.



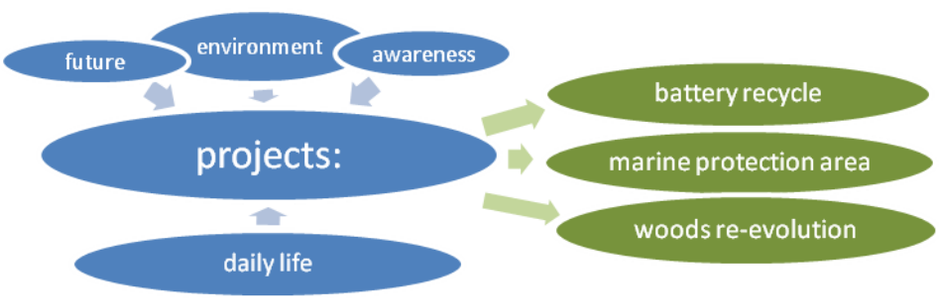
In 2003, we leaded 23 kids to WuLai Mountain area in Northern Taiwan for 21 days Camps, Called "Little Tarzan"(小泰山). This camp, in 2004, extended to 29 days and 30 kids, and 36 kids in 2005. Because we let kids play all the things happen in real world, but no such standard, as wash clothes, kids can try every kind of method to clean them and wear them, No matter they were real clean or not. And there were lots of "Work Stations"(工作站). Kids choice several ones to do, and they love it. That was a window for them to live in different way.


In 2007, we went to Penghu Islands, and stayed at the southern island alled QiMei(七美), Stared to connect the Marine Fishing Village, a life with nature time table. The great difference between WuLai and QiMei is not environment but people who real live at the place. At WuLai, there is no neighbor, But at QiMei, we live in a Abalone culture zone, we had run our life with others in this island. We participated the cultural activity and learned the local things, tried to get the life knowledge, about whether, farm, fishing and history. That also

pushed our kids go in the community then A dialogue between life was happened, the window of life was created.

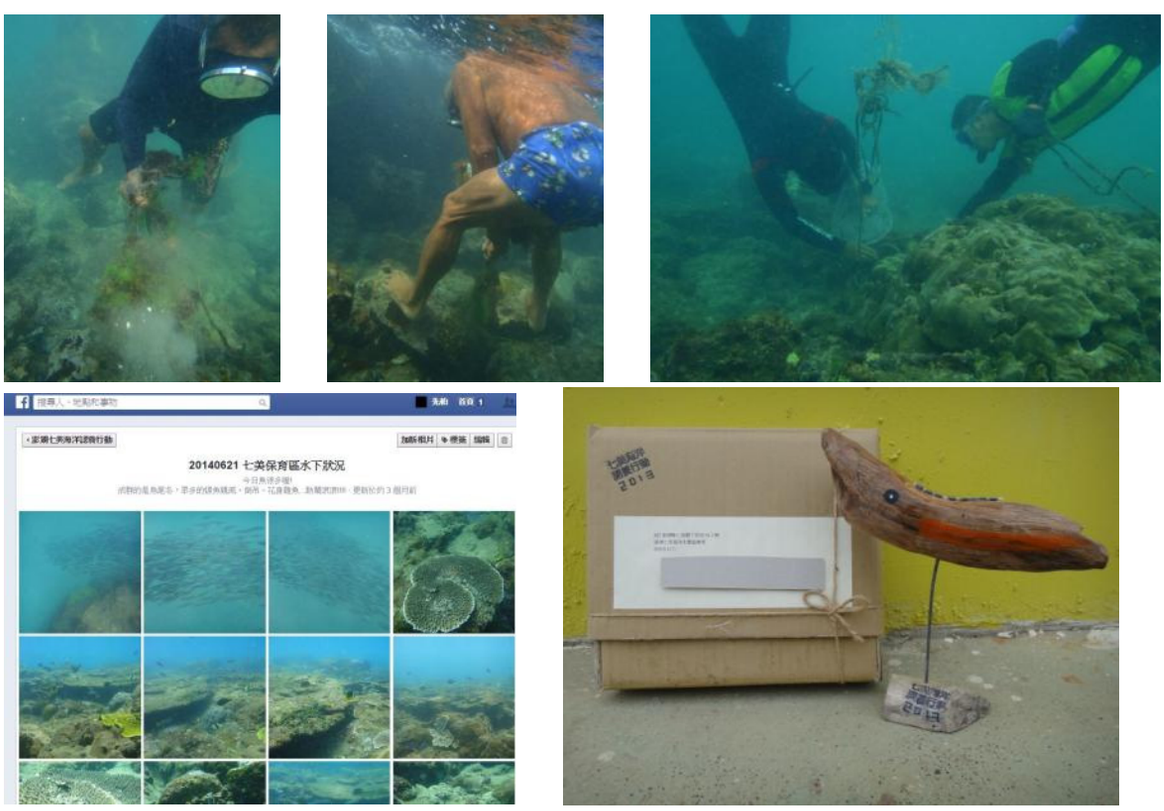
Through 5 years participation, we began connecting the community in Taipei and at QiMei with issues of life, such as marine protection(jobs) and sea food demand(money offer), seedling nursery(jobs) and working travel or company donation(money offer). We call these projects **Life Window**. Through them, the communication between life can really go on.

The icon of Qimei project is based on restudying the daily life on the island. If we could do something on this island, It should got three point: good for future life, good for environment, and enhance the Community Awareness.



The Battery recycle project, called "QiMei FishMen"(七美海男人), was started from a celebration dinner for we got the first prize of "LET'S COLOR, TAIWAN". There was a neighbor who also owed a fishing boat, and he told us, the "D" size batteries were used in a very large quantity and with discretion, they throw these batteries to water. He fear these batteries will pollute the ocean. Then all of participant of the game were agree to use half of the prize to promote recycle project.

The Marine protection area project, called "QiMei Marine Adoption"(七美海洋認養), was initiated at a chat with several elder fishermen, who caught fish in the same area, west side of Island. they talked about the amount of fish was less and less year by year and the price of some fish was cheaper in Qimei than the other bigger city. We asked the community in city, and there were 38 and 42 persons participating in the first and following year. and there are 24 persons join this program two years.



The Woods Re-evolution project, called "QiMei Ecological planting"(七美生態植栽), was begun earlier this year. When we found lots of trees die every winter, we try to figure out what's going on. even though we could not precisely point the reasons, but Nature showed us a process, evolution. We contact a foundation belonging to a computer company, and prepare this program for at least 10 years.

From a community greener to a landscape architect, to a teacher, to a community issue promoter, living in community to be one of them, through the tea time chat, dinner party, and observation, connecting any possibility is what i doing now. It let the two people in different communities meet through the **Life Window** program. It let fish purchase not just buying but supporting fishermen protect the ocean. It let trees planting not just labor work but ecological process. More expectance will be happen when we let these WINDOWs open.

09-PL-03

Green Buildings for Sustainable Urban Environment

Lee, Eun-Heui

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1. Introduction

Since the Earth Summit of 1992 in Rio de Janeiro the term “sustainable development” became of central interest even though the concept of sustainable developmentgoes back to the energy crisis and environmental pollution concerns of the 1960s and 1970s. Most nations seem to be in agreement for protecting the integrity of the global environmental and developmental systems. Especially in urban areas, it is important to recognize the integral and interdependent nature of the earth; however, the situation in urban areas is always conflicted between natural and built up areas. In this coherence, the green buildings, especially with green roofs, could be a compromise in the conflict between development and the protection of nature.

In this speech green roofs will be introducedas one of the component factors of green buildings. In the climate change period, green roofs contribute not only to reduce greenhouse gases but also to increase in green areas, the construction of which has steadily decreased. The green roofs can partially substitute real green areas on the ground, but they also contribute to the effects of green areas such as absorbing rainwater, creating a habitat for wildlife and micro climate, increasing amenity by providing a more aesthetically improved townscape and roofs landscape, and mitigate the heat island effect with lower air temperature.

2. Green roof system and effects of green roofs in urban areas

Rapid industrialization and urbanization have brought about serious ecological problems. Above all, is the ongoing reduction in green spaces and increase in non-porous surfaces in urban areas modified from the natural hydrological cycle. These problems caused such conditions as heat island effects, urban desertification and urban floods, in addition to others. Since environmental problems are becoming more and more serious, there are some new efforts to limit paving and to improve the urban environment by changing dead asphalt and concrete for live surfaces; for example, permeable paving, infiltration and green roofs. The green roofs will help manage surface water, provide for wildlife and provide for recreation for human beings, etc. In Seoul, flat roofs, present in 70% of built up areas, approximately 36% of flat roof areas (55km^2) are assumed as a potential area for green roofs. In other words, such rooftop areas can be transformed into rain water reservoirs and parks.

2.1. Green roofs system

Green roofs are divided into three different types, depending on use, maintenance and construction as follows: intensive greening system, simple intensive greening system or compound system, and extensive greening system(FLL e.V., 2002)

a) Extensive green roofs in Dongdaemum design plaza (left) and Seoul Women’s University (right)

b) Intensive green roofs in Shinsaegae (left) and Lotte department store in Busan (right)

Figure1. Pictures of different types of green roofs

Table1. Comparison of different types of green roofs system

Type	Contents	Extensive system	Simple intensive system	Intensive system
Maintenance	Low maintenance	●	○	
	Maintenance		●	●
Target of Application	New building	●	●	●
	Existing building	●	○	○
Depth of Soil	Below 20 cm	●		
	Over 20 cm		●	●
Planting	Grass		○	●
	Sedum	●	●	●
	Ground covering plant	●	●	●
	Shrub, Bush		●	●
	Tall tree		○	●

The intensive green roof system, with a deep depth of soil, can support a wider variety of plants but requires more maintenance and expense. In extensive roofs, which are shallow, lighter than intensive green roofs, and require minimal maintenance, dry resident vegetation has been imported.

2.2. Effects on the storm water circulation

Approximately two-thirds of rainfall is kept in the soil, rivers, and plants before its eventual evaporation. This temporary storage of water has a significant influence on local and global climate changes. Due to increasing ground pavement with non-filterable materials, soil surfaces have been disappearing, which have, in turn, disturbed the natural water circulation function and caused ecological problems in urban areas, such as urban flooding. An extensive roof planting system was proposed as a solution to this problem. Green roofs store rainwater in the plants and growing media and allow for evaporation of water into the atmosphere. The amount of water that is stored on green roofs and the evaporate is dependent on the growing medium, its depth and the type of plants used.

Green roofs reduce the amount of storm water runoff and also delay the time at which runoff occurs, resulting in decreased stress on sewer systems at peak flow periods(table2, figure2).

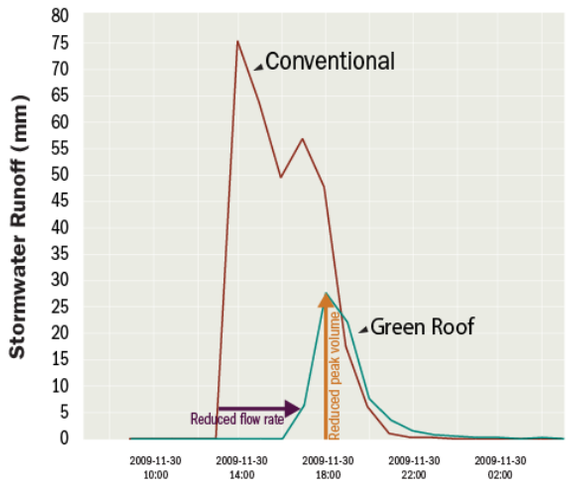


Figure2. Storm water runoff in compare with conventional and green roofs (Source, Eileen Zerba, 2010 in http://princeton.edu/reports/2010)

Table2. Runoff coefficient by surface materials

Type of surface material	Runoff coefficient
Roof of slope over a 15°	1
Roof of slope below a 15°	0.8
Green roof	0.3
Paving with asphalt	0.85～0.9
Park, natural ground	0～0.1

2.3. Improvement of Biodiversity

Green roofs with special vegetation improve habitats for fauna and flora. For example, the dry biotope is the smallest portion of all in Seoul, because it contains suitable sites for residential housing or other uses. Improving biodiversity can be help with providing special sites and vegetation. For example, the endangered butterfly -Parnassius bremeri-disappeared because of lost dry biotope with some species of sedums. Therefore the enlargement of green roofs areas can also contribute to creating different types of a landscape and biodiversity.

The number of species of spiders and beetles on green roofs in Basel, with structured and unstructured design, surveyed over a three-year period increased (Stephan Brenneisen, 2006). In addition 60% of the roof tops covered in green roofs had more species of spiders and beetles, as well as endangered insects, etc.It means green roofs could contribute to improve biodiversity.

2.4. Greenhouse gases' reduction

Greenhouse gases are produced mainly through the combustion of fossil fuels and the various economic activities of humans. The amount of CO_2 in the air has increased significantly since the industrial revolution. This increase is considered one of the most important causes of global warming. Green roofs help to reduce CO_2 in the air, and subsequently global warming. Photosynthesis in plants removes CO_2 from the atmosphere and stores carbon in plant biomass, a process commonly referred to as terrestrial carbon sequestration. Recently, many studies have been conducted to demonstratethe positive effects of green roofs on the reduction of CO_2, which can help improve ecological functions in cities and mitigation of climate change. When some of the studies were combined, they revealed that some green roof plants, such as *Hosta longipes* and *Sedum kamtschaticum*, are more effective in reducing CO_2 in the air. The CO_2 level in these plants was measured about 100 ppm lower than the ambient CO_2 concentration.

Urban spaces are hotter during the summer than suburban and rural areas because their paved surface and

clustered buildings hold and slowly release solar radiation, which is known as the urban heat island effect. Managing this phenomenon is a matter not just of comfort but of public health. Installing green roofs and cool roofs across urban landscapes can play a significant role in reducing the urban heat island effect. Green roofs are cooler owing to evaporation/ transpiration along with the shading effects.

Table3. Reduced ambient CO_2 concentration by each plant species

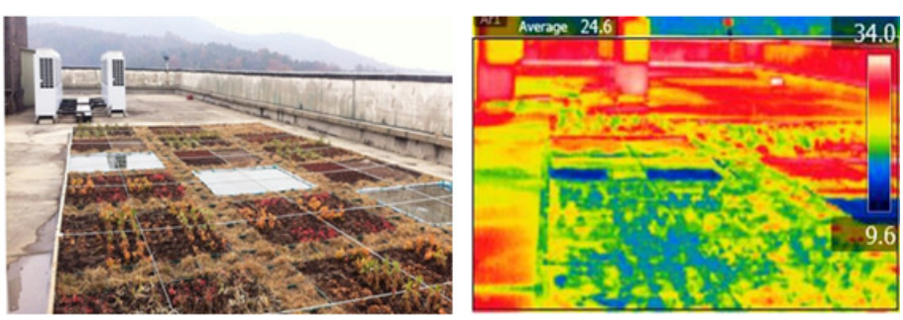
Plant	reduction(ppm)	plant	reduction(ppm)
Sedum kamtschaticum	143.7±2.8	*Saxifraga stolonifera*	71.4±3.4
Lysimachia nummularia	105.0±4.2	*Sedum sarmentosum*	96.9±2.5
Zoysia japonica	98.6±7.2	*Liriopeplatyphylla*	63.1±3.7
Hosta longipes	98.3±5.8	*Ophiopogonjaponicus*	56.1±5.8
Pachysandra terminalis	87.9±4.0	*Hedera helix*	38.1±2.6

(National Institute of Horticultural & Science, 2013; Ahn, 2010)

Consequently, roofs provide a unique opportunity to sequester carbon. If the land areas of rooftops in the metropolitan areas were covered with vegetation in some design, roofs of all urban areas would become enormous carbon sinks.

2.5. Micro-climate

The urban heat island effect has been registered in many cities in other countries. The concrete surfaces on roofs and façades and asphalted streets absorb the daily radiation. The mass of buildings and streets store this heat input. Plants could have two important effects: on the one hand, an umbrella effect; on the other hand, evaporation from the growth medium can influence the surface temperature. A comparable effect results from a cover of green plants and water, as in the followed figures.



a) The experimental site at Seoul women's university, taken June,2013
b) Green roof with a pond by Han Lilli(2012)
Figure3. Infrared photos of green roofs

3. Factors affectinggreen roofs in Korea

Green roofs are easier to implement than other programs because they just reuse the rooftops. The built up area of Seoul is 364km^2,which is 60% of the entire city of 605km^2. Within the built up areas, the roof area is 166km^2, corresponding to 36%. The potential green roof is assumed to be 55km^2. Some factors contribute to the expansion of roof greening.

3.1 "Biotope Area Factor" as one of the ecological solutions

Modern cities have many ecological problems to be solved, as stated above. Since environmental problems are more and more serious, there are some new efforts to limit paving and improve the urban environment by changing dead asphalt and concrete with live surfaces, such as permeable paving, infiltration and green roofs.

The biotope area factor is the unified planning indicator that can make full use of these techniques, such

as green roofs, permeable paving, and infiltration facilities. This originated from, the “Biotope Area Factor” (BAF) in Germany, and is a unified planning indicator comprehensively leading to improved ecological environmental functions at the three dimensional space planning level. It was fundamentally developed to resolve urban ecological problems. Its definition is the ratio of total planning area to the unpaved soil area with natural circulation functions. The Seoul Metropolitan Government applied an environment estimation indicator in the district unit planning and redevelopment project deliberation. The application of this indicator makes green roofs rev-up more, because green roofs are estimated as high as 0.5~0.6 weight rate (Table 4).

Table4. Weight by space type in Biotope Area Factor

	Space type	Weight/m²		Space type	Weight/m²
1	Greens on the natural ground	1.0	8	Paving in parts	0.5
2	Water zone(permeable)	1.0	9	Planted wall	0.4
3	Water zone(waterproof)	0.7	10	Porous Paving	0.3
4	Greens on the artificial ground 〉90㎝	0.7	11	Crevices paving	0.2
5	Green Roof 〉20㎝	0.6	12	Rain-infiltration roof	0.2
6	Greens on the artificial ground 〈90㎝	0.5	13	Paving	0.0
7	Green Roof〈 20㎝	0.5			

(Source: Seoul metropolitan government, manual of biotope area factor in urban planning, 2005)

In this way, green roofs have the following potential benefits: reducing the urban heat island effect, increasing wildlife habitat in built-up areas, filtering pollutants and CO2 out of the air, reducing storm water runoff, and filtering pollutants and heavy metals out of rainwater. For the resident, there are private benefits of providing amenity space for building users, reducing heating and cooling loads on a building, increasing building life span, and the soil and plants on green roofs help to insulate buildings for sound. However, the most important point of these benefits may be the green roof capacity of water retention and runoff in the urban environment with sealed pavements.

3.2 Green Building Certification Criteria (GBCC)

In Korea the GBCC was adopted from 2002 and revised in 2013. It is divided into the eight parts including the eco- environmental part. The latter equals from 12 - 18 points from 100 points total and contents consisting of ecological functions of outdoor spaces including façades and rooftops of buildings. The Biotope Area Factor (BAF),which is a revised version of the adopted GBCC, belongs to the latter and this item is obligatory to evaluate. The artificial ground greening including green roofs is a one factor of BAF (see table 3), even though the portion of green roofs and façade greening is not so high.The government encourages various works, making the green roofs, ecological pond and façade greening, through the political support such as Green Building Certification System.

Table5. Eco-environmental part in GBCC for example apartment housing estate

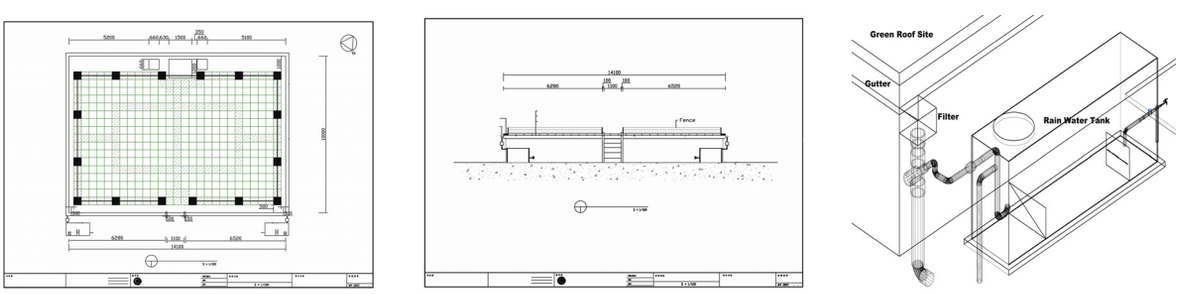
Part	Subject	Item	Evaluation	Points
Eco-environment	Creation of green areas in site	Networking of Green areas to the existing green axis	Evaluable item	**2**
		Ratio of green areas on the natural ground	Evaluable item	**2**
	Ecological functions of outdoor spaces including façade and rooftops of buildings	Biotope area factors	Obligatory item	**10**
	Creating habitat of flora and fauna	Creating biotope	Evaluable item	**4**

4. Case study of green roofs effects

4.1 Effects of retention and runoff delay of rain water

As impermeable surfaces like buildings and pavement replace open space and vegetation, green roofs can play an increasingly important role in storm water management. During rainstorms, green roofs act as a sponge, absorbing much of the water that would otherwise run off. To investigate the rain water retention capacity of existing green roofs accurately, a rain water storage system was constructed with a green roof system on the administration building at Seoul Women's University in Seoul, Korea.

The materials and methods are as follows. The green roof study was established in June 2007. The reference roof has no slope and the area is 140 m^2. This type is an extensive green roof system with 10 cm substrate depth. One hundred percent coverage was achieved in the green roof site before the data collection. Plant species used in this study included Korean native plants (*Caryopteris incana, Hemerocallis dumortieri*, etc.) and some sedum species (*Sedum kamtschaticum, Sedum sarmentosum*, etc.).



a) plan b) elevation c) tank system with filter

Figure4. The experimental site and systems at the Seoul Women's University

Figure5. Green roofs at Seoul Women's University

The rain water storage system was established with the green roof system to investigate rain water retention potential and runoff time after initial rainfall. Two tanks and an open-type gutter along the edge of the roof were installed to store rain water which passed through the substrate, and a flow meter tank was set up inside. It

measured volume of rain water into substrate over time. The photo voltaic system was established to use rainwater stored in tanks semi-permanently and water pumps were installed in each tank.

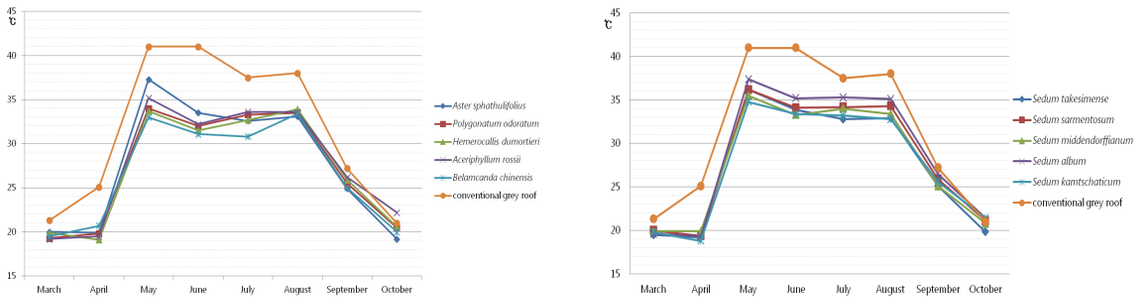
The investigated green roof effectively retained rainfall, and the mean percent rainfall retention was 87.8%, ranging from 79.4% to 99.3%. Also table6 shows that the green roof can delay the runoff by about 2 hours. Twelve rain events selected from the monitoring period are as follows:

Table6. Measured rain events and delay time of runoff on green roofs from September 2007 to August 2008

Num	Precipitation Period	Time(h)	amount of precipitation(mm)	amount of retention per ㎡ (㎜)	Percentage of retention(%)	Delay time(h)
1	2007.9.1 07:00~18:30	10.5	15.89	12.7	80.0	2.3
2	2007.9.6 04:10~17:20	13.2	11.56	9.2	79.4	2.5
3	2007.9.27 05:00~07:10	2.2	4.57	4.0	87.5	0.8
4	2007.10.19 09:20~12:20	1.7	4.82	4.2	87.8	0.7
5	2007.10.25 19:10~10.26 01:50	6.7	5.75	4.9	85.8	2
6	2007.10.21 09:10~13:50	4.7	5.28	4.8	90.0	4.7
7	2008.6.28 22:30~6.29 06:20	7.8	11.61	10.2	87.8	0.7
8	2008.7.2 08:30~16:20	7.8	6.33	6.0	95.3	2.5
9	2008.7.5 15:20~17:50	2.5	2.01	2.0	99.3	2.5
10	2008.7.12 05:00~08:00	3	3.79	3.7	97.0	0.4
11	2008.7.16 01:30~17:40	7.2	10.13	8.2	81.4	2.8
12	2008.8.1 22:50~8.2 07:30	8.7	8.85	7.3	82.1	1.8
Mean		6.3	7.5	6.4	87.8	2.1

4.2 Effects of green roofs on temperature

To suggest the most effective vegetation model of green roofs for heat island mitigation, the thermal capacity of each plant was monitored and analyzed from March to August, 2013. The experimental site is on green roof of library building at Seoul Woman's University in Seoul, Korea. Photos was taken with thermo-graphic camera (Model: FLIR T 200) targeting 10 plant species that are mainly applied to green roofs. The result is as follows: From April to September, the surface temperature of plants was lower than the concrete temperature, whereas, in the cold season, October to November, it was founded that the surface temperature of plants was higher than the concrete temperature. Namely, a green roof works as a cooling layer in hot summer, and acts as an insulation layer in the winter. The surface temperature of *Belamcanda chinensis* was 31.1 ℃ and 30.8 ℃ with the lowest surface temperature measurement in June and July respectively. According to the result of another study on the thermal capacity of green roofs, the surface temperature of grass was 2.37℃ lower than that of the concrete. And the surface temperature of Sedum was 3.57℃ lower than that of the concrete in September. In the case of green walls, the surface temperature of grass was 4.78℃ lower than that of the concrete and the surface of temperature of ivy was 2.55℃ lower than that of the concrete in September. The mitigation effect of the plant evaporation/transpiration at the lower temperature was also noted in green roofs and green wall surfaces. *Aster sphathulifolius* was especially actively growing from July to September to compare the other plants (Figure8).



a) different herbaceous b) different sedum arts

Figure8. The comparison of the temperature between different plants

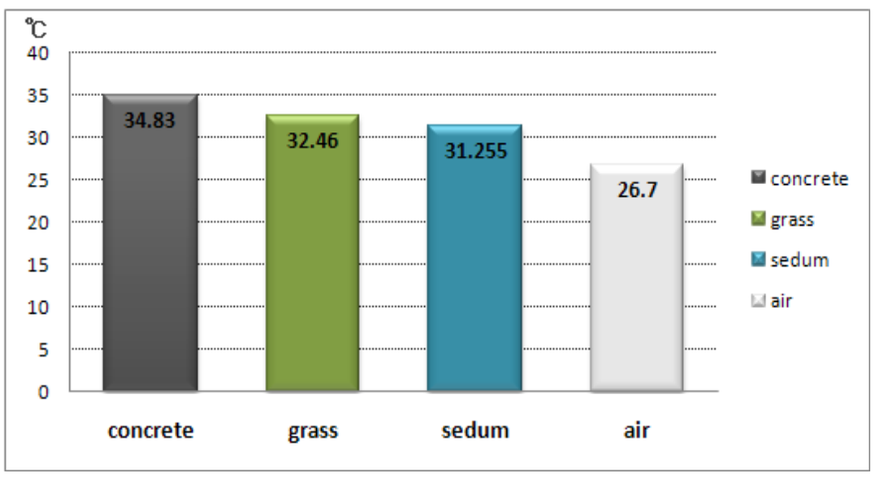


Figure9. The comparison of the temperature between different media on the rooftops

5. Conclusion

This result shows that the retention and run off delay effects of extensive green roofs can contribute to the improvement of urban water circulation. And the evaporation and oxygen-producing effect of green roofs can improve the micro-climate of urban areas. So it may be concluded that green roofs can mitigate the urban heat island effect and help with prevention of urban flooding.

Green roofs as substitutions of green areas are the best alternative plan in downtown areas like Seoul where land prices are ridiculously high. Incentives will be needed to be introduced so that citizens can participate in creating green roofs spontaneously and to increase active support about construction of such for sustainable urban environment. For example, in Seoul, flat roofs, which can be used possibly for making green roofs, constitute 70% of built up areas. In other words, in 70% of built up areas, the gray areas can be transformed into reservoirs of rain water and parks. The built urban landscape of most cities includes a huge amount of flat roof areas – more than 55km^2 in Seoul Metro City, which could, in many cases, be easily retrofitted to accommodate extensive green roof systems, which is not so dependent on the construction of existing building. Green roofs, if widely implemented, could have a significant impact on the urban heat island effect and CO_2 emission, improving the healthy urban environment.

Hereafter, studies on the impact of green roofs on the structure of existing buildings and the various administrative support and policies will be needed. In conclusion, green roofs may contribute greatly to an expansion of green areas and thus improvement of ecological functions cities.

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October 9

Oral presentation

15:30–17:30

09–OR3.3(Rm.101)

09–OR4.2(Rm.102)

09–ORV.1(Rm.202)

09-OR3.3-01

INTEGRATING NATURE IN DENSELY POPULATED NEIGHBOURHOODS: CHALLENGES AND OPPORTUNITIES

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For the last ten years, the City of Montréal has been implementing its Policy on the Protection and Enhancement of Natural Habitats to protect ecosystems and biodiversity. Most actions were undertaken in *ecoterritories*, which are vast sites that encompass most of the last remaining natural areas of the Montréal agglomeration. These sites are of great importance to foster contact between citizens and nature. Yet, as they are generally located at the extremities of its very large territory, they might be inaccessible for citizens living distantly. Considering the importance for all citizens to be able to enjoy the benefits of nature and ecosystem services, Montréal aims to enhance biodiversity in the center of the city, in densely populated and built-up areas.

In the context of the *urban promenades*, a Montréal initiative which proposes pedestrian trajectories in densely populated neighbourhoods, combining natural and cultural aspects and featuring a variety of experiences and social interaction, the Biodiversity and Urban Ecology Team considered which land management practices shall be put in place to increase greening and urban biodiversity while fostering health and quality of life. This led to the identification of numerous opportunities related to: the creation and enhancement of semi-natural spaces with a vision to improve connectivity between areas of high density and core zones of ecological interest; the choice of plants conducive to fauna (appropriate in an urban context, like birds and insect pollinators); and the presence of water and a diversity of plant strata, while ensuring favourable growing conditions.

Applying these new concepts to densely populated areas poses scientific challenges. For example, Montréal being a northern city, the selection of plant species resistant to urban conditions and extreme winter and summer weather variation is complex. Furthermore, the optimization of water management on hardscape surfaces might induce bringing surface water runoff into tree pits and landscaped zones for irrigation and rainfall control. This may create potential problems over trace metals contamination and de-icing salts pollution. In addition, success/failure indicators over time must be developed in order to assess the viability of this new urban planning philosophy.

This talk will give an overview on how the city of Montréal developed its scientific approach to integrate nature in densely populated neighbourhoods and will also present results of scientific protocols on trace metal urban soil dynamics, and artificial intelligence modeling of airborne multispectral and LIDAR laser greening imagery as success/failure indicators.

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09-OR3.3-02

AN ECOLOGICAL PROPOSAL OF ARTIFICIAL GROUND IN URBAN AREAS: A CASE OF DAEGU, KOREA

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Daegu experienced 48 days of heat wave and 35 tropical nights between June and August in 2013. This record showed an increase of 18 days and 7 nights compared to those in 2012, respectively. As a result, it is found that high temperatures of summer season in Daegu are extremely serious and it is necessary to make diverse efforts and practical proposals in our living environment.

The area of non-artificial ground is gradually decreasing as land prices rise and available land area is insufficient. Therefore, artificial ground, such as the roof and walls of a building, road, parking lot, retaining wall, and the top of an underground parking lot, is increasing and ecological areas are decreasing, instead. The increase of artificial ground causes emotional severance and lack such as psychological anxiety, mental and visual fatigue, emotional shortage, and a drop in educational function.

The ecological proposals of artificial ground in urban areas are expected to mitigate the phenomenon of urban heat islands and air pollution, to restore urban ecosystem, and to reduce the noise. In addition, it is anticipated to save energy cost, to improve building durability, to provide amenity space for rest, to improve landscape, and so on.

The purpose of this study is to make living spaces to be ecologically sustainable with ecological recovery program and regulational support program of the artificial ground. Particularly, the ecological recovery program includes methods, such as spreading cool spots, expanding rooftop-wall greening, and escalating pervious pavement.

<Dongseong-ro, Jung-gu, Daegu> <Jungang-ro, Jung-gu, Daegu> <Daegu Stadium, Suseong-gu, Daegu>
Artificial ground covered with impervious material
Transforming artificial ground into spaces covered with green and water
Applying double-planning method to artificial ground

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09-OR3.3-03

THE DISTRIBUTION AND COMPOSITION OF VACANT GREENSPACE IN BALTIMORE, USA: AN ENVIRONMENTAL JUSTICE APPROACH

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Urban vacant land is often considered to be a social and economic problem that is typically associated with overgrown, trash-ridden lots, depressed real estate values, and unwanted activities. However, vacant land could also serve as locations for new ecological and social enrichment opportunities through greenspace revitalization. Depending on the location, the biotic composition and structure of vacant land can vary considerably throughout a city, from remnant forest patches, early-successional shrub habitat, to gravel and grass covered lots. The distribution of vacant land is also typically uneven and clustered within dense, poor areas (Kremer et al. 2013). While informative, we still do not know if certain groups of residents have disproportionate access to vacant lots as greenspaces or those with more diverse avian communities and vegetation structure. Our objectives for this study were to 1) determine if there is any inequity between the placement and biotic quality of vacant land and neighborhood demographic variables; and 2) locate areas in which vacant land is clustered to focus greenspace revitalization efforts within Baltimore, Maryland.

With 2010 United States census data, we first determined if the amount of vacant land in each census block was associated with neighborhood demographic variables with a stepwise regression. In 2013 and 2014, 95 vacant greenspaces were surveyed throughout Baltimore for their bird diversity and vegetation structure. In order to determine which neighborhood demographic variables were associated with avian diversity and 16 measures of vegetation structure for each vacant lot, we ran a stepwise regression. We also used a geographic information systems (GIS)-based approach to determine if total vacant land area, and vacant greenspace floral and faunal characteristics were spatially autocorrelated and clustered.

Southern Baltimore had significant spatial clustering of condensed vacant lots, while communities in the Northeast had significant dispersion of vacant land. Total area of vacant land in census blocks was negatively associated with Hispanic and Latino populations, while positively associated with White populations and female-headed households. As we are currently collecting the 2014 biotic data, the following results were from 2013's lots. Shannon diversity for birds was only positively associated with African American populations. Tree cover, woody litter, total number of trees, and canopy height were all significantly clustered, with high values in the North. The White and African American populations were negatively associated with tree cover and count, while Females were positively associated with canopy cover, trees, and woody litter. These results indicate that the White population is currently experiencing environmental inequity regarding access to avian diversity and tree presence within vacant land across Baltimore City, especially within the southern census blocks. As the city of Baltimore begins to revitalize vacant land for its Growing Green Initiative, the information from this study is imperative to address these current environmental and social disparities.

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09-OR3.3-04

INTEGRATING OF BIODIVERSITY IN URBAN PLANNING INSTRUMENTS IN AFRICAN CITIES: CASE OF KUMASI METROPOLITAN ASSEMBLY, GHANA

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Land-use change and urbanization are being outlined as key threats to biodiversity. The dwindling of biodiversity and ecosystem services both within and outside city walls create critical challenges and opportunities for urban and land-use planning. Whereas there is a growing concern of integrating biodiversity in urban planning, discussions are concentrated on science-informed planning. Related to these developments, few established steps and approaches are provided by the Convention on Biological Diversity (CBD) to the local governments on how to integrate biodiversity in urban planning instruments. Less research explored the integration of biodiversity in planning instruments and in cities of developing countries. With the growing discussion of science-informed urban planning, little exists on the receptiveness of specific planning instruments to biodiversity and ecological science in developing countries. This research uses a descriptive method with Kumasi as a case study to demonstrate how and what components of biodiversity are integrated in master plans, medium term development plans, building codes, zoning code and permits. Kumasi for a long time is known as the 'Garden City of West Africa' because of its flora and fauna. Currently, 45.3% of the garden's forest and 88.71% of water bodies are converted into built-up areas from 1986-2007. This gives concerns whether the tools that the city planners have at their disposal are effective and efficient for integrating the city's urban biodiversity in the planning processes. Primary and secondary data were collected through an online survey, emails, Skype calls and literature reviews. It was found that, there exists a limited integration of biodiversity in most planning instruments and biodiversity components that appear are unintended. There is less prioritization of biodiversity in the city's planning process as well as budgetary allocation for biodiversity activities. Planning for biodiversity is no well decentralized to local level. The results suggest that knowing the biodiversity that exists is the first step to create an enabling environment for integration and the study, therefore, recommends the preparation of a biodiversity profile of the city. Effective integration depends on raising awareness of urban inhabitants to influence the planning process. Creating an opportunity for popular participation and utilising the decentralized planning system through integrated national planning could set the preconditions for local integration and revision of instruments. Contextualizing and simplifying the definition of biodiversity could increase local planners' appreciation, understanding and their ability to make use of biodiversity data. For sustainability purposes, long-term scenario master planning and redefinition of the mandate of local planning as a response to both 'harmony with nature' and 'health, safety and economy' are imperative.

Keywords: biodiversity, urban planning, planning instruments, integration, Kumasi, Ghana

09-OR3.3-05

Meeting supply and demand of ecosystem services in built-up areas: an illusion?

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Analyzing ecosystem services (ES) in an urban context is a very complex issue. Hence, assessing urban ES is a question of scale; a city as a whole, compared to its surrounding, might be seen as sealed, grey and ES provision is mostly reduced to large open green spaces. But zooming in, the view is changing. Built-up areas within the city often have a high share of green including green walls or roofs, hedges, lawns and trees. Thus those sites are able to provide ecosystem services and adding up their surface area, they play an important role for the mitigation of climate change and human well-being within a city. This becomes even more crucial for those parts of cities which can be characterized by a high degree of densification and scarce open green spaces (like parks or urban forests). High population densities usually entail a high demand for ecosystem services which often cannot sufficiently be provided by scattered open green spaces. Therefore, those sites have to meet their demand by providing their own supply. Because of these reasons we need a differentiated and integrative approach to assess provision and supply as well as synergies and trade-offs of ES of built-up sites within a city. Based on the concept of service providing (SPE) and service reducing elements (SRE) developed by the authors in previous studies we link for cities characteristic elements (e.g. young coniferous trees, meadows, pavers etc.) with specific values based on a literature review. We are focusing on regulating ecosystem services (air purification, microclimate and water flow regulation). By mapping and calculating budgets of supply and demand of elements within representative residential areas (highly compacted, less compacted, high share of green , low share of green), results show to which degree built-up areas can be regarded as service providing (SPU) or service reducing units (SRU). Additionally possible synergies and trade-offs have been calculated which might arise between the investigated ES to finalize the assessment.

We are able to show, that using our methodology, existing compounds as well as planned projects can be assessed regarding their potential to provide and reduce ecosystem services. The potential of built-up areas within a city to provide ecosystem services is very high. The results show, that green spaces and greened buildings, especially in highly compacted residential areas often are, or at least would be, adapting some changes, able to meet their own demand. Future studies can develop this concept further by analyzing potential land use and land cover changes of elements to improve ecosystem service supply in built-up areas.

09-OR4.2-01

FILTERS THAT SHAPE URBAN BIODIVERSITY

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A key question in both basic and applied urban ecology is "Are there unifying similarities in the patterns and processes of what makes an urban biota "urban"? We hypothesize that the biota of cities are shaped by a hierarchical series of both environmental and anthropogenic filters that determine species composition at different spatial scales, and that the contributions of these filters changes for different taxonomic groups. We employ a commonly used framework in community assembly theory, that of hierarchically imposed "filters" through which species must have the appropriate traits to "pass" in order to colonize or persist in a community. A key difference between urban biotic communities and non-urban ones, however, is that they are shaped in complex ways by human values, preferences, and activities. UrBioNet will establish a global network to collect and synthesize hierarchical databases for the filters, regional, urban, and local species pools, and life history traits for multiple taxa to understand the drivers of urban biodiversity and ultimately inform monitoring and management techniques to best conserve diverse taxonomic groups in cities. Here we will introduce our model of the filters shaping biodiversity, the data needed, and current research examining these filters.

09-OR4.2-02

OPPORTUNITIES PROVIDED BY COMBINING URBIONET DATA WITH SPECIES TRAIT DATA

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A key component of understanding urban biodiversity is to decipher whether or not there are life history traits that explain why some species are found in urban areas and others are not. Although much has been learned about urban plant and animal biodiversity, the role that life history traits play remains poorly understood. UrbioNet is a new Research Coordination Network established to gather data on urban species from around the world. The network will both house the data and offer opportunities for collaboration. When combined with existing species trait databases (e.g., TRY)the plant and animal data collected from various urban areas will help to provide a basis for understanding urban biodiversity and how life history traits may influence distribution patterns, local abundance, and community assemblages. To highlight the opportunities UrBioNet provides we will provide an overview of previously collected data and what we aim to do in the future. In addition, we will discuss how people can contribute life history data to the network and participate in network activities.

09-OR4.2-03

THE RESEARCH COORDINATION NETWORK PROCESS AND THE NEW URBIONET RCN

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In March 2014 a group of urban biodiversity researchers and practitioners received a Research Coordination Network (RCN) grant from the U.S. National Science Foundation. The national RCN program was established to, "advance a field or create new directions in research or education by supporting groups of investigators to communicate and coordinate their research, training and educational activities across disciplinary, organizational, geographic and international boundaries." Our Urban Biodiversity RCN (UrBioNet) provides an opportunity for researchers, managers, planners, and designers from around the world to meet to compile and analyze data on urban biodiversity; study ecological and social factors shaping biodiversity in cities; and review and develop approaches to management, planning and design that will help conserve urban biodiversity in cities around the world. In our presentation we will describe how to join and participate in network and discuss the there working groups that will do the work of the UrBioNet network.

09-OR4.2-04

THE URBAN BIODIVERSITY RESEARCH COORDINATION NETWORK: URBAN BIODIVERSITY MONITORING AND PLANNING

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The Urban Biodiversity Research Coordination Network (RCN) is a US National Science Foundation funded network of researchers, practitioners, and policymakers focusing on urban biodiversity research and practice. The network will engage scientists globally through regionally targeted workshops in locations that are currently underrepresented in urban biodiversity studies and acquire databases to expand the coverage of the existing databases, and develop new databases for additional taxonomic groups. Three working groups will use information in the databases to answer core questions regarding the ecological relationships of different taxa to urbanization, with consideration of cultural and social aspects, and develop recommendations for monitoring urban ecosystems. As part of the RCN, the Urban Biodiversity Monitoring and Planning working group seeks to develop recommendations for monitoring biodiversity in urban areas and share findings and data with students and practitioners in land management, urban design, urban planning, and policymakers as well as the scientific community. In this session we will provide an overview of the existing data and products that are available through the network and future activities of the Urban Biodiversity Monitoring and Planning working group.

09-OR4.2-05

URBAN BIODIVERSITY AND SOCIO-ECOLOGICAL PROCESSES

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Neighborhood and parcel scale human activities act as a fine scale filter for species composition in cities, and these activities are conditioned by socio-economic status and cultural preferences (Warren et al. 2010). Social scientists have generated rich, and sometimes conflicting, bodies of knowledge and theory about human life and the environment in cities. One key process, social stratification, links wealth and environmental quality, and predicts the unequal distribution of resources in different portions of a city, partly due to differential access to power by residents of higher socioeconomic status (Warren et al. 2010). Direct tests in a handful of single city studies around the globe show evidence for the predicted pattern of environmental quality following increasing wealth for birds, mammals, anurans, and plants (Warren et al. 2010, MacGregor-Fors and Schondube 2011, Smallbone et al. 2011, Cilliers et al. 2013). However, key counter-examples for birds and plants (Loss et al. 2009, Kendal et al. 2012) point to a need for a more sophisticated understanding of the interactions of time (i.e. lag effects), land use, and social processes.

We propose here a framework for examining the strength and nature of biodiversity- socioeconomic relationships. We reviewed more than 20 studies of within-city variation in biotic communities that included social stratification variables such as wealth, ethnicity or educational attainment. We examined characteristics of the cities in the sample of studies, including age of establishment, major forms of land cover, and city size (Aronson et al. 2014). We also classified studies according to their sampling design – e.g. single land use studies versus those encompassing multiple land use types. Our analysis suggests that urban form may set the stage for linking patterns of biodiversity and socioeconomic status, and that sampling design may contribute to the capacity for studies to detect biodiversity- socioeconomic relationships. In addition, we propose that these patterns are highly scale dependent. Key drivers of avian diversity, for example, are often quantified at the same spatial scale as national census units or "neighborhoods" (Warren et al. 2008). Thus, variation in bird or bee community structure may more readily be coupled with the neighborhood scale process of social stratification than, for example, soil arthropod community structure, which must be examined at the parcel scale (Goddard et al. 2010). We outline how our further work with UrBioNet will examine the relationship between species diversity and life history traits with socioeconomic gradients within cities to provide new insights into these complex, socio-ecological systems.

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09-OR4.2-06

DATA AVAILABILITY FOR BIODIVERSITY RESEARCH AND APPLICATION: AN OPEN DISCUSSION

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Data requirements for URBIONET are not only multi-scalar, but also dependent on the specific objectives: species traits and responses, socio-ecological, and monitoring and planning. In addition, standardized definitions will need to be defined for the metropolitan area, native and non-native species, and socio-economic metrics. All data will be post-2000. Traits and responses will be collected for flora and fauna (birds, bats, amphibians and reptiles, and butterflies and pollinators) and reported for the entire metropolitan area. Presence/absence data will be compiled, but spatially explicit data are highly desirable. Floral data will only be reported for spontaneous vegetation. Spatially explicit data will be linked to socio-economic metrics to examine to identify social drivers and socio-ecological interactions. The primary goal of the monitoring and planning component of URBIONET is to link biodiversity to planning. Unlike the traits and responses data needs, monitoring and planning will use both planted and spontaneous vegetation. Data will need to be spatially explicit. To facilitate data input for URBIONET, a website will be created and will outline the metadata requirements. Comments and recommendations from the session's discussions will be used to enhance data input.

09-ORV.1-01

CURRENT PROGRESS OF CENTER FOR DEVELOPMENT OF CLIMATE CHANGE ADAPTATION AND MANAGEMENT TECHNIQUE AND SUPPORTIVE SYSTEM

Dongkun Lee[1] · Namchoon Kim[2] · Hyunchan Sung[2] · Gwansoo Park[3] · Keumchul, Yang[4] · Dohwan Won[5] · Sunyong Sung[1] · Hogul Kim[1] · Yongwon Mo[1] · Hyomin Kim[1]

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In this research, climate change adaptation and management technique have been developing for supporting climate change secure city which will be a solution for adverse impact from urban development and climate change. In order to establish climate change adaptation, management technique and supporting system, we developed related research theme into four part: Urban biodiversity, Managing water resources, Carbon management and Supportive system.

First of all, managing urban biodiversity, urban green space has been categorized and evaluated for habitat suitability. Then methodology for the ecological network in urban area was established for dispersal of species. At the same time, connectivity structure was set for the detailed ecological network in urban area. Furthermore, shift of vegetation resulted from climate change has been projected for the consideration of national green network.

Secondly, managing water resources, Low Impact Development (LID) techniques have been tested, monitored and simulated for calculating the impact on water resource management. In the end, this research provides directions to make sustainable urban water resource from introducing better water management system in small district to establishing water resource management framework throughout city.

Thirdly, carbon management, indices for managing carbon stock management have been set for better assessment on sustainability of restored area. At the same time, carbon loss from development was calculated for managing natural carbon sink and finding alternatives in environmental impact assessment. Furthermore, the restoration model will be developed considering suitable vegetation spices for managing future carbon stock.

Finally, supportive system has been designed for comparison of technologies and helping policy makers get to know the impact of climate change adaptation management technique. Also, cost of climate change adaptation techniques to set alternatives was calculated for the sustainable urban ecosystem.

As a result of the research, ministry of environment applied the results of this research into cooperation charge on conservation ecosystem fund. Seoul metropolitan government modified the related regulation for better management on urban ecosystem. So, this research revealed the possibility of climate change adaptation techniques and their advantages on urban ecosystem management to policy makers.

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09-ORV.1-02

A STUDY OF RAINWATER STORAGE TANK UTILIZATION OF SHADE TREE PLANTING FOR URBAN ECOLOGICAL ENVIRONMENT IMPROVEMENT

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Hyunwoo Green Co., Ltd.

The bad weathers induced by climate change, such as local torrential rainfalls and heat wave, occur frequently in our life. Accordingly, urban areas try to enhance their capability of climate change adaption. Urban ecological problems become worse in the quantitative and qualitative aspects, leading into accumulation of environmental pollution, urban climate change, and destruction of urban ecological system. As a result, the restoration force and self-sustainability of urban ecological system become weak.

Therefore, this study tried to develop a rainfall storage and penetration tank for shade tree planting in urban pavements including street spaces and plazas, and apply the tank to control peak flow of rainfalls by the precipitation effect of rainfall storage, to provide a shade shelter in the climate changed induced heat wave, and constantly grow trees well even in drought. In addition, it tried to improve the restoration force and self-sustainability of urban ecological system by improving ecological water-circulation functions into almost natural ones.

This study brought out the following results: first, it is possible to reduce carbon emissions and heat island effect by growing various kinds of trees in pavements regardless of climate change; secondly, even local torrential rainfalls can be controlled in the way of quickly storing rain by local area; thirdly, the filtering and purifying process of non-point pollutants in roads, caused by daily increasing urban environmental pollution, can contribute to improving the quality of underground water and river water; fourthly, it is possible not only to recover water-circulation function through rainfall storage, retention, evapotranspiration, and penetration, but to save energy by improving and recycling underground water resource.

Through the effects, it is expected that it is possible to keep a stable urban environment from frequently occurring bad weathers, such as heavy rainfalls, drought, and heat wave, to reduce the costs for the change of the urban facilities responding to climate change (e.g., expansion of rainfall drainage facility), and to develop the tank into the system combined with various ways, including water-permeable pavement, and rooftop greening.

Key World: rainwater storage tank, shade tree, shade shelter, water-circulation, peak flow.

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09-ORV.1-03

CURRENT PROGRESS OF RESEARCH TEAM ON DEVELOPMENT OF URBAN ARTIFICIAL GROUND ECOSYSTEM ADAPTATION AND MANAGEMENT TECHNIQUE

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This study was carried out to investigate the differences of stormwater runoff reduction between soil types in green roofs. Each soil was put into the wood container, size 50(W)x50(L)x30(H), with drainage hole at the bottom to gather the water runoffs. The rainfall was controlled using spray nozzles in the plastic house of Eco& Bio cooperation.

Zeolite(K Co., Korea), perlite(K Co., Korea), vermiculite(S Co., Korea), bottom ash(P Co., Korea) and sand soil(K Co., Korea) were used as inorganic soils. Soil depth was 20cm, the amounts of rainfall were controlled 49.2mm in a hour and the rainfall duration time was 100 minutes(total rainfall was 82.0mm). Except vermiculite, the runoff start time was between 30.5 to 48.3 minutes, the amounts of runoff reduction were between 30.1 to 43.1 ℓ/m^2 and the runoff reduction rate was between 36.7 to 52.6%. In vermiculite soil the runoff was zero in this experiment.

As organic based or organic mixed soils, cocopeat(W Co., Korea), bedsoil(P Co., Korea) and ecosoil(E Co., Korea) were used. Soil depth was 20cm, the amounts of rainfall were controlled 40.16mm in a hour and the rainfall duration time was 150 minutes(total rainfall was 100.4mm). In most organic based or organic mixed soils, the amounts of runoff reduction were more than 80.0 ℓ/m^2 and the runoff reduction rate was more than 80%. To increase the stormwater runoff reduction in green roofs, organic based or organic mixed soils were more effective than inorganic soils.

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09-ORV.1-04

RESTORATION OF URBAN AQUATIC ECO-SYSTEM

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Recent climate changes throughout the world have been causing such abnormal events as the worsening urban heat island effect, drought, floods, and the unstability of the urban ecology, which in turn leads to decreasing habitats for urban animals and plants, decreasing number of species, and ultimately the loss of the balance and resilience of the eco-system. While there have been various efforts to solve the problems in the urban ecology by increasing biodiversity and making a clean environment, the restoration of the wetlands and rivers is considered to be the focus of the restoration of the eco-system.

Although the most important areas in the restoration of the biological function of the wetlands and rivers are animals and plants, the success of the restoration should be decided by the selection of plant species, vegetation restoration measures, structural stability, management method, the research into which areas has been poor. Especially, the bank protection constructed with eco-friendly concrete blocks proves to be very problematic in that the method prevents the growth of plants, the inhabitation of fishes and other aquatic creatures, so the natural purification of the rivers cannot function, which would never contribute to the improvement of the water quality. And due to the increased urbanization and industrialization, the area of impermeable surface is expanding, which makes it hard for rain to drain through the ground, and consequently causes floods. Urban floods and the depletion of water resources resulting from these problems cause drought, water pollution, the loss of flood control. To address these issues and to develop the effective technology for restoring the aquatic eco-system, this research aims to put the aquatic ecology restoration technology as part of the adaptive management technology for the urban eco-system to practical use.

The objective of this research is to ensure the adaptive management for the urban eco-system by developing practical technologies such as securing biodiversity, restoring aquatic resources including wetlands, streams. To achieve these goals requires many other technologies such as those for securing water resources and improving water quality, and for constructing habitats for living creatures like wetlands, and for restoring the streams and rivers. To be more specific, we are trying to secure biodiversity by utilizing rain water as an inflow of wetlands and streams with permeable blocks, and improving the urban water circulation system and water quality with the vegetated artificial island for purifying the ecology as a natural purification technology.

These efforts will ultimately contribute to developing the restoration technology for improving the urban aquatic environment through on-site applications, monitoring, reviews, and supplementation and consequently a higher level of technological completion.

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A STUDY ON THE ASSESSMENT FOR CONNECTIVITY ENHANCEMENT BETWEEN THE ECOLOGICAL ENVIRONMENT AND URBAN NEIGHBORHOOD PARKS

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The green zones, the only area-type except for the forests around the cities, are urban parks. But the urban parks are being reduced by urbanization, while their connectivity with the out-of-town areas are being severed and fragmentized. We cannot expect the functions of urban ecological habitats, the greenhouse gas reduction effects to adapt to the climate change, etc. in the parks and green zones created like this. So the purpose of this study is to suggest the measures to create urban parks and green zones which can respond to the urban ecological attributes and the climate change, and to enhance the connectivity between the out-of-town natural environment(forests, streams) and the urban parks, so that we suggest the techniques to establish the urban ecological networks.

For the subject cities, we selected three cities(Suwon, Seongnam and Namyangju) representing the capital area, and their neighborhood parks(Suwon 15, Seongnam 32 and Namyangju 16) which are thought to have direct connectivity with the natural environments of the cities. We will review the role of each example park at the connection axis, and analyze the ecological systems around the neighborhood parks by their types, so as to suggest three-dimensional connection measures considering the ecological connection system of a whole city and the types of the ecological systems around the parks.

The study result shows that, concerning the external connectivity between the neighborhood parks and the connection axis, 93.3% in Suwon, 62.5% in Namyangju and 53.2%in Seongnam of the cases are connected by unilateralconnectivity, while 6.7%, 37.5% and 46.8% of the cases are connected by bilateral connectivity in Suwon, Namyangju and Seongnam Cities, revealing differences between the cities. On the ecological system type, the type in which the ecological elements are connected in two sides is found the most, with the types in which one, two and three sides being 23.8%, 44.5% and 23.8%(continuous two sides in 39.7%, opposite two sides in 4.8%). Particularly, the distribution ratios of the ecological elements and the residential areas are high around the parks. About 50% of the parks in Seongnam and Namyangju are adjacent to ecological elements, while 35% of them are in Suwon. And 41.4%, 45.3% and 58.3% of the parks are adjacent to the residential areas in Seongnam, Namyangju and Suwon, while high-density residential areas are distributed the most in Suwon and Seongnam and the ratios of high-density and low-density residential areas are similar in Namyangju. In case of Namyangju, one or two-layer planting structures account for over 50% of the parks, with low naturalness, while the areas of facilities are about 40%, revealing the lack of the ecological attributes inside the parks. So you can see a problem that there is a limit in the connection, although the external connectivity is good.

Based on the problems drawn this way, in the future, we are going to suggest three-dimensional connection measures, such as the preservation of farmland around the parks, the creation of eco corridor, the complementary planting of vegetation under the street trees, etc., through the analysis of the domestic and foreign examples related to the connection with ecological axis

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09-ORV.1-06

The Economic Value of Urban Open Space: A Meta-analysis

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This paper presents a meta-analysis of the economic valuation literature on ecosystem services provided by urban open space in Korea. Urban open spaces provide a number of valuable services to urban populations, including conserving an ecosystem, recreational opportunities, aesthetic enjoyment, and so on. Until now, many studies conducted research to estimate the economic value of urban open spaces in Korea, but their results differ. Therefore, this study investigates the factors to make different results in the studies. We collect and construct a database from 45 studies in Korea, mainly for city parks in urban areas. Values are standardized to WON per household per year. The mean (median) values are analyzed by the characteristics of studies and urban open spaces. The values of these services are highly variable across individual urban open spaces. We include explanatory variables in the meta-analysis to account for these influences on estimated wetland values. The meta-regression is used to produce a value function for urban open spaces, which can be used to transfer values to other future urban open sites while controlling for site and context specific characteristics.

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A STUDY ON VEGETATION RESTORATION FOR DEDUCTING INTRA-URBAN ARTIFICIAL WETLAND CONSTRUCTION TECHNIQUE

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Waterfront space, as water environment-specific proper eco-system and also ecotone, not only creates urban culture space but it also promotes regional revitalization at a socio-economic aspect; therefore, intra-urban water eco-system restoration is the part that should be preferentially considered even at an economic level. In addition, vegetation restoration, which is the most vital element in recovery of waterfront eco-system function, displays the function of flood control, water quality purification, prevention of soil-corrosion, prevention of eutrophication and reduction in carbon, etc.; further, vegetation restoration is one of the ecological schemes to respond to climate change as well, let alone urban eco-system restoration.

This study conducted the vegetation survey on natural streams & wetlands, artificial streams & wetlands in downtown in an effort to deduct the intra-urban artificial wetlands construction technique, through which this study proposed the planting model consequent on waterfront space after classifying the vegetation types according to adaptation to water environment. This study put priority to the tree species which have high adaptation to water environment and carbon dioxide-reduction ability as wetland vegetation, and proposed the planting model which represents the artificial wetland cross section form by dividing the waterfront into underwater zone, waterside zone and high water bed zone.

The underwater zone refers to the range which includes a waterside, low wetlands, and the range which is submerged in water in time of flood, and in the underwater zone, planted are aquatic plants or march plants which can do growth even in time of permanent flooding. As restoration vegetation, this study preferentially proposed *phragmites communis* community, *Zizania latifolia* community, *Typha orientalis* community, *Typha angustifolia* community, *Scirpus maritimus* community, *Iris pseudoacorus* community, *Spirodela polyrhiza* community, *Trapa japonica* community, *Nymphoides peltata* community, *Nelumbo nucifera* community, and *Nymphaea tetragona* community, and their companion species include *Phragmites japonica, Acorus calamus, Scirpus lacustris, Sparganium erectum, Scirpus triqueter, Hydrilla verticillata* and *Salix gracilistyla*, etc.

The waterside, which is a transition area between landward boundaries and waters, improves water quality by filtering nutrient salts and earth& sand. Accordingly, it's important to secure species diversity unlike the land ecosystem; hereupon, this study proposes the *Persicaria thunbergii*, *Persicaria hydropiper*, *Phragmites japonica*, *Miscanthus sacchariflorus*, or their syantectic community, which have water quality purification ability. As companion species, *Pseudoraphis ukishiba*, *Artemisia selengensis*, *Cyperus amuricus*, and *Scirpus lacustris*, etc. are available for synantectic growth.

The high water bed zone refers to the range including bank slopes and upper bank, and it is an ecological buffer area which is mostly observed at the middle & upper stream section from the positional aspect. This zone is the range affected by flood or streams, and this study proposes *Salix* as marsh tree species in priority, and besides, *Salix chaenomeloides* community, *Salix gracilistyla* community, *Phragmites japonica* community, and *Acer tataricum* community are most suitable.

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October 9

Poster presentation

09-POV.1-01

THE PLANT SPECIES ADAPTABLE UNDER THE FUTURE CLIMATE CHANGES IN NOWON-GU, SEOUL CITY, SOUTH KOREA: THE SELECTING PROCESS WITH RCP4.5, 8.5 EMISSION SCENARIOS

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This study was proposed to adaptable plant species due to climate change scenarios using warmth index(WI) in Nowon-gu, Seoul. RCP4.5 and 8.5 climate change scenarios was used to estimate change of WI due to climate change in Nowon-gu, Seoul. According to the climate change scenarios, the WI was appeared to difference in Nowon-gu, Seoul. Furthermore, it was expected to change from cool temperate souther forest zone to warm temperate forest zone. The adaptable plant species were significantly different between scenarios. The following adapted plant species due to WI distribution change of Nowon-gu, Seoul from 2010 to 2099: 5 species in the tree later including *Quercus serrata*, *Q. variabilis*, *Pinus densiflora*, *Q. acutissima*, *Styrax japonica*, ect.; 5 species in the shrub layer including *Lindera obtusiloba, Zanthoxylum schinifolium, Rhododendron mucronulatum, Lespedeza bicolor, Ligustrum obtusifolium* ect.; 4 species in the herb layer including *Carex lanceolata, Oplismenus undulatifolius, Aster scaber, Arundinella hirta,* ect.; 3 speciees in the vine plants including *Smilax china, Cocculus trilobus, Parthenocissus tricuspidata,* ect.

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09-POV.1-02

A STUDY ON VEGETATION STATUS OF GREEN ROOFS IN DONGGUK UNIVERSITY AND SEOUL WOMEN`S UNIVERSITY*

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This study was performed to provide the base data on the status of vegetations in green roofs by analyzing vegetation of 4 green roofs in Dongguk University in September 2012 and 3 green roofs in Seoul Women's University in September 2013. Sanglokwon(SW), Dongguk Hall(DH), University Library(UL), and Information and Culture Hall P(IC) green roofs sites in Dongguk University were established in 2005, 2008, 2009, and 2010, respectively. The areas of green roofs were 700㎡, 2,300㎡, 1,240㎡, and 640㎡ in SW, DH, UL, and IC respectively. Green roofs sites in Seoul Women's University were established in 2005, 2006 and 2007. The areas of green roof sites ranged 90~100㎡.

The vascular plants in Dongguk University were identified as 26 families, 55 genera, 65 species in SW, 53 families, 99 genera, 112 species in DH, 43 families, 77 genera, 84 species in UL, and 41 families, 71 genera, 75 species in IC, respectively. A positive correlation is shown between the number of plant species and planting area. The number of introduced species were 45 in SW, 67 in DH, 66 in UL, 55 in IC. Compositae is family with the greatest number of species. In seed dispersal type, the most number of species were barochory. The naturalized plant ratio were 26.7% in SW, 26.9% in DH, 24.2% in UL, 21.8% in IC.

The vascular plants in Seoul Women's University were identified as 12 families, 20 genera and 22 species in the 2005 site, 24 families, 37 genera and 38 species in the 2006 site, 14 families, 27 genera and 31 species in the 2007 site, respectively. The total number of plant species decreased in the 2005 and 2006 sites and increased in the 2007 site since established. High proportion of dispersal type was barochory in the 2005 and 2006 site, and autochory in the 2007 site. And the proportion of the compositae family was high in the introduced plants over the sites for the all study sites. The number of introduced species were 15 in 2005 site, 29 in 2006 site, 24 in 2007 site. The longer the established time, the proportion of introduced plant species was low. The naturalized plant ratio were 33.3% in 2005 site, 27.6% in 2006 site, 29.2% in 2007 site.

Establishment with larger area of green roof might influence plant species number positively. Large number of introduced plant species since green roof establishment would be stabilized with relatively lower proportion of introduced plant species number as time passes. Compositae was family with the greatest number of species, and barochory was the seed dispersal type with the largest number of plant species. There was not a great deal of difference in naturalized plant ratios with the study sites.

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09-POV.1-03

A STUDY ON SOIL CHARACTERISTICS AND CARBON CONCENTRATIONS OF GREEN ROOFS IN DONGGUK UNIVERSITY AND SEOUL WOMEN`S UNIVERSITY*

Sangjin Lee[1] · Gwansoo Park[1] · Dongkun Lee[2] · Eunheui Lee[3] · Seongwan Jang[4] · Myeounghee Kim[5] · Sungho Kil[2] · Hanggoo Lee[1] · Kwanwoo Jang[1] · Hwanwoo PARK[1] · Junyoung Yoon[1] · Ohjung Kwon[6]

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This study was performed to provide the base data on the characteristic of soils in green roofs by analyzing 4 green roofs in Dongguk University in September 2012 and 3 green roofs in Seoul Women's University in September 2013. Sanglokwon(SW), Dongguk Hall(DH), University Library(UL), and Information and Culture Hall P(IC) green roofs sites in Dongguk University were established in 2005, 2008, 2009, and 2010, respectively. The areas of green roofs were 700 m^2, 2,300 m^2, 1,240 m^2, and 640 m^2 in SW, DH, UL, and IC respectively. Green roof sites in Seoul Women's University were established in 2005, 2006 and 2007. The areas of green roof sites ranged 90~100 m^2.

The total soil depths including vegetation soil and drainage soil at SW, DH, UL, and IC were 20cm, 10cm, 10cm, and 8cm in Dongguk University sites, respectively. The depths of vegetation soil at SW, DH, UL, and IC were <7cm, <3cm, <2cm, and <2cm respectively. The soil pH in vegetation soil ranged from 5.22 to 5.36 and from 6.13 to 6.39 in drainage soil. Available-P concentration ranged from 10.17 to 189.77mg/kg in vegetation soil and from 6.70 to 81.17mg/kg in drainage soil. Carbon concentration in vegetation soil ranged from 2.93 to 9.70%, and 0.50 to 5.03% in drainage soil. Carbon contents in 20cm, 10cm, 10cm, and 8cm soil depths were 2.62kg/ m^2, 1.89kg/ m^2, 0.50kg/ m^2, and 0.53kg/ m^2 at SW, DH, UL, and IC, respectively.

The total soil depths were 10cm at three green roof sites in Seoul Women's University. Average pH and organic matter concentration of green roof soil ranged from 5.25 to 5.96 and 7.17 to 8.96% in Seoul Women's University study sites. The organic matter concentration and pH of green roof soil were lower in 2013 than in the three establishment years. Carbon concentration of green roof soil in the three study sites ranged from 4.16 to 5.30% and total soil carbon in 10cm depth ranged from 1.57 to 1.98kg/m^2. Carbon concentration of green roof soil in Dongguk University and Seoul Women's University were comparable with forest soils at 0~10cm depths in South Korea.

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09-POV.1-04

THE ESTIMATION AND COMPARISON OF NET ECOSYSTEM PRODUCTIVITY (NEP) BETWEEN URBAN PARKS AND NATURAL FOREST IN SEOUL, KOREA

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Urban area has occupied about 2% interrestrial area, but 3 thousand billion people corresponding about 40% of total population in earth were living in the area. Because the carbon dioxide(CO_2) which isreleased by anthropogenic activities have great impacts on the global carbon cycle and balance, it is important to estimate the quantitative carbon budget in the urban area. In order to promote the capability and efficiency of reducing carbon in the urban area due to the ecological restoration process, we examined the carbon cycle and balance in the reconstructed urban park which is composed by applying landscape elements in the urban ecosystem (Nohae and Sanggye parksat the Nowon District of north-eastern Seoul). We also collected a reference data on a nearby natural forest (*Quercusmongolica* forest in Mt.Bulam) at two urban parks.

We deduced the net primary productivity (NPP) and net ecosystem productivity (NEP) based onthe field measurement of soil respirationand plant growth rates in the natural forest and two urban parks for one year. The NPP of *Quercusmongolica* forest in Mt.Bulam was calculated to be 6.44 $tonCha^{-1}yr^{-1}$, while the NPPs inNohae and Sanggye parks were found to be 0.14 $tonCha^{-1}yr^{-1}$ and 0.21 $tonCha^{-1}yr^{-1}$, respectively.The annualamount of soil respiration inMt. Bulam, Nohae and Sanggye parkswere 7.5 tonCha-1yr-1, 9.5tonCha-1-yr-1,and 6.1tonCha-1yr-1, respectively. In all study sites, the pattern of soil respiration presented theobvious seasonality, which also had the similarity with the change of temperature in soils. The Q10 values in Mt. Bulam, Nohae and Sanggye parks were 5.09, 3.23, and 2.96, respectively. These results reflected that the sensitivity of soil respiration response to the variation of soil temperaturewas higher in Mt. Bulam than those in the urban parks.

The NEP of Quercus mongolica forest in Mt. Bulam was 2.34tonCha-1yr-1. On the other hand, the NEPs in Nohae and Sanggye parkswere −5.1tonCha-1yr-1 and −3.2tonCha-1yr-1, respectively. It seemed that the urban park ecosystems did not perform as a sink by the CO2 uptake and carbon fixation through the photosynthesis, whereas they acted as a source by the atmosphericCO2emission through plant and soil respirations. Our results suggest that the low value of net carbon balance in the parks is attributed to the artificial construction of urban park based on only aesthetical value without the ecological function and restoration process.

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09-POV.1-05

IDENTIFICATION OF THE URBAN CATCHMENT FOR IMPLEMENTING GREEN INFRASTRUCTURE: FOCUS ON THE REDUCING PLUVIAL FLOODING

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Urbanization under human's convenience has changed the surface shape of the ground in natural state.Changed the urban topology by impervious area involves the change of hydrologic features that are increasing surface water flow and decreasing infiltration volume when local heavy rain.The pluvial flooding on the rise in old-high density cities has closely relates the change. It is also influenced by the artificial structures of the urban area.The related researches only have given the prognosis of existing state of the reasons of pluvial flooding yet.Nowadays, the green infrastructure (GI) suggested for one of the alternatives that make environmental restoration of urban water circulation. However it is very hard to apply on the established urban area already built. This research focuses on the changed urban hydrological condition because to concern about expansion of the GI.The approach is based analyzing of urban catchment area on the Arc-Hydro analysis of GIS applied rolling ball method and using modified DEM of the pluvial flooding recently occurred urban site that combined with existing urban vertical structures which are kerbs, buildings and walls.From the process, we re-define about the characteristics of urban catchment area for the implementation of GI and suggest the methodology.As the research result offers important geographical information of GI applying on the existing urban area which reduces the pluvial flooding risk.

Keywords : Catchment area, Urban water circulation system, Urban hydrological condition, Arc-hydro, Rolling ball method

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09-ORV.1-08

A STUDY ON COMPUTER SIMULATION AND TEST-BED MONITORING TO INVESTIGATE CORRELATIONS BETWEEN TEMPERATURE CONTROLLING EFFECT OF GREEN ROOF SYSTEM AND PV EFFICIENCY

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These day cities experience serious climatic changes due to environmental load caused by disturbance in the circulation systems of water resources and energy. As technological improvement to respond to various climatic changes and disasters are also requested in the field of construction, inter-disciplinary studies linked to the establishment of sustainable environmental control and energy systems is required in a consilient perspective.

This study is divided in two parts; the first part of this study aims to analyse optimal site conditions for photovoltaic system and green roof planting through solar radiation simulation in a integrated perspective. In so doing, it seeks to proffer basic study for developing a sound use of roof area that is sustainable in environmental and resources aspects. A computer simulation showed that, in the case of total seasonal solar radiation, summer season resulted 312.5kWh in 35% of total annual solar radiation. This season indicated the lowest radiation rate of the year for direct sunlight in 45.8% of total seasonal solar radiation.

The second part of this study aims to infer correlations in the impact of environmental changes caused by rooftop greening system on the photovoltaic power generation efficiency through computer simulation and test-bed monitoring. By doing so, it seeks to provide basic study for developing a photovoltaic system integrated with building revegetation that is sustainable in environmental and resource aspects.

A simulation showed that, in the case of sunshine hours in June, the green surface indicated temperature lowering effects of 9.19°C on average compared to the non-green surface and temperature was 9.81°C lower. Due to such greening effects, at the highest sunlight timepoint in June, P_{mpp} improved 119 W and heat loss rate dropped 7.8%.

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09-POV.1-07

EFFECT OF BIOCHAR BEAD ON ADSORPTION OF HEAVY METALS

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Biochar is a kind of charcoal produced by pyrolysis of organic wastes and has unique characteristics, high pH, CEC, and large specific surface area, so it has been used as amendment for contaminated and poor soil. However, biochar consists of unhomogenized particles and makes dust when grinding it for treatment in soil.

Alginate is polymer extracted from marine algae and it builds bead with poly-cations such as Ca, Ba, etc. by cross-linkage. Alginate bead was broadly employed for water purification, carrier of microorganisms, and food or medicine forming.

In this study, alginate bead forming technique was employed for making biochar bead, sphere shape and dust-free and equilibrium experiment was performed to prove adsorption effect of biochar bead on heavy metals (Cd, Cu, Pb, Zn, As). Results showed that biochar bead had effect on adsorbing heavy metals, especially lead and the order of adsorption intensity was lead, cadmium, copper, zinc, and arsenic. Arsenic had no effect of adsorption which is assumed that is why arsenic exist as anion, negative charge in solution.

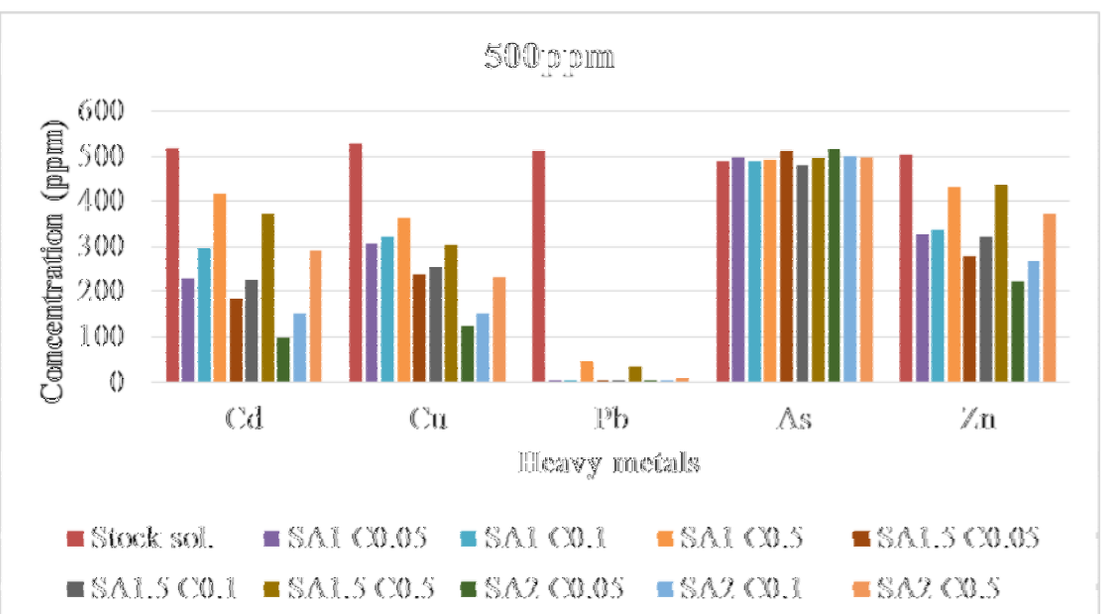

Figure 1. Adsorption of heavy metals in 500ppm stock solution.

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09-POV.1-08

COMMUNITY STABILITY AND FUNCTIONAL FEEDING GROUPS OF BENTHIC MACROINVERTEBRATES IN LENTIC AND LOTIC HABITATS OF URBAN RIVER

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We surveyed the community stability and Functional Feeding Groups (FFGs) of benthic macroinvertebrates in lentic and lotic sites of urban river. The surveyed sites are affected area by the large-scaled river restoration project, which was initiated by a Korean government in 2011, in upper Nakdong river of Andong-si, Gyeongsangbuk-do. The surveys were carried out for 4 times per year from 2012 to 2013. Immediately after the restoration project, the numbers of surveyed species were affected by the construction at both of lentic and lotic sites. In lentic site, the number of species was maintained from spring 2012 (9 species) to autumn 2013 (9 species), and increased to 22 species in winter 2013. In lotic site, the numbers of species were consistently increased from 10 species (spring 2012) to 24 species (winter 2013). In lentic site, the most abundant species and individuals belonged to GC (Gathering Collector) and P (Predator) typed FFGs, and in lotic site, GC and FC (Filtering Collector) typed species were abundant. As a result of community stability analysis with resistance and resilience of surveyed aquatic insects, the members belonging to section I, which is represented for high resistance and resilience indices, had the most number of species at all the surveyed sites.

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09-POV.1-10

DEVELOPMENT AND APPLICATION OF RIPARIAN ENVIRONMENT MONITORING METHOD

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This study suggests a riparian environment monitoring method as a standard of the steam health assessment provided for stream restoration. For the monitoring factors ten indices such as natural sand bars, water quantity (ratio of stream width to surface width), river bed material, crossing structures like small dam or weirs, channel naturalness, low stream revetment, levee materials, land use inside and outside levee, and levee type were developed. For the index of judging the healthiness of the riparian environment, Five levels of points like 5 to near natural state, and 1 to extremely damaged for each monitoring factors were determined. After applying these points, we made a guideline for healthiness of the riparian environment by determining point ranges from 15 point which is the lowest to 75 point which is the highest. We applied this guide to the mountainous valley stream. The total point was 60 points which is the second class. Although the upper streams usually correspond to the first class, the study site we investigated was lower class, the reasons of which is a steep-sloped valley that has little natural sandbars, and few water amounts due to the small basin area, and low channel revetment of concrete materials. To restore its natural state, natural formations of sandbars and preservations of more water amounts are required and the concrete revetment must be replaced by the vegetation revetment. This research has supported by the Korea Environmental Industry and Technology Institute(KEITI) grant funded by the Korea government(ME). (No.416-111-017)

Fig. 1. Monitoring of mountainous valley stream

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NATURE-ENVIRONMENT REVETMENT TECHNIQUES WITH HYDRAULIC STABILITY AND ENVIRONMENTAL HEALTHINESS

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Most of the revetments at riparian slopes are stiff revetments, which has unstable problems if one piece of them is dropped, then the entire structure collapses. This is not environmental nor natural and causes high costs which makes it uneconomic. Thus the soft revetment was developed to replace the stiff one. However, it also has a problem of the light mat and is easily effected to buoyancy. Overlap between the mats and the conjunction between the revetment and the ground surface against the flow intensity is also uncertain. Both the stiff revetment and soft one have their problems, and thus, new type of revetment that has both the resistance to erosion of the stiff revetment and the ability of rooting vegetation of the soft revetment is needed. This study suggests the improved revetment techniques which have advantages of the two types. For the low channel revetment, rock sack or rock basket revetment was suggested. They can be semi-stiff revetments having both the advantages. The material are stiff, but the sack or basket is soft. While for the high channel revetment, gabion revetment is suggested. Multi-step type and the flat type are recommended by the slope of the river levee. The materials are galvanized steal wires or fabric, but the latter one is recommended. For the rooting of vegetations certain amount of soil covering, water spraying and fertilizer will be needed. These revetments must be verified with application to the field site and with various monitoring. This research has supported by the Korea Environmental Industry and Technology Institute(KEITI) grant funded by the Korea government(ME). (No.416-111-017)

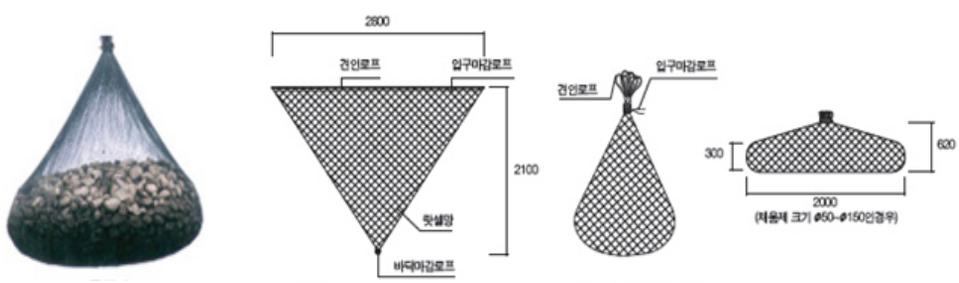

Fig. 1 Rock sack revetment

Fig. 2 Rock basket revetment

09-POV.1-12

Development of Vegetation model in ecological polis deal with climate change

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Natural environment, which is habitat of various organisms, including human being, was indiscriminately destroyed by rapid industrial development and population growth.

A definite and explicit study is necessary to resolve various demands such as reinforcing adaptation in climate change of city ecosystem and the easing of thermal island effect. In this study, enhancement of biodiversity and reduction of CO2 are treated to make invulnerable ecological polis from climate change. To approach our goal, we selected Seoul Dongjak Jeongeum village which contains width environment, slop, and artificial ground.

Jeongeum village, which locates center of a city, however, emphasizes 'environmental friendly.' Parks enclosed three sides of complex, and all parking lots locates underground, also inside of complex creates with car-free park. The slogan of eco-complex, which is rare in Seoul, seems very suitable to this village because of tree-lined streets by themes. We plan green coverage of Seoul where is exceeded the Dongjak-gu by eco-design.

We suggests plantation model with three types of methods; ecological research, carbon absorption storage for carbon reduction, and temperature irradiation and theme of temperature for easing of thermal island effect.

Ecological research showed vegetations and insects which were flowing from huge ecosystem, Seodalsan, and herbage vegetations were found in planting area. It indicated that vegetation of Seodalsan is linked with Jeongeum village, and it is ecologically excellent region. Carbon absorption storage experiment of vegetation for carbon reduction demonstrated that there are low rates of carbon absorption and storage form pine community inside the complex, and there are higher rates of carbon absorption and storage form biotope community form complex than other region ones.

Temperature irradiation of inside the complex showed that temperature of road area is higher than other region. Previous study demonstrated that planting on artificial ground of building is effective to reduce thermal island effect, and street planting strip with vegetation community of multiple layers is also more effective than single layer to ease thermal island effect.

Jeongeum village, however, is became a eco-apartment complex through reconstruction, specific and efficient model is suggested with accomplishing goals that we mentioned above. Ripple effect is expected with the beginning of Jeongeum village which would be suggested the most ideal ecological polis in Seoul.

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09-POV.1-13

SELECTION OF APPLICABLE PLANT SPECIES TO RESTORATION OF INTRA-URBAN WATER ECO-SYSTEM

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In recent times, the issue of climate change due to artificial emissions and increase in indiscriminate human activity is emerging as a threatening factor noteworthy around the globe. Therefore the research on adaptation to climate change by eco-system is beginning get attention, but in a strict sense, it's important to have concern for and to do research on the eco-system specially sensitive to climate change.

Water eco-system is a special eco-system much influenced by climate change and recently concern for restoration of water eco-system is on an increasing trend. This study proceeded with its research with focus on vegetation among restoration of water eco-system, proposed plant species applicable to intra-urban water eco-system through literature search and on-site survey, and finally selected the plant species applicable to restoration of intra-urban water-ecosystem by advancing the monitoring of steams and wetland in urban areas.

As the target area for research in a bid to select plant species, this study selected 4 targe areas based on documentary investigation and 9 target areas based on site survey respectively, and these selected target areas are restored streams and artificial wetlands which have commonly representability and are continuously being monitored in Seoul Metropolitan City and Gyeonggi-do Province.

At the level of verification of applicable species, this study conducted monitoring targeting artificial wetland additionally, and the number of target areas for monitoring were 10 in total including 3 areas in 2013 and 7 areas including 3 areas in 2013. As a result of grasping plant species from these target areas, there appeared 142 plant species in total. The species, whose appearance frequency was highest, was found to be *Humulus japonicus* identified at 7 spots, and next *Rumex crispus*, *Phragmites communis*, and *Rumex crispus* identified at 6 spots, followed by*Iris pseudacorus, Persicaria senticosa, Miscanthus sacchariflorus, Rhododendron schlippenbachii* identified at 5 spots, and *Persicaria longiseta,Conyza Canadensis, Typha orientalis, Pennisetum alopecuroides,* and *Trifolium repens*, etc. identified at 4 spots.

As a result of comparing to the applicable species as suggested above, it was found that *Phragmites communis*, *Iris pseudacorus, Miscanthus sacchariflorus* and *Typha orientalis* were high in appearance frequency at the target area for monitoring, and thus they were verified to be the vegetation well adapted to intra-urban water eco-system; it's judged that aeremchyma of their subterranean stem is well developed enough to be adapted to water environment as well. In case of the *Persicaria thunbergii* and *Equisetum hyemale*, they appeared in many target areas and their growth condition was found to be good ; further, they have the property of growing well in a place of much moisture, so it's judged that they are applicable to intra-urban water eco-system.

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09-POV.1-14

Effect of various biochars amendment on the chemistry of metal contaminated soil and plant (*Lactuca sativa* L.) response

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Biochar is a by-product from pyrolysis of biomass under lack of oxygen. Characteristics of biochar such as large specific surface area and high adsorption ability made it possible to be used as soil ameliorants. Its high pH level also helps to reduce the mobility of environmental pollutants in soil including heavy metals and pesticides. Thus, this study was conducted for investigation of chemical properties and phytoavailable heavy metal (Cd and Zn) contents ofbiochar-applied-soil after cultivating lettuce.

Soil used in this study was contaminated by Cd and Zn at7.6 mg $kg^{-1}$and 430 mg kg^{-1}, respectively. The total concentrations of Cd and Zn exceeded the warning levels in Soil Environmental Conservation Act. Biochars were originated from paper mill sludge, pruning branch and alcoholic waste (pyrolyzed at 400℃) whose pH were 8.6, 7.6, 6.2, respectively. Each biochar was incorporated into to contaminated soil at 0, 1, 2, 5% (w/w) with triplicates for each treatment level. After that, lettuce was transplanted in the soil incorporated with each biochar for 4 weeks until its harvest. Then soil pH, and phytoavailable metal concentrations (1 M NH_4NO_3 extracted) in soils, and metal contents in lettuces were determined after harvesting lettuces.

Application of each biochar declined the phytoavailable Cd and Zn concentration with observing the maximum decline in the soil received paper mill sludge derived biochar at 5% in which the phytoavailable Cd and Zn decreased by 100%, 94%, respectively from control (no biochar treatment) soil. The immobilization of heavy metals was related with the elevated soil pH following biochar incorporation. Compared to the control, the soil pH increased from 6.3 in control to 8.1, 7.3, and 6.6 in paper mill sludge, pruning branch and alcoholic waste derived biochar treated soil at 5%, respectively.The phytoavailable metal concentrations showed significant negative correlation with soil pH (r^2=0.822 (Cd); 0.914 (Zn)). As a result of decline in phytoavailable Cd and Zn concentration, metal uptake by lettuce was reduced showing positive relationship between phytoavailable metals in soil and metal contents in lettuce. The 5% paper mill sludge derived biochar treatments produced the highest dry weight of lettuce, which was 14% higher than in the control. From this study, it can be conclusive that the biochar originated from paper mill sludge, pruning branch and alcoholic waste would be good candidates for soil amendment for heavy metal contaminated soil.

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October 10

Keynote lecture

10-PL-01

Urban Waters - Ecosystem Services, Restoration and People's Perception

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1 Urban Rivers and streams under pressure and in change

Town waters are (urban), flows and standing waters which is subject to characteristic influences of the towns (commercial use, flood protection, aesthetic design, pollution eutrophication etc.) (Shoemaker 1998). You show thus considerable changes compared with waters of the same type outside towns. The standing waters are natural created small body of waters, ponds, seas, but also park waters and storm water holding bank. Flowing waters are rivers, brooks, channels and drainage ditches (Gunkel 1991). They are important habitats with them marginal areas for plants and animals. (Gilbert 1989)

Changed are particularly at municipal flowing waters:

- Hydrology and hydraulics (drain donation/-dynamics, velocity of flow),
- Waters structure (breadth, run, profile, bank),
- Type spectrum of the plants and animals, abundance,
- Waters near use (e.g. leisure and relaxation use) and
- Water condition (Endlicher 2012, p. 87).

Municipal flowing waters can take over functions in the town with that:

- Habitats for flora and fauna (ecological potential),
- Town climate improvement (climatic potential),
- Industrial and commercial use (use potential),
- Photo of sewages (disposal potential),
- Embellishment of the human habitats town (relaxation and aesthetic potential.) (Endlicher 2012, S. 89) and
- Socio-cultural, economic and ecological functions (DVWK 1996).

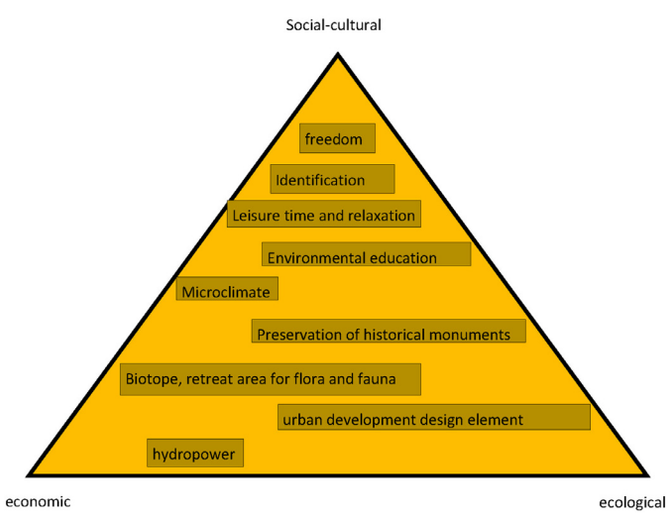

Fig. 1 Functions of municipal waters (DVWK 1996)

Table 1 shows the changes of urban waters in central European cities by anthropogenic utilization and perception. The urban rivers and streams are now most important for recreation and nature experience.

Tab. 1 Change of the functions of stretch of water and waters in Central European interior towns by anthropogenic use and perception (Kaiser 2005, S. 22)

	before 1750	1750 -1850	1850 -1915	1915 -1950	1950 -1980	starting 1980
protective function	●	•	–	–	–	–
Food, fisheries, watering	●	●	•	•	–	–
transport route	●	●	•	•	•	•
energy supplier	●	●	●	•	•	●
drinking water supply	●	●	•	●	●	●
Industrial water supply	●	●	●	●	●	●
disposal	●	●	●	●	●	●
recreational – and relaxation use	–	–	–	•	•	●
Upgrading living environment	–	–	–	–	–	●
Habitats for plants and animals	–	–	–	–	–	●

● big importan ce • Average importance • Lower importance – Carry no weight

The water quality is the most important indicator of the waters condition. Loads of municipal flowing waters due to substance entries are declining in Central Europe but in many other countries also in Argentina still available. Rivers are abused as sewers. There are other functions and with that the use for the residents at the rivers are disregarded with that or even destroyed. Substance entries cannot be tolerated therefore. They must be reduced and avoided at the sources (Kausch 1991).

A lowering of the oxygen salary which partly with technical means should be counteracted often occurs through the frequent discontinuation of the filter function of ecosystems in the waters sphere. A constant monitoring of the water quality is necessary to recognize and prevent loads early. A large part of the precipitation water does not come to the seepage through big municipal sealing areas. .It is brought by the sewage system or aboveground to the nearby flowing waters. This causes additional risks at high water there and lowers the ground-water level in the surroundings.

The technical control structure of the flowing waters leads to the isolation of habitats. The new urban

physical, chemical and biological conditions reduce vegetable and animal specialists in the damp area and promote ubiquity (diminution of the type spectrum this causes additional risks at high water there and lowers the ground-water level in the surroundings.

The technical control structure of the flowing waters leads to the isolation of habitats. The new urban physical, chemical and biological conditions reduce vegetable and animal specialists in the damp area and promote ubiquity (diminution of the type spectrum).

The often far advanced technical development of the flowing waters up to the sewage system for the reduction of the high water risk has destroyed many waters-related habitats in urban landscapes or impaired in her habitat functions considerably as a consequence. Particularly the river meadows in urban rooms as natural retention space hardly fulfill her ecological functions by river straightening and bank reinforcements and by groundwater lowering. The disturbance marked habitats meadow has often disappeared largely (Schuhmacher u. Thiesmeier 1991, Schuhmacher 1998)

2 How can people benefit from urban ecosystems – in particular from urban waters?

Ecosystem Services include all functions and processes of ecosystems people and society benefit from in economic terms or for their quality of life (Costanza et al. 1997; DeGroot et al. 2002). These ecosystem services are also provided in urban areas and cities and can be defined there as urban ecosystem services (Boland and Hunhammar, 1999). Ecosystem functions humans benefits in cities from range from water and climate regulation functions over biodiversity and pollination to aesthetic and recreational services. Since the first theoretically founded reflections about ecosystem services in the 1990ies (Daily et al. 1997; Costanza et al. 1997; DeGroot et al., 2002) but at least with the publication of the Millennium Ecosystem Assessment (MEA, 2005) it became clear that people depend on nature and ecosystems, their functions and the variety of processes and fluxes. Most of them we use without associating any (economic, social) value (Norberg 1999). In particular in urban regions and cities where the majority of people is living (United Nations, 2008) nature and ecosystems are intensively used and appear to be more and more degraded and devastated. They develop into a state where no longer being able to provide any service (MEA, 2005). According to McDonald (2009) urban ecosystem services are provided at different scales within an urban landscape: at the local (e.g. temperature regulation by tree shade, water and pollutant filtration at a single soil plot or timber production in a specific tree estate), at the regional or landscape scale (recreation, climate regulation, biodiversity) and at the global level (carbon mitigation, contribution to the continental or worldwide gene pool and biodiversity as such). Urban ecosystem services are in urban landscapes provided by vegetation area (urban green) and urban waters (urban blue). The sealed and impervious surfaces (urban grey) doesn't provide ecosystem services, it reduces them (Breuste et al. 2013).

As far as the urban dwellers should profit from urban ecosystem services the services must be provided where the people live and benefit from in their urban residential surroundings.

According to the Millennium Ecosystem Assessment (2005) and Costanza et al. (1997) four categories of urban ecosystem services (Table 2) can be defined (Breuste et al. 2013):

- Provisioning services (food and timber production, water supply, the provision of genetic resources),
- Regulating services (regulation of climate extremes such as heavy rainfall and heat waves, floods and diseases, regulation of water flows, treatment and handling of waste),
- Cultural services (recreation and tourism, provision of aesthetic features, spiritual requirements) and, finally,
- Supporting services (soil formation and processes, pollination or energy, matter and nutrient fluxes).

Urban ecosystem services can be related to the partially complementary concept of urban Quality of Life (Santos and Martins 2007) which also covers the different dimensions of sustainability from an anthropocentric point of view (Schetke et al. 2010). Table 2 lists and compares both concepts of urban ecosystem services UES and quality of life following the three dimensions of sustainability (Breuste et al. 2013).

Table 2 Services and indicators of quality of life related to the dimensions of sustainability (Breuste, et al. 2013 according to Millennium Ecosystem Assessment, 2005 and Santos and Martins, 2007).

Sustainability dimension	Urban Ecosystem Service	Quality of life indicator
Ecology	Air filtration Climateregulation Noisereduction Rainwaterdrainage Watersupply Wastewatertreatment Foodproduction	Health (clean air, protection against respiratory diseases, protection against heat and cold death) Safety Drinkingwater Food
Social sphere	Landscape Recreation Culturalvalues Senseofidentity	Beauty of the environment Recreationandstressreduction Intellectualendowment Communication Placetolive
Economy	Provision of land for economic and commercial activities and housing	Accessibility Income

3 Ecological restoration of urban rivers, streams and flood plains – international experiences

Rivers and brooks in urban landscapes are last nature elements in the urban landscape with her littoral zone. A more or less natural fauna and flora can get themselves here and remain connected by the waters under each other in a corridor differently than into parks and gardens. It is prerequisite for it, though, that the flowing waters as valuable connection rooms are recognized and treated. They are not valuable only as habitats for plants and animals but also as relaxation areas for the people and as areas in which the urbanites can re-establish the contact to nature already lost long ago. Intact flowing waters in towns are part of an intact urban landscape with that and put a particularly valuable potential, virtually the network of a green infrastructure in her. Her management aiming at it concerns a variety of possible and necessary measures. The improvement on the water quality is often the prerequisite for the re-use of the flowing waters. They must be often fetched again to the surface at single ways from the underground. The status of expansion of her banks must often be built back to make her accessible for the urbanites again. The safe accessible making makes first the perception of the municipal flowing waters possible. This concerns technical and property legal regulations. If this is possible, the restoration can be striven and realized in suitable sections of the flowing waters. Be aimed it usually cannot be which corresponds to it to strive for a condition before there has been human influences. It is all about at restoration measures to determine an aim condition which has as many features as possible of natural flowing waters therefore an as close to nature as possible to form condition and for which self-design of the river create a clearance new habitats arise from it for plants and animals in the area of waters, wetland and littoral zone which should be accessible to the urbanites as relaxation and nature experience rooms.

The urbanites already early alienated from nature must largely already be tied into these measures and them acceptance for this should be won; very good design successes are then possible. This means that reservations must get because of risks (natural and social), flagged opposite "unkemptness" and unfamiliarity and a new ratio of the town-dwellers to her waters must built upthis has already worldwide been realized successfully in projects in many towns. Flowing waters have become a new, integral part of the urban habitats there. They are straps of important ecosystem services and enrich the quality of life of the town population. Projects carried out successfully show the great potentials of the urban flowing waters for a new lasting design of the town landscapes and for the improvement on the quality of life in towns.

By waters restoration the functions at least partly and into certain often only little areas having been lost shall be established again. The original state usually cannot be the reference aim. Instead a "condition close to nature" is defined newly and by at first technical measures support. The improvement on the water quality by cleaning of the started water is at first place.

The rise of the low water drain and the connection of the flood protection with restoration measures are

current challenges in the urban waters management (DVWK 2000).

Also conservation and nature development on the one hand and on the other hand relaxation use can go together to create be able to be taken at the example of urban waters as very attractive relaxation rooms in towns again together.

Examples in Europe and Latin America show strengthen for restoration of urban streams and rivers and the integration of them into the urban landscapes.

4 Restoration of river Isar in Munich (2000 – 2011)

The river Isar flood plain is an attractive recreation area for whole Munich with its islands, gravel benches, meadows, riparian forest and parks and special for the almost 200.000 people who live near to the Isar districts. Suns, crickets, cycle, go for a walk, jog, games, and sometimes is even cross-country skiing in winter are possible. Freeing endeavors, the river Isar from fastened shores in the municipal area in some sections from her corset and there already was middle of the eighties restore to its natural state. Since June 2011 the river Isar has been between Großhessloher Wehr and the German Museum in her new natural variety experienced now.

With the project of the river Isar restoration in Munich three aims were pursued:

- Better flood protection
- More room and nature proximity for the riverside
- Improvement in the leisure and relaxation function of the urban river landscape.

Within the 1980s years the reputation got louder and louder to an Isar river closer to nature with higher relaxation quality in the city.

The river Isar plan, a restoration project which was developed by citizens, associations and political committees under participation in the context of the planning since 1995, was made in 1988.

The exemplary River Isar Restoration started in Munich in February 2000. The riverbed was enlarged and the high water dykes were repaired.

Flat, partial terrace, usable bank arose.

Gravel areas and natural bank formations with relaxation possibilities and new, interesting view relations to the river are part of the project.

Sufficient water leadership and water quality support the habitats close to nature developing of fauna and flora.

The river will design his riverbed wider in the course of the time itself.

Within eleven years the River Isar Restoration Plan was carried out on a length of eight kilometers to 2011. The reached water quality of the restored river Isar in the city of Munich was unique in Europe!

The first DWA (German union for water-supply and distribution, sewage and waste e. V.) water development price for measures carried out exemplarily for the preservation, design and development close to nature of waters in the urban area went to the water management office Munich and the country capital Munich for the project River Isar Restoration Plan in 2007.

The widening of the riverbed improved the high water flow. Today, low riverside, offshore gravel banks, gravel islands and flat ramps of big stone blocks with basins between this ("dissolved soling ramps") make the river Isar a river close to nature in the city again.

The habitat variety improved by the typical of river Isar animal and plants. Nature development, town and relaxation use can go together. The costs for the project (flood protection and restorationmeasures) amounted, to approximately 35 Mio. Euros which were carried to 55% of the Federal State of Bavaria and to 45% of the city of Munich (Wasserwirtschaftsamt München 2011).

Fig. 2 The section of the restoredriver Isar in Munich. Photo: A. Voigt 2013

5 Restoration and environmental sanitation of municipal watersheds in Belo Horizonte, Brazil (The Baleares creek restoration project 2003 – 2009)

Baleares creek restoration project was part of the SWITCH Project (Sustainable Water Management Improves Tomorrow's Cities' Health), which is coordinated by UNESCO and constitutes of a 32 institutions working net leaded by the Belo Horizonte Government (PBH) and Universidad Federal de Minas Gerais (UFMG). One of the interventions conducted by PBH was the Demurs Program that aimed at the restoration and environmental sanitation of municipal watersheds. Revisiting the river's original form, in many cases, is impossible and it is most commonly drawn to small watershed areas (Brown, 2000, Wade et al. 1998) like the ones investigated in Belo Horizonte, as a recent approach of study in Brazil. The thalweg of the first reach (s. Fig. 5) was deflected because a construction of a lateral street .The new thalweg was covered by a rock structure, it gave stability to thalweg and banks and provided roughness and permeability. The banks were recomposed with grass, bushes and young trees. Additionally a sewage network was constructed. In the second reach the creek was maintained in its original position, however, it was covered by a rock structure too. The left bank was with geotextiles and bushes. Streets and sewage network were implanted too. The reach three belongs to Baleares park area where the thalweg and floodplain were maintained in natural state, and riparian vegetation was restored. In both sides of the bank full width were constructed stream bank connections. Inside the park, the riparian vegetation was restored. The fourth reach is a small tributary of Baleares creek. It was all covered by a street with sewage network. There was no eco-morphological or landscaping intervention. The last one (reach five) is headwater areas outside the Baleares park and it is closed to public visitation. The riparian vegetation was restored and the area is still permeable. In relation to the survey, 179 structured questionnaires were applied along the Baleares creek catchment and were applied in October 2008, on the post-restoration period. It could be shown how important the assessment of the stream restoration interventions in urban neighborhoods is. The monitoring of the water quality (pre-restoration, September 2003-November 2006 and post-restoration February 2008- February 2009) results revealed a significant improvement in all assessed physical and chemical parameters. The survey indicated that the results of the intervention were well accepted by the population. This gave good perspectives in relation to the deployment of similar projects in other urban watersheds of the city. However, the preference for a "sanitary avenue" is clearly visible in relation to a more natural status of the river (Macedo and Magalhães Jr 2010).

Fig. 3 Five Reaches of Baleares Creek Restoration Project, Belo Horizonte, Brazil (Macedo and Magalhães Jr 2010)

Tab. 3 Survey results of Baleares Creek Restoration Reaches, Belo Horizonte, Brazil (Macedo and Magalhães Jr. 2010)

Questions	Responses		
You have been informed about the restoration program?	Yes: 76% (132/172)	No: 24% (40/172)	
How was it informed?	Neighbors: 46% (80/172)		Media and flyers: 23% (40/172)
	Goverment functionary: 7% (12/172)		Planning assemble: 7% (12/40)
Once informed, you were asked to planning of the restoration?	Yes: 31% (41/132)	No: 69% (91/132)	
Do you go to or want to attend the park?	Yes: 61% (106/172)	No: 29% (65/172)	
Would you rather the total cover of creek?	Yes: 50% (86/172)	No: 50% (86/172)	
Why?	Car access improve: 44% (38/86)		Reduce sickness vectors: 19% (17/86)
	Protect the creek of the pollution: 14% (12/86)		It more aesthetic attractive: 10% (9/86)
	Cover the creek: 8% (7/86)		Knew only the canalization: 8% (7/86)
	Flood Control: 4% (3/86)		The park will be dangerous: 4% (3/86)
The restoration exceeded your expectations?	Yes: 78% (135/172)	No: 32% (37/172)	
Why?	Water quality improve: 55% (74/135)		Aesthetics improve: 49% (66/135)
	Reduce sickness vectors: 29% (39/135)		Create the park: 25% (34/135)
	Car access improve: 19% (26/135)		Remove the slum: 14% (19/135)
	Flood control: 5% (7/135)		The restoration is finish: 3% (4/135)

6 Investigation on socio-ecological restoration of river Matanza-Riachuelo in Buenos Aires, Argentina

The Matanza is a less long river (80km), caudal ($8m^3/s$) and hill slope (0,35 %) that crosses over the Planicie Pampeana, a smoothly wavy landscape with fluvial modeling. Traverse the south of the metropolitan area of Buenos Aires and ends in the Río de la Plata. The contribution of numerous streams - 232 curses- receives waters above, though only three streams: Rodríguez, Morals and Cañuelas are maina basin of irregular shape

of 204.768ha constitutes, with a maximum width of 40km that shelters the 12% of the Argentinian population. The 22.14% of that area of this basin is urban, 54. 55% is rural.

Tab. 4 Land use of Riachuelo-Matanzas catchment, Buenos Aires, Argentina

Land use	Area (ha)	Area (%)
Urban	45.305	22,14
Peri-urban	18.901	9,24
Suburban	14.476	7,07
Rural	111.631	54,55
Afforestation	5.828	2,85
Bathing water	7.815	3,82
Water body	700	0,34
Total	**204.656**	**100,00**

In the superior stretch the river is not too much deep (0, 3-0,5m) and runs without bigger problems, although some canals exist to ensure the drainage. When entering to the short plain, the riverbed loses his natural feature. When entering to the short plain, the riverbed loses his natural feature. The inferior course of the river is channeled and corrected and denominates Riachuelo in his last 15 km of his exit in the Río de la Plata estuary, reaching his biggest depth there(7 m).

The river Matanza-Riachuelo is the most contaminated of Argentina and he has a long history of negative environmental impacts. Buenos Aires second city founding took place in 1580 on the banks of its exit impacting the natural landscape and water quality. Governments have implemented programs by far breath; to the same time that civil society continues lathe programs to the participation, the city control and diffusion of the environmental problematic of the basin. The contamination situation that aggravated one in the 19th century by the installation of meat factories (saladeros) in his borders goes back to colonial period. During the 20th century the predominant contamination went by production agricultural rancher in the superior course or by effluent industrial and domestic who were put its waters in the inferior and middling/half courses.

Measurements made between 1998-2001 revealed critical conditions in the contents of dissolved oxygen, high leaden values and chromo that impacted life in the river. For the contamination by effluent the joined numerous rubbish dumps opencast and illegal occupancy of his banks. Such urgent environmental situation sensitized the civil society.

The Foundation City (La Fundación Ciudad) made between 2002 and 2003 discussion forums in the three sectors of the basin calling multiple actors in searching of consensual solutions that were high in her authorities.

Although several environmental improvement attempts existed, the situation starts to improve from 2006 with the creation of the Authority of the catchmentMatanza-Riachuelo (Autoridad de Cuenca Matanza-Riachuelo, ACUMAR). His operating dynamited one in 2008, in replaced to the intimation from the Supreme Court (Corte Supreme de Justice de la Nation de Argentina) as a result of a judicial case presented in 2004 by a group of lower basin neighbors. Although punctual contamination foci persist still, generally, water quality has started to improve by decrease and control of effluents illegals. In the river banks they took measurements to extract the barrels from abandoned boats, re-localize people who lived in poor way on the brooks, completed the towpath, eliminated garbage dumps and was a plan of cleaning and afforestation implemented in some sectors. The river covers a slow but contestant path towards his recovery. Governments have implemented programs by far breath; to the same time that civil society continues lathe programs to the participation, the city control and diffusion of the environmental problematic of the basin.

In the management and special in programs of rehabilitation/restoring of space of the banks the environmental perception that has the community is useful to identify problems and discover potentialities and synergies. To worldwide level there is you are seen of which the opinions and attitudes that people has environmental quality towards the river and his brooks is related narrowly to the landscape and depends on proximity to the water courses. To long of the basin 2012-2013 brings in one

Domiciled until 1 brook km. User a poll that explored the experiences and memories associated with the river, made activities, his aesthetic value, and the perception on water quality residua, human impacts and risks. Also asked about which possibilities of changes discerned and which could be the individual commitment in the environmental quality improvement searching.

The neighbor opinions reveal that most considers that the banks landscape is ugly (33%) or very ugly (49%) because of the water contamination and to the garbage (80 %.) , 63% considers to quality of the water as bad and a 27% as very bad basing on the color and on the perceived smell. For a 90% of the polled the river does not offer any possibilities of recreation.

More than half of the high and half basin neighbors' show have negative experiences with the bank environment because of the floods or reek, meanwhile that 57% of the residents of the lower basin do not have relation to the river. The insecurity as disturbing feature was mentioned by a 48% of lower basin people and 28% in the middle.

Around 75% parts of the upper and middle basin polled are provided to collaborate with the municipality in the cleaning, maintenance and bank environment control. This predisposition is smaller in the lower basin (59 %.)

Although the space of the bank is not used, the residents state that it could be a place where their children could play at present (66% in the upper, 75% in the lower and only 39% in the middle basin).

The close residents to the riverine edge say having a negative relation with the river because of the flood danger and the reigning environmental conditions, whereas the more moved away they show not have any relation and they complain about the insecurity, but they think that the river has certain potentiality of being used to the recreation.

The predisposition to collaborate on the cleaning, maintenance and control is bigger in the neighbors domiciled until 500 m of the brooks (84% <100 m and 76% between 100-500 m) and reduces to 51% for the most distant.The resident women until 500 m of the brooks were significantly more inclined to give help than the men.

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10-PL-02

RESTORATION OF URBAN WATERWAYS AS A GREEN INFRA

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ABSTRACT

Since the dawn of human civilization, the built environment has changed the natural environment surrounding human settlements to varying extents. Urbanization, particularly when developing regions in the world started to accelerate their urban expansion, has dramatically changed the ways that humans and nature interact, degradingthe quality of human life and biodiversity in the urban areas. This articlepresents a state-of-the-art review, in Korea, of how the degraded urban waterways have been restored, as a green infra, and thus have helpedincrease the biodiversity and improve the aesthetics of urban areas.

Ⅰ. INTRODUCTION

Green Infrastructure (or simply GI in this article) is a concept that originated in the USA in the mid-1990s that highlights the importance of the natural environment in decisions about land-use planning. It is also called the blue-green infrastructure or green-blue urban grids, and usually refers to the patchwork of natural areas that provide habitat, flood protection, and cleaner water. More specifically, USEPA (2014)refers to GI in reference to water conservation and waterways restoration, such as rainwater harvesting, bio-swales, permeable pavements, green streets and alleys, and land conservation of riparian areas and wetlands.

On the other hand, GIis more broadly defined in EU as a strategically planned network of high quality natural and semi-natural areas with other environmental features, which is designed and managed to deliver a wide range of ecosystem services and protect biodiversity in both rural and urban settings (EU Commission, 2013). Similarly, GI is defined as a network of high-quality green and blue spaces and other environmental features, including parks, open spaces, playing fields, woodlands, wetlands, grasslands, river and canal corridors allotments and private gardens (Natural England, 2014).

This article is focused on the restoration of urban waterways such as streams and rivers that have been degraded by urban settings and human activities. They may be an essential element among a variety of green infra tools to foster a better quality of urban life and improve biodiversity in urban areas. Recently, Korea has carried out various stream restoration works,particularly in densely populated urban areas, and similar projects are still being undertaken in many cities as a way of promoting a blue-green infrastructure for improving the ecological networks as well as quality of life.

This article provides some basic statistics onthe urban streams and rivers in Korea, the initiation of urban stream restoration works, and somepending issues related to the presentrestoration practice.

Ⅱ. STATISTICS OF URBAN STREAMS IN KOREA

As of 2012, thetotal length of all the streams and rivers managed by law is about 65, 000km with a stream length density of about 0.65 km/km^2. Among these, a total length of about 30,000km of mid- and large-scale rivers and streams are called “National/Regional Rivers” that are managed by the “River Act”.The remaining small-scale streams are called “Small Streams” that are managed by the “Small Stream Improvement Act”.Among the streams and rivers managed under the River Act, the length of urban streams is about 3,000km, with a stream length density of about 0.33km/km^2. Currently, more than 90% of the total population in Korea dwells in the urban areas, which indicates the importance of the urban streams as a green infra to provide a better quality of life in the urban areas.

Since the 1960's, accelerated industrialization and urbanization have greatly altered the natural river ecosystems in Korea, particularly in the urban areas. About 80% of the total lengths of the streams and rivers that need levees or other protections for flood control have been totally channelized, while the urban river basins have been fully or partially covered impermeably with houses and streets.

Ⅲ. INITIATION OF RIVER RESTORATION WORKS

Since the progress of urbanization in the 1960s,the streams and rivers in Korea have been changed in four or five distinct stages (Woo, 2010). Before then, most streams and rivers remained in their natural conditions, with few artificial structures such as dams (including irrigation weirs) and levees. During this period, the ecological functions of rivers were well preserved. A typical example of such rivers is shown in Fig. 1(a).

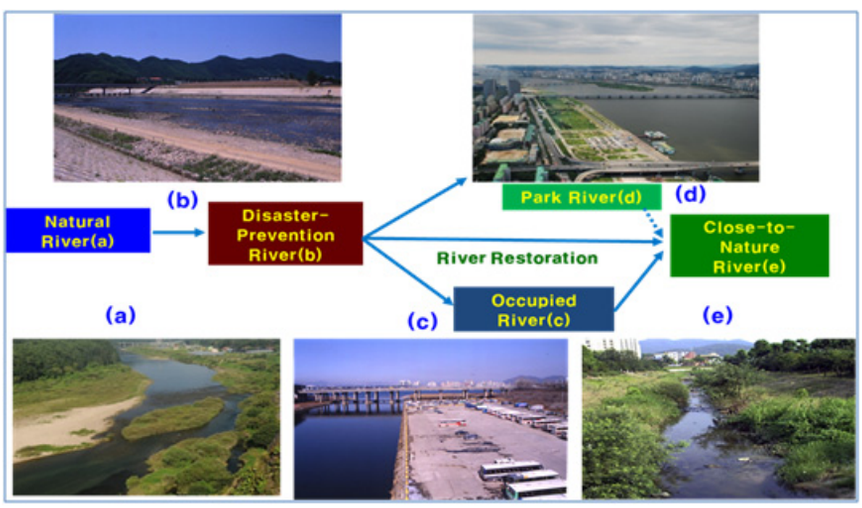

Fig. 1 Changes in river management practice in terms of channelization and restoration(Woo, 2010)

Since the mid-1960s, however, rapid urbanization, industrialization and reclamation of cultivated lands caused the overall environments of many streams and rivers to continuously deteriorate. Major causes during those years were single-purpose channel works for flood control, reclamation and the readjustment of riparian cultivated lands, i.e., so-called channelization. This type of river is called a "Disaster-prevention River" because in such rivers, flood control is considered first, while in most cases the ecological function of the river is neglected. A typical example of such rivers is shown in Fig. 2(b). As result, many rivers and streams have lost their precious natural functions including ecological habitats, self-purification of river water, and riparian scenery.

Since the 1970s, another pattern of river work practices began mostly on the urban streams; that is, to occupy the floodplains of the streams for purposes other than those belonging authentically to the streams, such as roadways, parking lots, and even covering the streams. This can be referred to as "*occupied river*" - A typical view of such streams is shown in Fig. 1(c).

In the early 1990s, the necessity of the restoration of those channelized and/or occupied rivers particularly in the urban areas emerged with a social mood of social development and environmental concern. Attention was paid in particular to the channelized urban streams with concrete-covered revetments, and clear-off corridors. City managers have converted these into pleasant-looking "river parks" for the public. Such rivers can be referred to as "*Park River*" - in which the aesthetic value of the river is restored. This trend of the conversion of channelized rivers into *Park Rivers* continues in Korea today. A typical view of such rivers is shown in Fig. 1(d), which was first made in 1986.

Stream restoration or river restoration, including the restoration of the natural functions of the rivers, had only begun in Korea in the late 1990s, initially as some demonstration projects under government-supported

research projects. Such river reach regenerated by restoration works can be called a “Close-to-nature River” as their natural functions are significantly enhanced. A typical view of such rivers is shown in Fig. 1(e).

Examples of Urban Stream RestorationWorks

The Yangaje-cheon (stream) Demonstrative Stream Restoration Project (Woo, 2010) was a part of the National R&D Project (1996-2001) funded by the Ministry of Environment (KICT/MOE, 1998). The test reaches are located in a small urban stream, the Yangjae-cheon, originating in a hilly and mountainous region, located southwest of Metropolitan Seoul, and eventually merging into the Han River. The stream had been thoroughly modified for its maximum flood conveyance in the 1970s (Fig. 1a). Fig.2b shows the same reach after topographic and vegetative restorations. More species have been found in the stream reach after restoration.

(a) Before Restoration Work (1996) (b) Three-years after Restoration Work

Fig.2A Demonstrative Stream Restoration Project(The Yangjae-cheon)

The success of this research project stimulatedthe implementation of similar projects in the urban streams nationwide from the late 1990s. They are, however, still in the *park river* stage, because they have focused mainly on improvingthe stream water quality and enhancing the riparian aesthetic value rather than on restoring the river ecosystem, which may be inevitable in such highly urbanized areas. One such case is the Cheonggye-cheon Restoration Project in Seoul, a well-known urban stream restoration project in Korea, which was completed in 2005. It is now one of the most popular tourists’ spots as well as one of the best walking and resting places for citizens in Seoul.

Fig.3 Comparative pictures before and after the Cheoggye-cheon project
(Left: a highway-decked street, right: a revived stream)
(Photoscourtesy of the Seoul Metropolitan Government)

Ⅳ. ISSUES AROUNDURBAN STREAM RESTORATION

In Korea, there are two distinct views on stream or river restoration works, sometimes collidingwith each other because of the different perspectives of groups concerned. One group, which we could call "upper perspective" group, usually includes ecologistsand environmentalists, and considers the present level of stream restoration practice in Korea being at the "*park river*" level. They sometimes look downon it as another artificial type of river works, far from restoringthe river's natural or environmental functions. On the other hand, another group, the "lowerperspective" group, usuallyincludeslocal residents and river managers, and considers restoration of river's natural functions, such as close-to-nature river in Fig. 1(e), to interfere their living environment because of the hindrance presented by the naturally-looking riparian condition to recreational activities such as walking, roller-skating, and fishing in the stream. In addition, they are afraid of the flood conveyance of the stream being reduced due to the thick vegetation grown in the channel. As such,they re-changed the re-naturalized stream reach in Fig. 2(b) to Fig. 4!

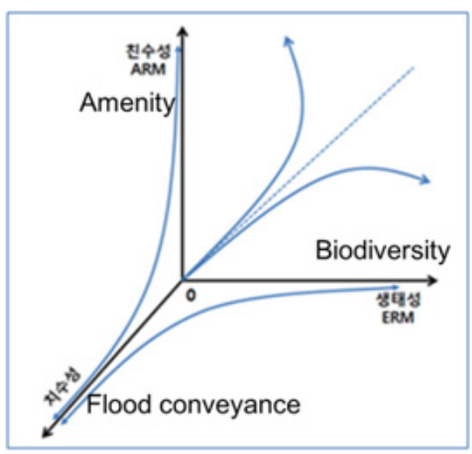

Fig. 4Re-work of a demonstrated streamrestora-Fig. 5 Relation of the three functionswork tion(Personal photo by the author, 2009)(biodiversity/amenity/flood conveyance)

These conflicting views may be attributed to the conflicting functions of streams, i.e., flood conveyance and ecological habitat expressed in biodiversity as shown in Fig. 5. In addition, a stream has aesthetic value, which is usually proportional to its capacity to provideecological habitat (biodiversity) in the beginning. The flood conveyance function, however, is usually in conflictboth with amenity and biodiversity.In most cases in Korea, urban stream restoration practices do not consider river widening because of the high land price in the urban areas. Amenity, expressed in the aesthetic value, may increase as biodiversity increases, such as in the *close-to-nature*type of stream, but their relationshipeventually becomes divergent.

In order to consider both of these two different views on the present practice of stream or river restoration in Korea, two types of river restoration models, different from but interrelated to each other, have been suggested, theAmenity Restoration Model and the Ecosystem Restoration Model(Woo and Kim, 2006). Fig. 6 shows the schematic diagram of the characteristics of the two models.

The Amenity Restoration Model (ARM) focuses mainly on the restoration of the aesthetic values of river. Here, aesthetic values mean amenity, accessibility, recreation, and historical/cultural values. It is a human-orientedmodel that results mostly in the"*park-rivers*" shown in Fig.1 (d) or Fig. 3(right). This model may be more plausible forrestoring highly urbanized watersheds and highly developed river corridors, where any efforts for ecosystem restoration may be limited due to socio-physical conditions surrounding the river.

On the other hand, the Ecosystem Restoration Model (ERM) focuses mainly on the restoration of the ecological system of a river; i.e.,the self-sustainability of the physical and ecological dynamics of a river. It is nature-oriented. This model may be more plausible for restoring sparsely urbanized watersheds and less developed river corridors. Ecosystem in the rivers restored under this concept should be self-sustained. Good examples of this model are still rare in Korea.

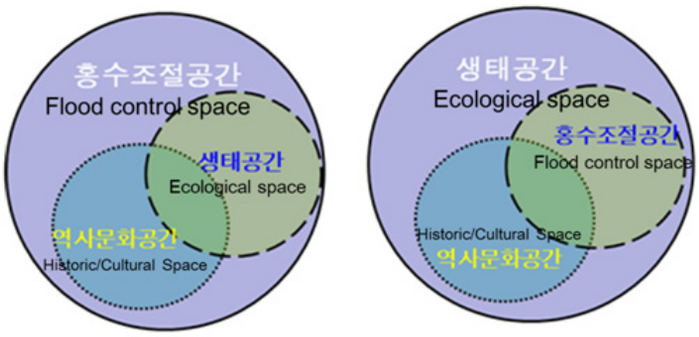

Fig. 6 Schematic diagram of ARM (left) and ERM (right)

In the design process, the allocations of river corridor space for these two models, ARM and ERM, should be different. In ARM, the space for flood control mostly encompasses spaces for ecological habitat and historical/cultural spaces (Fig. 6 left). On the other hand, in ERM the space for the ecosystem needs not be limited to within thespace for flood control. It can be larger than the space for flood control, and interconnected with neighboring terrestrial habitats (Fig. 6 right).

The reference for each model is also different. For ARM, it is usually hard to delineate the 'original' river because of a long time-span as well as urbanization and channelization. ARM, therefore, focuses naturally on the landscape architecture and sometimes the restoration of historical places. On the other hand, for ERM time-span is usually short, and a proper reference can relatively easily be obtained from the old maps, pictures and data of the relevant river.

Ⅴ. SUMMARY

The EU Commission (2013) clearly indicatesthe various benefits provided by Green Infrastructure, such as environmental, social, climate change adaption and mitigation, and biodiversity benefits. Restoration of urban waterways in particular provides with clean water, better human well-being, enhanced tourism and recreational opportunities, strengthened ecosystem resilience, improved habitats for aquatic wildlife, and ecological riparian corridors.Among these benefits, present approaches to urban stream restoration in Korea obviously enhance tourism and recreational opportunities, improve habitats for aquatic wildlife to a certain degree, and increase property values along the restored stream in many cases. However, floodingfrom the urban streams, which is one of the most critical factors in urban region management, could be rather increased with the current stream restoration practice in Korea due mostly to re-vegetation in the stream. However, this can be mitigated using typical green infra tools such as rainwater harvesting, permeable pavements, green streets and alleys, and land conservation of riparian areas and wetlands.

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10-PL-03

The Power of Doing:
The Case for Creating Local Examples of Green Practices in Cities

Mark Hostetler

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Mark Hostetler is a Professor, Department of Wildlife Ecology & Conservation, University of Florida. With over twenty years of experience in urban wildlife and green development issues, Hostetler conducts research and outreach on how urban landscapes could be designed and managed, from small to large scales, to conserve biodiversity. He has extensive experience in working with homeowners, developers, and policy makers on ways to manage and design residential developments for biodiversity. Hostetler co-founded University of Florida's Program for Resource Efficient Communities and collaborates with an interdisciplinary team of scientists and graduate students. Hostetler works with policy makers, developers, and homeowners to establish natural resource conservation strategies in communities that are billed as "green" developments. In particular, he conducts a national continuing education course on conserving biodiversity in subdivision development, and he has recently published a book titled, *The Green Leap: Conserving Biodiversity in Subdivision Development*.

Built environment professionals and the public are reluctant to adopt new conservation practices that benefit urban biodiversity. Conventional inertia, perceptions, economics, and policies stifle innovation, making it difficult to gain a foothold in cities and neighborhoods. Academics, environmentalists, and built environment professionals alike are adverse to promoting and trying new solutions. Academics have had successes in defining the urban biodiversity problem through monitoring the decline of plant and animal species, but we are reluctant to jump into the "real world"and push for solutions. Academics get bogged down in the nuances and "what if" scenarios. Built environment professionals, citizens, and city planners, waiting for that maverick to step forward,are unable to make that first step themselves.Fear of failure often cuts down implementation of innovative designs or management practices. People want to have the perfect solution that is tried and true, and often this entails waiting many yearswhileopportunities passby. Embracing uncertainty is not in the vernacular of most urban decision makers. How can new paths be forged? What steps are critical to foster innovation and implementation within metropolitan areas?

Over the past 10 years, I have been involved with an interdisciplinary group at the University of Florida, the Program for Resource Efficient Communities (http://www.buildgreen.ufl.edu); we partner with cities and built environment professionals to explore and implement novel urban design and management practices. We have had failures and successes, and in this talk, I will outline lessons learned and commonalities of successes that we have had. Over the years, I have become convinced that nothing speaks louder than a local example of a conservation practice that benefits urban biodiversity. Implementation could be in a yard, a neighborhood, or a public space. Built environment professionals and citizens have a chance to see, touch, and discuss a local design or management action. This pays huge dividends in terms of community acceptance for innovative practices that benefit local flora and fauna. But how can environmentalists and academics alike get the ball rolling?

Using several case studies, I will demonstrate and discuss U.S. and international examples where local initiatives have spurned new ways of doing business. Examples span the gambit of low-impact development (that address stormwater issues and biodiversity) to targeted open space conservation that balances human and wildlife needs. The devil is in the details and each example has specific solutions that are transferable to any situation around the world. For example, working with developers in Florida, we helped the developers of the Town of Harmony and Madera (http://www.wec.ufl.edu/extension/gc/) to implement novel design and management practices that had biodiversity benefits. One novel approach adopted in Harmony was the installation of a "Wildside Walk" that consisted of educational kiosks that educated residents about natural resource conservation

and how to minimize impacts stemming from the built space, keeping nearby conserved areas healthy (http://www.wec.ufl.edu/extension/gc/harmony/documents/wildsidewalk.pdf).

In addition, I think that we need to integrate ecological data into design in such a way that visual outputs will allow city planners and developers to assess different scenarios and achieve results that provide optimal biodiversity solutions. Collectively, researchers over the past 60 years (or more) have collected a good deal of data on urban biodiversity and impacts on urban plants and animals. From urban gradient studies to patch dynamic studies, we have a plethora of empirical data that suggests how various urban designs would impact various species. However, these studies have not affected actual planning decisions in most cities (there are exceptions of course).

Often, to address biodiversity, urban decision makers do not use empirical studies because they are too detailed and/or they target particular taxa (i.e., urban bird studies dominate the scientific literature). Most planners and other urban decision makers rely on broad ecological theories to shape planning. Planners can manipulate three things that affect urban biodiversity: 1) the quality, amount, and patch size of conserved open space; 2) how open space and nearby built areas are managed; and 3) the degree of open space connectivity. Currently, to guide green infrastructure conservation, planners and landscape architects use island biogeography theory (MacArthur and Wilson 1967), using species-area curves and distance to source calculations, which translates into conserving large remnant patches (Linehan et al. 1995). They also create wildlife corridors and improve landscape connectivity, which stems from meta- population theory (Keymer et al. 2000). Overall, these ecological theories translate into clustering built areas, conserving some percentage of open space, and protecting lands for corridors (Arendt 1996). While conserving some connected patches is a good step, in reality, it is much more complicated to determine which species gain and/or lose from one design versus another.

In reality, suites of flora and fauna respond differently to sizes of connected patches, nearby land use impacts, and fragmentation/edge effects. A given corridor and patch arrangement has different effects on mammals, butterflies, herpetofauna, birds and the associated vegetation community. For example, scattered patches of habitat are more connected for birds and butterflies than for mammals and herpetofauna, because the built matrix impedes the movement of ground-dwelling animals (Hourdequin 2000). Size of the animals also matters as very small species, e.g., small beetles, hummingbirds, small lizards, and mice, operate at different scales than larger animals, e.g., large butterflies, raptors, alligators, and bears. Also, edge effects impact different species within a taxonomic group; for example, specialists are more vulnerable to fragmentation than generalists (Hilty et al. 2006). People may believe that only large patches are worth conserving but even fragmented landscapes, if done correctly, are capable of benefiting a whole suite of species (Dupre and Ehrlen, 2002; Bastin and Thomas 1999). Typically, we do not have the opportunity to evaluate the impacts on different species, and we just go with general principles in urban design.

Design is important, but both the conserved areas and the landscape matrix surrounding the conserved areas must be managed appropriately. Any green infrastructure can dramatically lose its biological integrity over time due to lack of appropriate management for both built and conserved lands (Hostetler 2012). For instance, invasive plants and animals may spread into conservation areas, requiring invasive exotic control within conserved habitat. Additionally, most urban natural areas are missing certain ecological processes and need some type of habitat management; examples include prescribed burns, roller chopping, restoration through native plantings, and other activities used to improve or maintain the habitat for native plants and animals. Even day-to-day human behaviors can impact green infrastructure (Hostetler 2010; Hostetler and Drake 2009): ATV vehicles running through conserved areas, infiltration of feral cats and dogs and other exotic pets, nutrient and chemical intrusion caused by improper use of fertilizer/herbicides/pesticides, and increased impacts from light and sound pollution (Longcore and Rich 2004). Thus, even with green infrastructure design, funded management plans are needed and residents in nearby built areas must be engaged so that their homes, yards, and neighborhoods enhance and rather than damage local biodiversity efforts.

With all these nuances, it is no wonder that planners and conservationists rely on broad theories to make decisions. Also, many of the urban studies are not understood (or heard about) in the planning world, and they are not incorporated into urban planning. To date, urban decision makers state that they do not have sufficient information to holistically address how alternative design and management practices can improve the biological integrity of cities (Ahern 2013). Tools have not been created that synthesize urban ecological data into a format that can be used by most city planners.

What to do? I suggest that we (ecologists) explore (more often) what urban planners actually use in the "real world" to make decisions. Typically, most city and county planning rely on land use maps and evaluate different designs by utilizing GIS software, such as ArcGIS Desktop software. One robust decision-support tool, called CommunityViz®, is an extension of the ArcGIS Desktop software that enables formula-driven alternative future scenarios, as well as, front-end web-based and digital presentation-driven information sharing. The software is flexible and facilitates, land use scenario planning, sketch building, time scale interval visualization, social-ecological impact assessment, urban growth modeling, and similar GIS related functions. CommunityViz® has been in use for over a decade with an extensive, and growing, track record of application to public and private sector urban land use planning processes (http://www.orton.org/tools/communityviz). By the way, this is not an endorsement as there are other similar tools available, it is just one that I am familiar with.

In other words, if we had flora and fauna biometric equations that would plug into CommunityViz®, planners would have a tool to evaluate different design and management options and their impacts on a suite of species, *simultaneously*. This planning tool permits biometric equations that run in the background and display various impacts from alternative planning design and management decisions. For example, planners can manipulate patch sizes and management practices for a 100 ha site, and the outputs would display impacts on birds, mammals, and insects simultaneously. I believe such an integration of ecological data with a visual planning tool will provide the three characteristics needed to make sustainable development decisions: *saliency* (relevance to decision making), *credibility* (scientific adequacy), and *legitimacy* (fair and unbiased information production that also respects stakeholders' values) (Cash et al. 2003).

Of course, we are currently missing these biometric equations. I propose getting a group of ecologists, planners, landscape architects, and other interested built environment professionals and tackle this problem. I have ideas about how to do this (e.g., meta-analyses) but we need various expertise involved to create usable and realistic equations for taxa big and small. Conserving green infrastructure and implementing management practices takes effort and money, and the use of these biometric fauna and flora equations will help cities to develop better planning strategies and be more confident that they are getting "bang for their buck!" Perhaps through a workshop, we will map out a strategy to generate biometric equations, ultimately helping urban decision makers to evaluate which species and groups lose or gain from different urban designs and management strategies.

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October 10

Oral presentation

14:00–15:30

10–OR1.1(Rm.306)

10–OR2.1(Rm.202)

10–OR3.1(Rm.101)

10–ORV.2(Rm.102)

10–ORV.3(Rm.307)

10-OR1.1-01

AN ANALYSIS OF SPATIAL CHANGESIN GREEN INFRASTRUCTUREIN SEOUL METROPOLITAN, KOREA

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Green Infrastructure (GI) relies for its systematic assessment on understanding hubs and links (Weber et al., 1006). Hubs are anchors of GI networks that provide origins and destinations for the wildlife and ecological processes moving through them, and links are the connections tying the system together to make the networks work (Benedict and McMahon, 2002). Hubs in GI are represented as the most ecologically important large natural areas that are critical to many species, while links are linear features connecting hubs together to allow wildlife movement between them (Weber et al. 2006). Thus it is essential to identify and protect critical hubs and links in advance of development for planning and management of GI.

This study aims to understand spatial changes in hubs and links of GI in Seoul Metropolitan from 2001 to 2010. To map GI networks systematically, the study employed Morphological Spatial Pattern Analysis (MSPA) (Soille and Vogt, 2009) which allows for a generic segmentation of binary patterns into categories representing specific geometric features such as size, shape, and connectivity (Soille and Vogt, 2009; Vogt et al., 2007). The principle of MSPA can be applied to identify hubs and links from a single land-cover map by creating structure from the spatial relationships among land-cover features that are critical for GI (Wickham et al., 2010). For input data to run MSPA, we used 30m pixel-sized land-cover data of 2001 and 2010 provided by Ministry of Environment of Korea (MOE). Land-cover data are widely used as foundational information of GI network mapping. To perform MSPA, we used GUIDOS (Graphical User Interface for the Description of image Objects and their Shapes) program distributed through online by European Commission Joint Research Centre. In data input process of the program, we applied four classes (forest, wetland, grassland, and recreational areas such as urban parks) selected as focal classes for GI network mapping, while assigning all other classes to background. Using raster image data, MSPA conducts a segmentation of the image foreground data into mutually exclusive feature classes.With the use of MSPA in conjunction with GIS, we first examined spatial changes of hubs (cores) and links (bridges) from 2001 to 2010 in Seoul metropolitan as well as in municipalities. We also analyzed spatial changes of networks for the 10 years. Finally, we compared our analyses of network changes with Environmental Conservation Value Assessment Map (ECVAM), a topographic map developed by MOE to assist decision-making for effective conservation and development, to see how ECVAM is effective in conserving networks, a key component of GI.

From the analysis of changes in the key GI components from 2001 to 2010, we identified that core areas in the Metropolitan decreased by 19.6 percent, while bridge areas increased by 78.7 percent. This indicates that large core areas have been fragmented to smaller areas with increased number of bridges. We also observed that only 10.7 percent of the link areas in 2001 are left in 2010 links. This implies that, although not all links may deserve same level of conservation, almost 90 percent of the links in 2001 in the metropolitan lost potentially an important green infrastructure element with network value. We also found that the network areas in 2010 are corresponding to 87.8 percent of Grade I (the area of highest conservation priority) of ECVAM, with variation by municipality from 68 percent to 99 percent.

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10-OR1.1-02

URBAN TREES COMPOSITION AND PUBLIC PERCEPTION OF BIODIVERSITY: A CASE STUDY IN NOVA FRIBURGO, RIO DE JANEIRO - BRAZIL

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Urban trees contribute to people's well-being offering a wide array of ecosystem services, such as moderate local climate, reduce air and water pollution and avoid soil compaction, among others. The first step to be able to conserve and manage urban trees is to assess their diversity. It is also important to acknowledge the citizen's perception of the role of native biodiversity in urban areas. In this manner, it is possible to develop participative planning, design and programs to support effective preservation actions with people's appropriation of local biodiversity. This research objective is to evaluate the trees' diversity (richness) of the historic central square Getúlio *Vargas* in the city of Nova Friburgo, located in the hills of Rio de Janeiro State, Brazil (22º 17' 14"S/ -42° 32' 1"W). Another goal is to present initial results of a pilot research about dwellers' perception on local biodiversity. The square was designed in 1881 by the French landscape architectAuguste Glaziou, and is now classified as a National Historic Heritage. The square is located in a dynamic commercial center next to the city's bus station, with high automotive circulation. The landscape design by Glaziou included eucalyptus, and planted gardens with native and exotic tree species. All trees were identified and measured the Circumference at Breast Height (CBH) and the height. During the data collection the researchers applied pilot qualitative interviews to assess how local users value the local trees' diversity. The assessment species results accounted for 169 trees belonging to 18 species. The dominant tree species (128 individuals) is *Eucaliptus cf. urophylla* S.T. Blake. They are higher and with widest diameters (mean height=12.38±5.36m and mean CBH = 250 ± 188.33cm), some have 28 m high and 1380 cm of CBH. From the remaining trees, 14 are native species and 2 are exotic. The native trees are smaller in height (mean=4.78±3.29m) and CBH (mean = 56.45 ± 39.25cm), and representative of the local Atlantic Forest flora, such as *Caesalpinia echinata* Lam, *Handroanthus chrysotrichus* (Mart. ex A. DC.) Mattos, *Handroanthus serratifolius* (Vahl) S. O. Grose and at least 3 species that belongs to Myrtaceae family. The other exotic species are fruit trees species *Artocarpus heterophyllus* Lam. e *Mangifera indica* L. Regarding the social perception of the local biodiversity two main factors were recognized, what enabled to classify two major groups. The first relate the eucalyptus to "the city's and citizen's identity", therefore defend the maintenance or the needed replacement with the same species. The other group understands that the old trees must be substituted e support the square "flora diversification", since they are capable to offer the same benefits in terms of climate moderation that the eucalyptus offer. In conclusion, our first findings show that the Getúlio Vargas square is an important urban public green space that has meaningful urban trees diversity, and that it may be increased and enriched. The preliminary social assessment results indicate that to further increase the urban biodiversity it is essential to develop strategies to educate and raise awareness about native biodiversity and to select species that can provide ecosystem services as good as the eucalyptus that they praise and recognize.

10-OR1.1-03

CULTURAL LANDSCAPE AND HABITATS OF AQUATIC PLANTS IN A LAKESIDE CITY WITH SPRING-FED WATER

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This study is composed of two parts. One is to introduce a cultural landscape with spring-fed water and characteristic ways of using water in daily life. The other is to indicate growth environmental conditions of an endangered aquatic plant for conservation.

The study region was Takashima City, Shiga Prefecture, located beside Lake Biwa, the largest lake in Japan. Main rivers have formed alluvial fans, and spring water tends to discharge at the bottom of the fans. Spring water also flows into channels around paddy fields.

Firstly, a cultural landscape in a lakeside area will be introduced. Harie District, Shinasahi-Cho is particularly rich in spring water. Several houses have "Kabata" in the kitchen or garden, the characteristic water place for drinking and washing vegetables or dishes. Used water is streamed into channels. A channel is shared by three "Kabata"s to minimize water pollution. Carp is kept in washing places and channels, and it contributes to making water clean by eating food particles. Harie District was selected as an important area of cultural landscape by Agency for Cultural Affairs in 2010 because the clean water environment and the unique lifestyle using spring water were evaluated.

Harie District was broadcasted on TV in 2004, and then more and more tourists including foreign people visited there. However, some tourists violated private areas of local people. Therefore, Harie Shozu-no-Sato Committee was established for managing the security. Meanwhile, local people came to understand the precious environment and landscape from evaluation by tourists. The committee turned the aim from protecting privacy to guiding tourists. Tourists can look around "Kabata", drink spring water, and stay in traditional houses by participating eco-tour. Harie District got 9th Ecotourism Grand Prize by Ministry of the Environment in 2013.

Secondly, growth environmental conditions of an endangered hydrophyte will be indicated. *Ranunculus nipponicus* (Makino) Nakai var. *submerses* Hara is an important landscape element and regarded as an indicator species for limpid stream. *R. nipponicus* is also a significant tourism resource. Recently, a decrease of its habitats is becoming a serious problem. The purpose of the second part was to determine favorable growth conditions of *R. nipponicus* to develop appropriate conservation plans.

Aquatic plant distributions, water quality including pH, EC, and DO, water temperature, flow velocity, bottom sediment and structure of rivers or channels were surveyed for 162 plots in Takashima City in December 2010. A classification tree model was constructed to analyze relationship between *R. nipponicus* distribution and growth environmental conditions.

Selected conditions were the ratio of clay <77.5 %, water temperature ≥ 9.7 °C, and water depth <44 cm. Overall prediction success of the model was 0.75, and Cohen's kappa was 0.52, which indicated that the model was moderate.

It was suggested that *R. nipponicus* mainly lives in a shallow river or channel with enough spring and moderate- to low-level clay sediment. River or channel management such as removal of hydrophytes is practiced at least once a year in the study sites, which practice seemed to prevent clay accumulation. Continuous management of rivers and spring is necessary to preserve *R. nipponicus*. Avoiding depletion of spring is also required to conserve the habitats.

10-OR1.1-04

EFFECTS OF URBAN NOISE, IRRIGATION, AND SOCIOECONOMICS ON BIRD DIVERSITY AND ABUNDANCE IN A SEMI-ARID CALIFORNIA CITY

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Recent studies have shown that products of urban development, such as landscape changes and anthropogenic noise, have an impact on the behavior and ecology of animals, such as songbirds. Urban bird communities have been shown to have higher densities but often lower diversity compared to their surrounding wildlands, but the underlying drivers behind this difference are not fully understood. A combination of ecological, landscape, and socioeconomic variables must be studied concurrently to understand the composition, distribution, and population dynamics of urban bird communities. Previous research in the Fresno-Clovis Metropolitan Area (FCMA) has shown that poverty, property value, and residential irrigation influence both plant and bird diversity in this rapidly urbanizing region of the Central Valley of California. Building upon these results, this study focuses on three ecological factors mirrored in the natural environment: ambient (urban) noise, wetspace (primarily groundwater recharging basins), and greenspace (city parks). Within a GIS framework, we analyzed bird abundance (total number of birds) and species richness (total number of species), to test how each of these are influenced by ambient noise and distance to nearest wetspace or greenspace patch. We used data from point counts conducted across the FCMA, at 238 randomly located points, by citizen scientists of the Fresno Bird Count (FBC). The volunteers also concurrently recorded ambient noise levels (none, moderate, extreme). We obtained greenspace and wetspace data from aerial imagery, analyzed using ArcGIS.

Our results support the hypothesis that anthropogenic noise has a negative effect on bird species richness. Specifically, urban areas with extreme noise levels had fewer species (5.4 spp on average) than areas with moderate noise (7.2 spp; ANOVA post-hoc test, $p = 0.05$) and significantly fewer species when compared to areas with no noise (7.4 spp; $p=0.03$). As predicted, the overall abundance of birds is not influenced by noise levels (ANOVA, $p = 0.09$), suggesting factors other than noise (such as food availability) play a bigger role in determining urban bird population levels. Similarly, proximity to recharging basins has a significant effect on species richness ($R^2=0.057$, $p <0.0002$), but not so much on abundance ($R^2=0.007$, $p = 0.21$), while proximity to parks followed the same trend for both species richness ($R^2=0.016$, $p = 0.05$) and abundance ($R^2=0.0024$, $p = 0.45$). Further, multivariate analyses indicate that these effects persist after controlling for neighborhood property value, and yard irrigation levels, both of which have previously been shown to influence both bird species richness and abundance.

We conclude that, while socioeconomic variables generally explain overall bird species diversity at the city scale, spatial variability in species diversity within the city at local scales is also influenced by landscape (proximity to green or wet spaces) and behavioral (noise) variables. Further, while greater food availability in urban areas appears to increase bird population densities, species composition is more sensitive to noise and landscape factors other than food. Urban ecological research as well as policy and planning must take more multi-scale, multivariate, landscape-based, and taxon specific approaches to understand and better manage urban spaces for biodiversity.

10-OR1.1-05

Green Infrastructure as Water Sensitive Urban Landscape Design Strategy for the Restoration of Sound Urban Hydrological Cycle

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The world is struggling against extreme droughts, heavy rain, and heat waves because of climate change. These abnormal climate cause urban flood, urban heat island, and water pollution and shortage and these natural disasters not only threaten citizen's health and amenity but also negatively affect cities economically, environmentally, and socially. Thus, this paper discusses about green infrastructure as the water sensitive urban landscape design strategy in terms of the restoration of sound urban hydrological cycle.

To do this, this paper reviews concept, context, and current trends of green infrastructure as water sensitive urban landscape design and this paper examines relations between green infrastructure and water sensitive urban landscape design for the restoration of sound urban hydrological. And then this paper analyzes various case studies on green infrastructure as water sensitive urban landscape design, which are categorized by city-scale's case studies such as Kallang River Bishan Park and Tanner Springs Park, site and building-scale's case studies such as Mount Tabor School rain garden, Sidwell Friends School wetlands, and California Academy of Sciences green roof, and street-scale's case studies such as NE Siskiyou Green Street, SW 12th Avenue Green Street, and Taylor 28 Green Street. After analyzing these various case studies of green infrastructure as water sensitive urban landscape design , this paper draws water sensitive urban landscape design strategies for the restoration of sound urban hydrological cycle.

The result of analysis is as follows. Firstly, water sensitive urban landscape design strategy for the restoration of sound urban hydrological contains various green infrastructure elements such as stormwater parks, eco-streams, constructed wetlands, green roofs, rain gardens, bio-swales, buffer strips, stormwater planters, permeable pavings, and cistens. Secondly, these various green infrastructure elements could be applied on the various types of land-use such as buildings, roofs, roads, streets, parking lots, and grounds as well as green and water space in urban areas. Thirdly, these multi-dimensional green infrastructure could evaporate, infiltrate, filtrate, and reuse stormwater ecologically through vegetation, soil, and minerals which is applied on green infrastructure. Fourth, these biological green infrastructure could be linked and connected each other to supply more environmental benefits such as urban flood prevention, water purification, and habitat supply for plants and animals than to be applied alone on the various types of land-use.

Eventually, these water sensitive urban landscape design strategies as green infrastructure could restore ecologically urban hydrological cycle which is distorted by indiscriminate urban development and could enhance urban biodiversity which is destroyed by massive urban sprawl.

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10-OR2.1-01

LOW IMPACT DESIGN (LID) AS AN IMPORTANT TOOL FOR URBAN BIODIVERSITY IMPROVEMENT. NORTHERN EUROPEAN PECULIARITIES

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Low Impact Design (LID) is an environmentally friendly approach mainly aimed at managing urban stormwater (establishing open swales, rain gardens, green roofs, detention ponds and ecologically friendly pervious surfaces). It is originated in the US and recently spread to many European countries, Australia and New Zealand (Ignatieva 2010). The New Zealand variation of LID- LUIDD in particular emphases urban biodiversity design aspects. It called for alternative, cost-effective ecological design with native plants since the problem of native biodiversity loss is especially acute (Ignatieva et al 2008). Despite of this, principles of LID could work in any urban environment; in each case it will need adjustment according to particular climatic as well as economic and social conditions.

Northern European countries such as Sweden, Finland and North-West regions of Russian Federation share a similar climate. Here, lower temperatures and a large amount of snow require adjustments for all LID stormwater management devices. These countries do not have a severe problem with invasive species due to cold climate, compare to other parts of the world. One of the most important parts of the LID strategy and a wider ecological design practice is to find an effective alternative to conventional grass surfaces (lawns) in urban areas. Lawns require using a lot of resources (watering, mowing, nutrients, fertilizing). At present time in the Northern Europe there are several practices of creating meadow like plant communities based on native plant species which are used in the design of swales, green roofs, road wedges, roundabout and tall grasslands within residential neighborhoods.

In this presentation we will discuss several case studies from Sweden (Hammarby in Stockholm and Augustenborg in Malmö), Finland (practice from the town of Porvoo) and Russia, St. Petersburg (Novoe Devyatkino). Russian case study is based on the most recently implemented Low Impact Design. This is the first example of the use of LID ecological principles in a big scale real Russian urban neighborhood. Novoe Devyatkino consists of multistory apartment residential buildings with common green areas where LID devices such as rain gardens and alternative lawns were introduced. Realizing that LID calls for an interdisciplinary approach, the social research (questionnaires, interviews and observation studies) was also conducted in Novoe Devyatkino. These results show a very positive attitude of local citizens towards this innovative landscape architecture practice.

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10-OR2.1-02

ANALYSIS ON FLOODING REDUCTION EFFECT THROUGH GREEN INFRASTRUCTURE INSTALLATION FOR EACH FLOOD AREAL TYPE IN SEOUL

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As regional torrential rains become frequent due to climate change, urban flooding happens very often. That is why it is necessary to prepare for fundamental measures. The flood control strategies are installation of the flood reduction facility such as rainwater tank, pump station, retarding reservoir, maintenance of the sewer pipe and reduction of the non-penetrative pavements. However, in Seoul, where urban areas are narrow and development density is very high, sensitivity is much higher than other cities ina little climate change, so it needs a sustainable flood mitigation strategy.

Recently, the importance of urban green infrastructure is growing as a method to solve urban flood problems and improve a city's resilience to climate change. Creating green infrastructure in open space without any criteria has an effect on runoff reduction. However it can differ by flood reduction effect through not only urban natural characteristic such as elevation, slope and soil but also urban social characteristic such as sewer pipe, existence of rainwater tank. Therefore, to maximize flood reduction effects of the green infrastructure, placement of green infrastructure should be different depending on the flood type by categorized flood causes.

The purpose of this study is to classify flood area in Seoul, Gu, using statistical analyses, and to analyze the difference in flooding reduction effect on installation of green infrastructure for each flood area type. Flood area for each Gu is calculated based on inundation trace maps in 1998, 2001, 2010, 2011, and a number of factors that influence the flooding are used to practice the correlation analysis and cluster analysis to categorize flood area type. As a result, the flood area types are classified four groups: the factors such as elevation, the ratio of green infrastructure area, the ratio of the rainwater pump station, distance from stream and slope, mainly influence on the categorization. Representative modelling sites decided by each flood area type are analyzed according to the various green infrastructure arrangement scenarios to calculate flood reduction effect using SWMM, an urban hydrological model. The flood reduction effect by green infrastructure is not efficient if there are big mountains and steep slope-land in drainage sector or green infrastructures are placed with flood vulnerable area.

The results of this study could be helpful in establishing criteria of green infrastructure arrangement to adapt urban flooding resiliently.

10-OR2.1-03

OPTIMIZING NATURE QUALITY IN ELEMENTS FOR URBAN STORMWATER MANAGEMENT – A CASE STUDY IN DENMARK

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Urban areas are continuously expanding. Thereby land available for nature is diminished and the hydrological cycle is significantly altered in both quantity and quality. Implementation of Sustainable Urban Drainage Systems (SUDS) is an increasingly used technique in the transition of cities towards climate resilience. While the sizing of SUDS elements is determined from rain statistics and required service level, the design is flexible, thus the same hydrological functionalities can be provided by a number of different designs.

In this study, we have developed SUDS specifically designed for increasing biodiversity (bio-SUDS) in a selected case area. The development was based on identification of adjustable parameters important for the functionality of SUDS in regard to stormwater management as well as for habitat quality. This includes physical structures (terrain modifications, soil composition), water dynamics (soil humidity gradients, water fluctuations, flooding frequency), vegetation and water quality. The solutions also take into account local analyses of species presence and local political goals for biodiversity.

The developed bio-SUDS include a dry basin, a wet basin and a swale and are integrated into an otherwise plane common grassland surrounded by a private housing area, childcare institutions and a young planted forest. The bio-SUDS elements are expected to create habitat diversity at site level and among sites, thereby contributing to the overall nature quality in a larger area otherwise dominated by urban structures. Designing and implementing bio-SUDS is an interdisciplinary task involving water management, ecology, landscape design and urban planning, and successful future design of bio-SUDS will rely on well-researched designs and good documentation of test sites.

10-OR2.1-04

TWO DEVELOPMENT SCENARIOS FOR KAMEOKA FLOOD PLAIN: THE NEED FOR A PARADIGM SHIFT TOWARD THE GREEN INFRASTRUCTURE MOVEMENT

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The local government of Kyoto Prefecture is planning to develop a large sports stadium in the Kameoka flood plain, which is the current habitat of a national registered fish species,kissing loach (*Leptobotia curta*). Thelocal governments of Kameoka city and Kyoto Prefecture are promoting the project with a conservation plan for the speciesin cooperation with local people; however, some academic societies and the World Wildlife Fund (WWF)-Japan have serious concerns about the kissing loach. The controversy is not simply between conservation and development, because the species'habitat is not a natural river, but rather a human-controlled river for the purpose of irrigating rice paddies.Local farmers who support the development of the stadium have been participating in conservation activitiessuch as damming up parts of the river to facilitate spawning of the fish. The goal, therefore, is not only to preserve the habitat, but also to develop acomprehensive solution that enables continuation of the dynamic agricultural environment needed for the conservation of the species. This study alsoconsiders the relationship of the stadium construction with other river development plans, such as banking and digging the river channel, which may negatively alter the natural landscape with artificially degraded scenery. We compare two scenarios for the development of the Kameoka basin: "Fortress type," or "gray infrastructure,"which does not allow any flooding and isconcrete oriented, and "willow type," or "green infrastructure,"which allows flooding andis nature oriented (Morimoto, 2012).

We studied various landscape characteristicswithin the basin, previous studies on the habitat of kissing loach,applied a population viability analysis (PVA)(with a contribution by Prof. Natuhara of Nagoya University),and studied related projects in the area and along the river to identify scenarios that may enable the sustainable population of kissing loach.

Kissing loachwas once a common species prior to agricultural modernization and in 1977 was recognized as a national natural treasure, designated as a rare wild species by the Act for the Conservation of Endangered Species of Wild Fauna and Flora in 2004. The reason such a rare species is still in the Kameoka basin is deeply related to the basin's proclivity toward flooding by the narrow Hozu-kyo valley.This valley hasprovided many tourists with beautiful scenery while boating down the river to the national registered historic and scenic beauty of Arashiyama in Kyoto.Following the severe flood in 1953, however, the Hiyoshi dam was constructed at the upper stream of the HozuRiverto protect the Kameoka alluvial floodplain from flooding. Ironically, the frequent flooding is the main reason there are many as 50 species of fish in the Kameoka basin, and that supported the survival of endangered species such as the frog species *Rana porosa* and*Rana nigromaculata* and aquatic plant species *Euryale ferox*.

Results show that the "gray infrastructure" scenario involved a high cost as well as asignificant risk of flooding and degraded nature.The "green infrastructure" scenario, however,involved a low cost, high adaptability to climate change, and continuing unique amenities of the *Satoyama*, all of which may contribute to the sustainability of Kameoka city.

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10-OR2.1-05

RAINWATER HARVESTING FOR URBAN FLOOD-DISASTER MITIGATION

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Frequent inundation has become a serious problem in urban areas all over the world. This is because the impervious surface covers most of the city area, and rainfall there tends to intensify due to heat-island effect and, in addition, global warming. Measures such as dredging rivers, increasing the capacity of the sewer system and constructing flood walls may be necessary; however, they drastically change the urban riverine ecosystem. Moreover, these public works are insufficient in that the urban-flood disaster inevitably deteriorates without decreasing runoff by improving rainwater retention and infiltration within the entire urban watershed, which usually includes a huge number of private properties and enterprises.

We report private, small- to mid-sized rainwater harvesting tools/facilities installed in urban watersheds and their impacts on the public, flood-disaster mitigation. We also show a large-sized facility to be constructed in another watershed. The facility not only has a rainwater-retention function but also involves ecological and educational roles. The purpose of this study is to discuss how private rainwater-retention activities can be spread gradually and steadily in the city.

Small- to mid-sized tools/facilities are attempted to be installed in the Hii River Basin located in the city of Fukuoka, Japan. The lower areas of the watershed have experienced inundations three times in the past 50 years. The latest took place in 2009, and just after this event, a citizens' alliance for flood-disaster management was established. This collaborative group, in association with local governments, has helped residents in the watershed install rainwater harvesting tanks (0.2 m^3) in their premises. After the installation we carried out a questionnaire survey for the residents and inquired about their attitudes toward the rainwater management. As a result, it is found that most of the users of the tank have become more aware of the frequency and intensity of rainfall when they use retained water for gardening etc. This may implicate their daily preparedness for emergency, which is essential for an effective disaster evacuation.

In the Hii River watershed, a rainwater-harvesting house was constructed in 2012. The cisterns of the house retain about 43 m^3 of rainwater and cost about \4 million (US$ 39,500). The unit cost (\/m^3) is as low as a sixth of a big rainwater-storage (60,000 m^3)/-discharge system constructed by the municipal government. The rainwater retained is used domestically, and the amounts of the input/output are closely monitored. The attempt has inspired the construction of a rainwater-harvesting housing complex in an adjacent city. The complex was so popular that its apartments have been sold out soon after sale.

The complex can retain over 100 m^3 of rainwater, and the water is provided for its communal garden. The input/output to/from its cistern is also closely monitored. In order to discharge water effectively from the cistern just before a heavy rainfall, it is necessary to mount on the cistern an automatic discharge system involving the meteorological agency's information --the system is currently under development.

An elementary school is slated to be built by another, nearby municipality inspired by the installation of the above-mentioned rainwater-harvesting tools/facilities. The school premises are located on the land reclaimed from an old irrigation pond that had been left behind in the urbanization-designated area. Naturally, the land and surrounding areas used for residency are prone to inundation. It is thus necessary for the school facilities to be smartly adapted to the condition. 2,400 m^3 of runoff from the surrounding residential areas will be retained within the schoolyard, under which two rainwater-retention cisterns will be installed. One of the cisterns (1,000 m^3) is also to retain rainwater from the surrounding areas whereas the other (200 m^3) is to collect rainwater that is fallen on the schoolyard and used afterwards to water the lawn covering the ground. The school buildings will also have another 200 m^3-cistern to retain rainwater fallen on the facilities. The water will be used to flush the toilet and water flowers to be grown by pupils. The rainwater-reuse system in the building is powered by photovoltaics. The water will also be used for a school biotope to be built. The amounts of retention

and discharge will be monitored, and the data will be utilized for science education. The project is thus called "Smart School Project".

The installation process of these tools/facilities and their monitoring data may encourage the public to get involved more in urban-runoff reduction. Smart adaptation to flooding in the city should be a prerequisite for the preservation/restoration of urban biodiversity in the long run.

10-OR2.1-06

CLIMATE CHANGE AND CONIFERS: PAST AND FUTURE

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Out of 660 million hectares of Korean forest area, which covers sixty seven per cent of country, coniferous forest with areas of 273 million hectares (42.4%) forms major forest vegetation, along with mixed forests of conifers and broad-leaved forests (28.8%). Evergreen coniferous forests occur in the high alpine areas of the southern, central, and northern regions, where the annual mean temperature is normally below 5°C and the mean temperature of January is as low as -12°C. However, original coniferous forests were replaced by deciduous broad-leaved forests of birch, poplar, and elm trees or by mixed forests due to excessive development and frequent wild fires. Pine trees are a common conifer distributed in the plains and mountainous areas. However no biogeographical concern has been placed on the distribution of the Korean conifers in connection with climate change.

Present work deals with the spatio-temporal distribution of native conifers in the Korean Peninsula, which includes both South and North Koreas and predict their future in connection with climate change. Past distributional of conifers came from both micro- and macro-fossils of the geological periods, and several historical documents of Joseon Dynasty, which dated back to 15th century. Current horizontal and vertical ranges of native conifers are based on numerous flora reports as well as author's field works.

Coniferous trees, such as *Elatocladus, Ullmannia*, and *Walchia*, appeared during the Permian Period of the Palaeozoic Era, but they became extinct. Earliest Korean conifer, *i.e.,Pinus* occurred at central and southern parts of Korea, and dates back to the Cretaceous Period, Mesozoic Era, and then diversified into different species with time, and at present shows extensive distributional range from northern subalpine belts to southern coastal areas. *Abies* also shows broad distribution and long history of vegetation development, along with conifers, such as *Juniperus, Picea, Larix, Taxus, Thuja* and so on. Conifers were gradually replaced by dicotyledon species in the Cenozoic Era.

Early-evolved conifers have achieved higher species diversity, and show at present wider geographical range in the Korean Peninsula. During the glacial periods, the ranges of cold-tolerant conifers, such as *Pinus*, *Juniperus*, *Abies*, *Picea*, *Larix*, *Taxus*, and *Thuja* had expanded. On the other hand, the ranges of warmth-tolerant ones, such as *Tsuga, Torreya, Cephalotaxus* couple of *Pinus* such as *Pinus densiflora* and *Pinus thunbergii* and hadretreated as the climate deteriorated.

Major Korean conifers consist of *Pinus densiflora, Pinus koraiensis, Abies holophylla, Picea jezoensis, Larix gmelinii* and *Taxus cuspidata*. Species at alpine and subalpine belts with narrow vertical range, such as *Juniperus communis* var. *saxatilis, Juniperus communis var. sargentii, Abies koreana, Larix gmelinii* var. *olgensis, Picea koraiensis* var. *koraiensis, Picea koraiensis* var. *pungsanensis* and *Juniperus davurica* might be more vulnerable to global warming.

Presence of Korean endemic conifers, for example *Abies koreana, Picea koraiensis* var. *koraiensis* and *Picea koraiensis* var. *pungsanensis* on the subalpine belts of both ROK and DPRK mountains may be the result of long-term isolation of conifers on high mountains since the Pleistocene glacial period, and they might now belong to species vulnerable to global warming.

Typical life form of native Korean conifers is evergreen tree, blooms in spring, and fruits ripe in autumn or following autumn. Their oval and elliptical seeds with wing, which is beneficial for dispersal, are common.

Further works on the migration, dispersal, genetics, ecology and natural history of native Korean conifers are required for the better understanding of past environmental change and future destiny of conifers in terms of global warming.

10-OR3.1

(RE)DISCOVERING URBAN BIODIVERSITY IN QUEBEC, CANADA, THROUGH THE METADATA OF FIELD RESEARCH IN BIODIVERSITY

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Following the launch of the *Global Partnership on Cities and Biodiversity* of the United Nations and other international, national and regional initiatives, protecting and promoting urban biodiversity has emerged as a major issue and core objective of urban planning and management. The first step in meeting this objective is to acquire knowledge on existing biodiversity in cities. In the Province of Quebec, Canada, the Quebec Center for Biodiversity Science (QCBS) and its Working Group on the Drivers and Management of Urban Biodiversity have undertaken a project to record metadata on all biodiversity studies made within the urban environments of the province. This project is part of a larger project on the biodiversity of Quebec called the Biodiversity Metadata Management System (BMMS), originally developed in collaboration with Nature Serve Canada, and now developed in partnership with the Canadensys project.

The BMMS provides a standardized framework for entering, storing, searching and displaying metadata related to field studies of biodiversity in Quebec. BMMS is implemented as a module of the Drupal open source content management system. Eventually metadata will be exported using the EML (Ecological Metadata Language).

The project started in the summer of 2013. Its objective was to compile metadata from studies conducted in diverse urban microhabitats (woodland, river, lake, park, urban setting, etc.) that were not published in scientific journals and that were not available on the web. The first step undertaken to reach the project objective was to solicit the participation of researchers based in academia and researchers from other research institutions such as governments, non-government organizations and the private sector. The second step consisted of a literature reviewof graduate research projects and other research reports found in libraries. Using specific key words, the databases of the Botany Library of University of Montreal, the Biology Library of the University of Montreal, the Montreal Botanical Garden library, the Science Library of the Université du Québec à Montréal (UQAM), and the University Laval Library were searched. From each study, information such as species studied, location and type of research was extracted and added to the BMMS.

The literature review yielded a total of 238 datasets dating from 1936 until today with a peak of 57 studies for the 1981-1985 period. Woodlands (54%), aquatic habitats (31%) and urban settings (13%) were the most studied habitats, while the most studied taxa were vascular plants (45%), birds (13%) and mammals (11%). Approximately 83% of the studies are inventories whereas 17% of the studies aimed at understanding species abundance or distribution in relation to abiotic or biotic drivers in urban environments. Finally, 9 % of the researchers responded to our request and contributed a total of 3%of metadata. This tool will become an invaluable resource for researchers to perform longitudinal historical studies, and for policy makers and funding agencies to identify future research needs. Moreover, since the data will be accessible to the general public, it could help to improve public knowledge of local urban biodiversity.

10-OR3.1-02

The harmonious coexistence of Industry and the environment

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1. Development using Close-to-Nature Construction Methods

SANDEN FOREST of 64 hectares was developed with the concept of "Coexistence of Industry and Natural Environment with consistence" in 2002 at the south foot of Mt. Akagi, Maebashi- city, Gunma Prefecture, Japan . The basic concept for creation of land is Close-to-Nature Construction Methods.

The use of Close-to-Nature Construction Methods began in Switzerland in the latter half of the 1970s as environmentally friendly alternative construction method. Although it is only 20 years since the methods were introduced to Japan, they have been developed in many original ways, for example, by combining traditional stone masonry techniques that are suitable for Japanese climate.

The restoration of nature using Close-to-Nature Construction Methods isto regenerate the physical environments around the edges made up of the atmosphere, the water and the soil while taking into account the geographical and climatic conditions characteristic of the local area. That is to take measures to help a damaged area to recover its natural state while leaving the sphere for the natural ecosystem to develop on its own, i.e. we should try creating an environment which is closer to the original natural environment.

Sanden Forest is the first industrial site in Japan developed using the ideas and techniques of Close-to-Nature Construction Methods.

【Environmental monitoring】

We are implementing continuous environmental monitoring surveys every 3 years from 1998 before development, it has been confirmed 12 years after the completion of the development, the number of animal and plant species living in the compound increased and the populations of endangered species.

And we are studying the new survey methods through measurement of forest'sand soil's CO2 amount absorbed and colonized.

2. Establish the collaboration system with government, NGO, NPO

Sanden Forest defines policy "Challenge, Creation and Contribution" as Akagi Plant's action target. One typical action of contribution for earth environment and local community is to establish social system in order to utilize rich natural environment through close collaboration with various organizations such as companies, government, NPO. We have been introducing SEGES (Social and Environmental Green Evaluation System) as a third party evaluation from 2008 and obtained highest Superlative Stage Award 2014 of Urban Green Technology Institute. Such social system establishment through providing fieldwork studies in natural environment was appreciated by OECD in 2010, introducing in the world as "Sustainable manufacturing good practice"

http://www.oecd.org/innovation/green/toolkit/sustainablemanufacturinggoodpractices.htm#sanden

And in Japan, a NPO acting based in Sanden Forest was praised Environment Minister Award 2012. For greenification plant activity, SANDEN was awarded Excellent Forestry Plant Award by the Minister of the Ministry of Economy, Trade and Industry in 2008 and Japanese Prime Minister Award in 2013 as greenery promotion contributor .

In the future, we are planning to work on developing forest management systems which contribute to both biodiversity conservation and the prevention of global warming,

10-OR3.1-03

Ecological Landscape Design for Urban biodiversity Ecological education

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Preserving the amount of open or natural space as wildlife habitats and spaces where children can play is a very important issue nowadays in urban area. Additionally, "Children's Play" is an important experience in learning about the structure of nature whilst "Environmental Education" has been afforded much greater importance in primary and secondary school education in Japan since 2002. Forman (1995) discussed habitat fragmentation and how it occurs naturally as well as being a result of human activity.

The habitat fragmentation has already been caused by the development of housing projects. If we create a green space in an urban area, it will serve as a stepping stone for species dispersal (Forman, 1995). And even if the site is not so large, it will contribute to ecological education in the urban area. Fjortoft and Sageie (2000) have discussed the natural environment as a playground and learning arena is a way of rediscovering nature's way of teaching or "learning from nature". They also mentioned that landscape diversity was related to different structures in the topography and the vegetation, which were important for children's spontaneous play and activities.

It is thus becoming very important to preserve open spaces as biotopes these days. Previous studies have focused on children's experience of a place, their particular liking of an unstructured environment that has not yet been developed and how they interpret a place and space (Hart, 1979; Moor, 1986; Fjortoft and Sageie, 2000).

We have designed a school garden, river bank, urban forest and city parks in these 10 years. The aim of these projects are to create an area for preserving biodiversity, children's play and ecological education that can simultaneously form part of an ecological network in an urban area. Additionally, I would like to discuss the process of ecological design for urban biodiversity and people's participation for the project in Japan.

Fig. Design process of Megurizaka-pond, Japan
Planning and Design, Keitaro ITO Lab. Kyushu Institute of Technology
+ Tenraiji primary school + Kitakyushu City

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10-OR3.1-04

SMARTPHONE AS A TOOL OF CIVIC SCIENCE
- COLLABORATIVE SURVEY OF SPECIES DISTRIBUTION -

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Knowing distribution of species is the essential matter for establishing a plan of ecosystem conservation. However it is hard to know distribution of wildlife in broad area by researchers or governmental officer alone, and thus collaboration with public people is necessary. Easiness of participation is necessitated in collaborative survey, but hurdle lies on each step in survey process; collecting, reporting, summarizing, and sharing data. Smartphone, GPS is equipped and rapidly widespread into all generations of society, can easily obtain photo of target species and location where the species is found, and immediately send data. Once those data are received and stocked in the server, it is easy to show finding places and photos on Google Map. It means that participants can know and share survey result soon after the survey. Using photos, accuracy of species identification can be secured through confirmation by specialist. Researchers can analyze distribution pattern and develop a spatial model of species distribution by using locality data, and can return for decision-making. The smartphone, therefore, becomes a strong tool for survey with/for citizens, as well as GPS equipped digital camera.

Based on the concept mentioned above, Greenfront Research Laboratory developed a system of smartphone-assisted survey. Using the system, survey plan was established in collaboration with members of NPOs in Tokushima Prefecture, and collaborative surveys were conducted for entire Tokushima Pref. in August of 2013 and January of 2014 under a management of the NPOs as the test cases. Target species in the summer were 3 swallow species, Barn swallow (*Hirundo rustica*), Red-rumped swallow (*H. daurica*) and house martin (*Delichon urbica*), and channeled apple snail (*Pomacea canaliculata*), which is an invasive alien snail causing damage to rice plant. Invasive alien plant, Madagascar ragwort (*Senecio madagascariensis*), was for the target in winter.

During a month in summer, 458 and 301 distribution data were reported for swallows, and channeled apple snail respectively, and a month in winter 224 data of Madagascar ragwort were reported. It was confirmed that reported positions were not much different from true positions; 75% of sample data were within 30m. The positional accuracy is enough to develop spatial model for predicting potential habitat in regional scale.

Workshop was organized by NPOs in order to inform survey process and its results to general. Officers of local government, enterprises, media and public people got together, and discussed measure against invasion of alien species. The WS was another result of collaborative work for survey by NPOs as civic sector; consciousness and responsibility of the member on data use was raised through a collaborative survey, and hence they hold the WS. Conclusively say, the collaborative survey assisted by smartphone has possibility to promote civic science and to raise social capital.

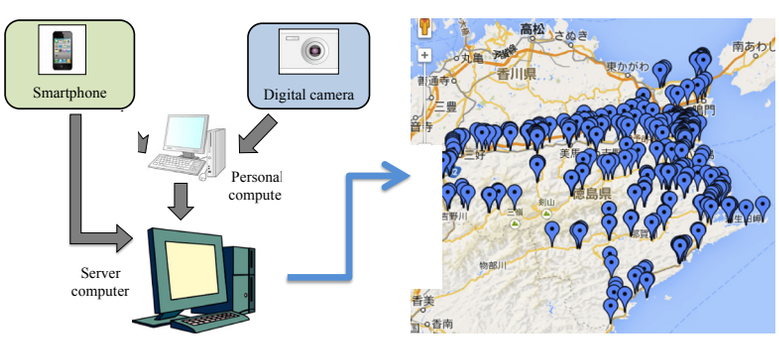

Fig.1 System for data collection and sharing

Fig. 2 Workshop for data use

10-OR3.1-05

ENHANCING URBAN RESILIENCE THROUGH IMPLEMENTATION OF ROOFTOP PADDY FIELDS

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The expansion of the urban population has created various issues such as the heat island effect, air pollution, degradation of environment for fauna and flora in cities around the world. The loss of contact with nature is a serious issue in densely populated cities of Japan. For example, 82.9% of the citizens of Tokyo demand to have more chances to be in contact with nature, whereas the same demands of citizens living in the rural area only reaches 65.6%.

Rice cropping experience is a compulsory subject for fifth grade elementary students in Japan. Although the Japanese dietary habit has changed over the years, rice is still the principle food of Japan, and the paddy field where it is cropped is an essential component of the traditional landscape of Japan. The students living in the rural area of Japan enjoys the opportunity to learn how rice is made in a real paddy field. Therefore, they have the chance to learn the individual process of traditional rice cropping as well as the ecosystem of the paddy field.

On the other hand, the majority of students living in the urban area must use buckets to crop rice since only a small portion of paddy fields are left in the city. These students are able to observe the growth of the rice, but lack the chance to experience the traditional landscape and ecosystem of the paddy field of Japan. As a solution to this problem, implementation of rooftop paddy fields is an emerging trend in the urban setting. The rooftop is utilized for urban dwellers to experience rice cropping and interact with living creatures that inhabit the paddy field environment.

Although the rooftop paddy fields provide a valuable environment for urban dwellers, its implementation has several challenges. One of the biggest challenges is the creation of the suitable landscape in a spatially limited and closed environment. If the efficiency of rice cropping is prioritized, the rooftop will be covered by rectangular shaped paddy fields with artificial levee. Instead, to maximize the educational and scenic value, the traditional landscape of the “Satoyama” shall be demonstrated with the essential components such as water ways made by natural materials.

In this case study, the educational impact of the rice cropping experience in a rooftop paddy field was investigated by questionnaire survey. The survey was conducted on 5th grade students of Totsuka elementary school. The rooftop paddy field was designed to re-establish Satoyama landscapes by using local natural materials such as soil taken from abandoned paddy fields nearby. A water way which provides habitats for indigenous aquatic plants and animals was placed adjacent to the paddy field functioning as an educational tool. Results of the survey showed positive effects that enhanced the interest to the surrounding natural environment and agricultural issues which lead to raising the awareness of urban biodiversity.

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10-ORV.2-01

CHARACTERIZING THE DISTRIBUTION AND CONCENTRATION OF MONTHLY RAINFALL IN KOREA

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Rainfall is one of the most important variables to represent climate change influence. The recent IPCC report confirmed a continuous increase in rainfall for near future, due to global warming. Climate change has also brought larger temporal and spatial variability in rainfall, often leading to frequent flood damages and landslides in Korea. Therefore, accurate understanding of rainfall characteristics on temporal and spatial scale is needed for sustainable management of water resources.

The monthly rainfall dataset provided by Korea Meteorological Administration (KMA) was used to analyze the spatial and temporal variability throughout the country. A total of 7 weather monitoring stations were selected in this study for analyzing rainfall characteristics. Three rainfall variability descriptors, such as Precipitation Concentration Index (PCI, Oliver 1980), Fournier Index (FI, Fournier 1960), and Modified Fournier Index (MFI, Arnoldus 1980). were employed to detect the relative distribution of monthly rainfall. Temporal change in annual rainfall also analyzed to compare rainfall amount and pattern among locations and years.

A significant increase in annual rainfall has been detected in almost weather stations of Korea. Higher concentration of monthly rainfall has been found, indicated from three concentration index for all stations

Rainfall variability has caused serious problems over the last few decades in Korea. Recently, intense rainfall in summer season has induced natural disaster (for examples, flooding and landslides) in rural and urban regions, and caused human and financial losses. Therefore, the results of this study are valuable for policy makers to implement disaster mitigation activities, even though past trends of rainfall are not always indicative of future tendencies.

* This research was partly supported by the Korea Forest Research Institute, Korea Forest Service

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10-ORV.2-02

TECHNOLOGY FOR ALGAL BLOOM USING ZOO-PLANKTON

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The occurrence of algal bloom and the damage by it is even worsening with global warming, causing various problems like the odor, the cost of purifying water etc.

The technology for algae controls which triggers algal bloom in ecological way strengthening virtuous circulation. In this technology, algal bloom is considered as the first producer of hydro-ecology rather than harmful plant, which is different from the existing physical and chemical approach dealing with algal bloom.

The process of the technology is as follows. After taking water from the targeted water-area, zoo-plankton and phyto-plankton are separated and cultured under the most proper conditions, and the cultured phyto-plankton is provided as food source for the natural enemy(zoo-plankton) so that the natural enemy can be cultured in volume. Lastly the natural enemy is provided to the targeted water-area in order to control algal bloom.

The technology was used in Jeon-Dae reservoir(Surface Area : 15.6ha, Water storage : 587.000㎥) in Dangjin, Chungnam from Jan. 2010 to Dec. 2012 and the effectiveness of the technology was verified and the result is as follows.

(1) Using the culturing system of the natural enemy, zoo-plankton in natural water-area was chosen and cultured. The result showed that the average figure of in-flow water was 943 inds./L and cultured average figure of 4,316 inds./L, which means the culture-effectiveness of 450%.
(2) By separating/culturing zoo-plankton as natural enemy and delivering that to the water-area, the reduction effect of *Chl-a* was 85% and especially in case of blue-green algae, it was 98%.

Based on deep understanding of natural ecological food-chain and by activating proper connection chain, the restoration of hydro-ecology healthiness is expected. The new approach for solving algal bloom issue is also expected to b innovative and fresh direction to improve algal bloom situation not only in domestic area but all around the world.

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10-ORV.2-03

THE STUDY ON CHARACTERISTICS AND IMPROVEMENT OF SUBSTITUTE HABITAT OF KOREA EXPRESSWAY CORPORATION ARBORETUM -FOCUSED ON ENDANGERED PLANTS-

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In 1974, Korea Expressway Corporation Arboretum was initiated as Nonsan branch ' Jeonju nursery field' and the name changed to "Jeonju Arboretum ' in 1995. In 2004, Jeonju Arboretum has been registered in The Forest Service and the name was changed to "Korea Expressway Corporation Arboretum 'in 2007.

On the other hand, Korea Expressway Corporation Arboretum has been registered with the Ex Situ Conservation Institution in 2011. By 2014, the total of eight species including *Iris koreana, Lycoris chinensis var. sinuolata, Iris dichotoma* and so on are conserved and increased. Accordingly, Korea Expressway Corporation Arboretum progressed Ex Situ Conservation Institution species conservation projects and highway restoration project by habitat survey of endangered plants. Additionally in 2013, Korea Expressway Corporation Arboretum progressed Ex Situ Conservation Institution species conservation projects and highway restoration project by habitat survey of endangered plants. Also, endangered plants exhibition was created to increase education effects and strength endangered plant characteristics of growth environment for intension function of plant conservation Also Ecological Wetlands was designed as a habitat design project for endangered species conservation.

But for designing the substitute habitat according to the endangered plants, there are not many researches. This study is for the designing the substitute habitat for the endangered plants preservation through reviewing endangered plant habitat spaces. A new case study of the Ex Situ Conservation Institution registered as a Pyunggang Botanical Garden on 2009 and Shingu Botanical Garden on 2010 should be researched for the desirable substitute habitat of endangered plants.

This study proposes the designing methods for the damaged endangered plant habitat spaces from industrialization and urbanization's development works and indiscreet use of nature resources and endangered plants of Ex Situ Conservation Institution's preservations

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ANALYSIS OF SIDEWALK COMPLETENESS WITH A FOCUS ON THE ANYANG AREA

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In the last 60 years, the United States has invested hundreds of millions of dollars in building highways. However, the United States is now encouraging people to use public transport to ensure urban sustainability. South Korea is also trying to enhance its public transport systems. To facilitate the use of public transport, sidewalks must be usable.

Consequently, Seoul is trying to extend sidewalks. However, in some old cities, sidewalks are not included as part of the infrastructure. In some parts of Anyang in particular, the infrastructure is dilapidated. This study analyzes sidewalk completeness in certain areas in Anyang. Of the many types of land use, this study focuses on residential areas, apartment complex areas, and metropolitan areas, which are traversed by substantial numbers of people.

Douglas defined sidewalk completeness based on the ratio of road with sidewalks on both sides. However, in this study, road with sidewalks on only one side that posed no disturbance to users was considered complete. This study used Formula 1 to calculate sidewalk completeness.

$$\text{Sidewalk completeness} = \frac{\text{the length of sidewalk}}{\text{The length of road}}$$

Formula 1. Sidewalk completeness (Douglas, 2007)

Metropolitan areas have the highest levels of sidewalk completeness and residential areas have the lowest. This is because residential areas are extremely compact and there is insufficient space for sidewalks. In metropolitan areas, there are several blocks in which cars are restricted from entering; sidewalks in such areas are thus extremely usable.

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10-ORV.2-05

NEW GARDEN DESIGN PARADIGM WITH RAINWATER MANAGEMENT

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The purpose of this study is to explore rain garden, the new garden paradigm of rainwater management, and to find out its characters, types, principles, cases and introduction plan of legal systems. The Garden and Rainwater are historically and ecologically showing various paradigms.

In the past rainwater absorbed into the soil and flew into the river with cleaning effects so it was able to prevent the pollution. But as the impermeability layer has been increased, due to the urbanization progress and the policy of drainage water management, the water discharges directly to the river and could not infiltrated into the soil. This phenomenon distorted the water balance, caused the flood and landslide and affected the city ecosystem. Also as the city's living environment gets worse, the need for green space in the city is increasing. Additionally the social interests of the living environment increase, the gardens and the positive effects of gardening, such as improvement of living environment, education-emotional cultivation functions and etc., are increasing. For the domestic, the movements for vitalizing garden cultures are increasing trend, but it is still in inefficient stage to take root in Korea as a national living culture.

Consequently, the awareness of the rainwater revitalization plan based on the new garden paradigm for the water management, has increased. There are several research about rain water management and land use of dispersal type for rain water management (LH,2013).

The purpose of this study is to stereotype rain garden into a small rain garden of pollution purification and substitute habitat living space and a huge rain garden of flood retention and rainwater retention. Then establish design and management guidelines according to its scales. Moreover, rain garden's dried form should be considered for the citizens and residents to participate the activity programming when it is on dry format. The current legal policies' (Urban Park Act, Building Act(Gardening in a lot), Landscape Architecture Criteria based on vibration) improvement directions should be proposed for the rain garden and gardens.

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10-ORV.3-01

RESTORING URBAN WATERFRONTS TO INCREASE ECOLOGICAL SERVICES: A RISING TIDE

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A modern understanding of the value urban waterfronts includes much more than a listing of industries which can be sited along river edges and marine ports. The new interest in ecological services is exploring the many valuable ways in which habitats near waterfronts can advance the health and sustainability of our cities for residents. As venues for exercise, community interactions, artistic inspiration, and a sense of place, waterfronts help define our cities' personality in important ways and add to the joy of everyday life. Recognizing and teaching the real value that ecological design can add to waterfronts is part of a complete discussion of urban planning at a time when cities worldwide are rapidly growing. How can we make new cities and growing older cities more sustainable? Urban waterfronts almost always have a long history of past land-uses which have degraded their ecological character. Waterfronts often have poor soil with chemical and physical damage from past industrial use. Many waterfront areas are also very small parcels, not connected to expansive areas which can support many of our plant and animal species. Cities are also relatively hot. In a time of rapid climate change around the world, this heat island effect will be magnified. There are case studies which illustrate ways that ecological thinking can improve water resources and waterfront habitats for urban dwellers.

In New York City, the government has created an ecologically themed Brooklyn Bridge Park, a thin, 2 km long waterfront. Many habitat types were introduced to advance sustainability. Similarly, with the closure of urban landfills, we have opportunities to improve urban life. At the Fresh Kills landfill in New York City, about 1000 ha are being redesigned into a public park. Experimental studies have shown that birds play an important role in introducing seeds of many species to this degraded site. New stresses are now appearing, driven by rapid climate change and rising sea levels.

Along the Atlantic Ocean, the ocean is expected to rise at least 1 m in the next 50 years. One solution is to create new areas to where marine natural resources can migrate as the ocean rises. Soil that is removed can be used to create higher berms around existing human communities to shield them from storm surges. In our biggest cities, they can be little movement of habitats or people away from the current heavily used edge. For Manhattan, a series of remedies have been proposed. This design takes the vulnerable existing waterfront roadways and walkways and transforms them into more valuable and safer civic spaces with a strong ecological expression. Meshed with the new uses are also a series of protections to stop saltwater from devastating lower Manhattan. The new scheme combines storm protection with social amenities and ecological structures to give a triple improvement to land which will not be abandoned by the city government. We have added bioswales to control and clean storm water, coastal meadows and shrublands, bird and butterfly habitats, intertidal habitat interventions, and urban agriculture areas to complement traditional playgrounds, sports fields, and meeting places. These are all imbedded in a high vegetated berm that protects the inland buildings or by moveable gates which descend from elevated roadways when there are storm warnings. New land for nature and culture is created while public safety is advanced.

10-ORV.3-02

LAWN AS ECOLOGICAL AND CULURAL GLOBAL PHENOMENON: SEARCHING FOR SUSTAINABLE LAWNS IN SWEDEN

Maria Ignatieva[1]

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Today, lawns cover a significant part of all green open spaces in cities (up to 70%) in, e.g., the front- and backyards of private gardens, public parks, cemeteries, and in addition golf courses and along roads. Most people of the Western world view lawns as natural elements of the urban landscape, without questioning their functional, ecological or aesthetic value. There are very few studies of the biodiversity, environmental impact, public opinion about and the historical and contemporary motives for planning and management of different types of lawns.

This presentation is about FORMAS (Swedish Research Council) project running by 11 scientists from SLU in Uppsala. This is an interdisciplinary collaboration, including stakeholders, to study lawns from different perspectives as social and ecological phenomenon in order to understand their roles in sustainable urban planning, design and management. Ecological knowledge, values and norms influence the management of urban green areas and may thus influence the environmental impact of, biodiversity in and ecosystem services provided by lawns. Potential alternative solutions are impossible to find without an understanding of the social motives behind the strong attachment of the modern Western society to lawns. The interdisciplinary approach allows us to exchange knowledge between disciplines and to achieve a multi-dimensional understanding of the lawn as a phenomenon.

One of the long term objectives of this research is to deliver results in the form of an urban greening manual, demonstration sites, and different management packages for municipalities and communities with recommendations on how to establish and manage sustainable lawns which should be also much more economical comparing to conventional lawns.

References

http://www.slu.se/lawn

10-ORV.3-03

URBAN GREENIZATION AND ECOLOGICAL RESTORATION IN JAPAN AFTER THE FUKUSHIMA ACCIDENT

Tatsuaki Kobayashi[1]

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Japan society has changed to be static after the period of economic fast-growth. Sustainability had been pursued under the recent social condition. Low carbon, ecological cycle and biodiversity were the key-words of environmental policy. Satoyama was called as the symbol of human-nature harmonized ecosystem. Nuclear power had also been the key-measure for the realization of such ideology, because it was set as the renewable energy.

The earthquake and the accident damaged our land physically, and influenced seriously our environmental thinking. Radioactive nuclides broadly polluted Fukushima Prefecture and adjacent area. Many people were urged to evacuate homes from the severe contaminated area and agricultural activities were prohibited there. The distrust of environment and agriculture in Fukushima has occurred, therefore foods of Fukushima were avoided in markets and the price has stayed low. Japan society seems to be divided to two nations of Fukushima and others. Nuclear accident compels the re-consideration of energy and environment policies from Japan.

Actual condition of satoyama in Fukushima is as follows. Radioactive plume had flown toward northwest through Abukuma hills from Fukushima I Nuclear Power Plant. Wide area of satoyama was heavily polluted by radioactive nuclides along the track of the plume. Spatial distribution of radioactive Cesium (rCs) was very heterogeneous in such area on any level of scale on region, landscape, vegetation, micro-topography and canopy structure. The temporal changes of air dose rate were almost explained by the physical decay of radioactive rCs. Although rCs was accumulated on canopy and forest floor just after the deposition, it is currently supposed to be cycled in forest ecosystem. It also shows that the pollution by rCs is developed to all the elements of ecosystem. Decontamination of rCs and the restoration of damaged satoyama are tried in difficult conditions.

On the other hand, Japanese policy of energy and land use have not been changed much. Nuclear power is set as the national base-load power even now. Small new changes are that hydraulic and geothermal energy was set as the base-load power. Other renewable energy was set as the peak power whose cost is high but the generation is changeable.

For the forests and parks around urban area, biodiversity and nutrient cycling have been put as important issues, however, biomass use has not been much regarded. In order to discuss the possibility of sustainable city, I would like to introduce the examples of forestation and restoration in coastal areas around Tokyo-bay.

October 10

Oral presentation

16:00–17:30

10–OR1.2(Rm.306)

10–OR2.2(Rm.202)

10–OR3.2(Rm.101)

10–OR4.1(Rm.102)

10–ORV.3(Rm.307)

10-OR1.2-01

BUILDING URBAN RESILIENCE WITH BIODIVERSITY TO MITIGATE IMPACTS OF CATASTROPHIC EVENTS AND GLOBAL WARMING

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The area and quality of green space in cities is often used as a predictor of human health, happiness, equity, and biodiversity, but functional attributes of the urban ecosystem are also key indicators of whole-city health, adaptability, sustainability and resilience to catastrophic events such as earthquakes, fires, hurricanes, floods, tsunamis, sea level rise, and dust storms. Yet the use of such indicators to inform planning and management is often an afterthought or is ignored completely. The increase in catastrophic climatic events and ever larger human populations crammed into marginal environments means that more attention should to be given to building resilience into urban ecosystems to ensure they are sustainable. On top of conventional engineering solutions and more energy efficient building codes, constructive management of vegetation and biodiversity will be critical to developing urban resilience and in the long term will a cheaper option. The opportunities include firstly avoiding development or progressive retreat from susceptible areas like coastlines, floodplains, liquefaction-prone substrates, fire-prone forests and unstable areas prone to land or mud slips, ensuring robust vegetation buffers within and along the edges of such vulnerable areas. Second, managing stormwater by the use of vegetated roofs, walls, rain gardens, swales, and pervious paving. Thirdly, greening for cooling, carbon and fire-resistance; and fourthly, bee and bird friendly vegetation plantings. In this presentation I explore urban indicators of resilience to catastrophes and adaptive approaches to managing the environment and incorporation of green space and biodiversity in order to meet these new challenges.

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10-OR1.2-02

VEGETATION DYNAMICS FOLLOWING THE 2011 HUGE-EARTHQUAKE/ TSUNAMI DISTURBANCE IN AN URBAN COASTAL-ECOTONE

Yoshihiko Hirabuki[1] · Mizuki Tomita[2] · Hiroshi Kanno[3] · Yi Zhao[2] · Keitarou Hara[2] · Ippei Harada[2]

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The Pacific coastal areas of northern Honshu suffered severe damage caused by the Great East Japan Earthquake/Tsunami of March 11, 2011. This landscape ecological study focused on the sand-dune coastal ecotone in the Sendai metropolitan area, and analyzed the heterogeneity of both the huge earthquake/tsunami disturbance and the rapid autonomous recovery of vegetation. We also proposed an integrated landscape design aimed toward the nature-harmonizing reconstruction on the basis of the fragility, unpredictability and unique ecosystems of the costal ecotone.

Hirabuki *et al.* (2011) had already (1) summarized both the geo-ecological and historical characteristics of this sand-dune coastal ecotone (e.g., landform patterns, natural disturbances, abiotic stresses for wildlife, land-use history and vegetation/ecosystem varieties in ca. 1.5 km wide strip along the seashore), and (2) evaluated this transitional area as a catenate landscape involving unique kinds of species and ecosystem services. Based on this integrated concept, we carried out a multi-scale landscape analysis in the sand-dune/alluvial plain environments of the eastern edge of Sendai city, the capital of Miyagi prefecture. Our two main approaches were (1) the remote sensing analyses employing data from Terra/Aqua MODIS (250 m spatial resolution), SPOT/HRG-2 data (10 m resolution), GeoEye-1 (0.5 m resolution), LiDAR and aerial photos and (2) the on-site investigations in the Minami-Gamou monitoring site (38°14.1´N, 140°59.5´E; a 550 m by 700 m strip of coastal ecotone) since June 2011 (https://sites.google.com/ site/ecotonesendai/).

Major land-cover types such as coastal forests, paddies and residential areas were severely destroyed mainly by the huge tsunami, although varying responses to the natural disturbance (e.g., subsidence, landform change and collapsed-patterns of trees) were detected within the catenate-landscape. In addition, from June 2011 on, reconstruction activities rapidly produced artificial bare-land, and these land-cover types were degraded and fragmented.

Precise surveys in the Minami-Gamou monitoring site revealed the presence of a total of 411 living vascular plant species until the end of 2013, including endangered species and alien/ruderal species. The survey also showed that some unique vegetation patches in specific habitats, such as sand-dune herbaceous plants, *Phragmites*-dominated brackish marsh and *Pinus*-dominated coastal forest on interior sand-mounds, narrowly survived as small patches. A number of plants were also observed to be recovering from buried/drifted seeds and/or subterranean-organs in 2011, and most of them flourished and bore seeds in the following years under the sunny conditions.

These results indicate that sources of autonomous vegetation/ecosystem recovery remained and functioned, even after the huge tsunami, and emphasize the necessity for wise-use and integrated management of the sand-dune coastal ecotone for rebuilding a disaster-resilient and sustainable society.

Acknowledgements

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10-OR1.2-03

ENVIRONMENTAL HETEROGENEITY AND PLANT DIVERSITY IN A COASTAL FOREST NEAR SENDAI CITY, JAPAN, INFLUENCED BY A SEVERE TSUNAMI

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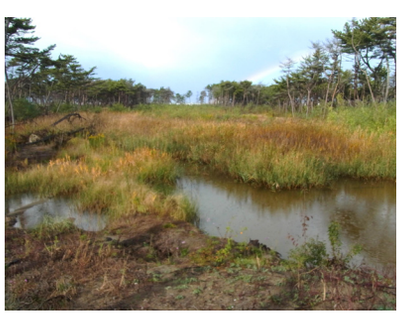
Spatial patterns of plant diversity and environmental heterogeneity were analyzed in a coastal forest, 2 years after a severe tsunami caused by The 2011 Great East Japan Earthquakein Japan, to gain basic knowledge for the planning of coastal forest management after severe disturbance.

The ~60.5 ha study site was divided into four patch types: 1) forest with mostly remaining tall trees (TR), 2) forest with mostly fallen tall trees (TF), 3) forest with mostly fallen shrub (SF), and 4) back marsh remaining post-tsunami (BM).First, species composition was conspicuously different among patches. The numbers of woody and coastal herbaceous species were significantly larger in TR and SF patches, respectively, than in other patches. Species composition was conspicuously different between TR and TF patches, although environmental conditions were similar before the tsunami, i.e., 65.2% of the 92 observed species were restricted to either patch. A survey revealed that four endangered or vulnerable species (*Swertia diluta* var. *tosaensis*, *Penthorumchinense*, *Patriniascabiosaefolia*, and *Dianthussuperbus* var. *longicalycinus*) were restricted to only TF patches. The number of species in 1 × 10 m quadrats was positively related to the difference between the quadrats' highest and lowest ground points; this gave an index of unevenness within a quadrat. Thus, markedly uneven ground surfaces were created by falling of tall trees. Our results suggest that the tsunami increased both the β-diversity (among-patch diversity) and the α-diversity (within-patch diversity) of the coastal forest.

Such spatially heterogeneous coastal forests and coastal herbaceous vegetation which had been established after the tsunami, however, were almost completely replaced by a monoculture pine plantation or concrete levees. Such modifications were conducted as public works aimed at a tide and storm protections.

Many urban areas are located near the sea in Japan. On the other hand, total population is declining and the population distribution is also changing. The balancing of the biodiversity conservation and the tide/storm protections might be an important issue toward the sustainable land use. Careful monitoring and adaptive management in Tohoku region, when it realized, should provide good lessons to the future coastal management.

Forest with tall trees (TR)



Forest with fallen trees (TF)

Back marsh (BM)

10-OR1.2-04

FUNCTIONAL TRAITS FOR UNDERSTANDING URBAN ECOSYSTEM SERVICES AND THEIR RESILIENCE?

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Lists of species still provide the most common type of data for understanding and managing urban ecosystems. However, this information is not really sufficient for addressing more nuanced concerns such as specific ecological functions or processes or particular ecosystem services. To better relate biodiversity to system dynamics functional traits have been suggested as a way to address both ecological functions and changes in these functions as organisms respond differently to disturbances and drivers of change. In this framework e*ffect traits* relate to the different functions while *response traits* indicate how organisms may respond to different environmental conditions and changes. Cities and urban environments impose environmental filters that select for certain response traits and thus promote certain species rather than others. Effect traits in turn can help us understand how these species contribute to the functioning of urban ecosystems, but to get from an understanding of function to one of ecosystem service supply is not yet explored in depth.

This article explores what – in terms of functional traits – we actually know about urban ecosystem services and how they are connected to biodiversity and species communities. Based on the existing literature we show how some ecosystem services have been connected to effect traits, highlight other cases where we have some, yet incomplete, evidence for ecosystem service – traits connections, and discuss the services where we to date do not know how to link services to traits as they have traditionally been defined. Finally, we return to response traits and how they can be used to assess the resilience of different services. A more developed traits framework addressing the identified gaps could help us understand and navigate future urban development and help us manage and design city landscapes for resilient supply of said services.

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Applicable URBIO sub-themes:

I. Blue and Green Infrastructure for resilient cities
   1. Water, green infrastructure, and ecosystem services
   2. The environmental drivers of urban resilience
   3. Flora and fauna of cities

II. Landscape Design and Restoration
   3. Landscape design and management practices for urban biodiversity

III. Participation and Collaboration
   4. Research agenda on urban biodiversity, ecosystem services and design

V. Young Student Session

10-OR1.2-05

UNDERSTANDING AND REDUCING THE BIODIVERSITY EXTINCTION DEBT IN CITIES: A CASE STUDY

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Previous research has shown that the extinction rates of plants from cities around the world are highly influenced by the development history of the city, and by the amount of natural vegetation remaining within the city (Hahs et al. 2009). Based on the amount of natural vegetation remaining in the landscape, many of the cities had lower than expected rates of local plant extinctions. This suggests that cities may be carrying an extinction debt, where an initial disturbance event results in a delayed but inevitable local extinction. which species are most likely to become locally extinct can provide critical information that may help in reducing how much of the extinction debt is realized.

In Melbourne, Australia, 55% of the 1200 indigenous plant species that currently persist in this highly altered landscape are predicted to become locally extinct over the next 100 years. Using several techniques, we explored which species are likely to form part of the local extinction debt for Melbourne, Australia. These analyses highlighted that there are multiple ways to become extinct (Duncan et al. 2011), making it difficult to identify vulnerable species based simply on their functional traits or phylogeny. In Melbourne, the influence of geographic location and vegetation associations was much more informative, indicating the Plains Grasslands are currently carrying the highest extinction debt (184 species or 21% predicted to be lost over the next 100 years; Hahs and McDonnell 2014).

While the planning and design of cities and towns is an essential part of conserving and enhancing biodiversity in urban areas, management is critical to reducing extinction debt in urban landscapes. Without effective and efficient management practices, the remaining areas of native vegetation, either remnant or restored, are unlikely to deliver the desired outcomes for conservation of native species. Developing effective and efficient management requires new thinking around where conservation actions occur, to identify the opportunities for complementary and supplementary management beyond the remnant patch; as well as flexibility in allowing these systems to adapt and respond to new environmental conditions and stressors.

Identifying and implementing a more social-ecological approach to the management of greenspaces across the entire city, including those that are designed, cultivated and novel, will be critical if we wish to minimize the realization of the biodiversity extinction debt. This is where the communication and cooperation of ecologists, land managers, built environment professionals, state and local government, and the general public are critical to ensuring that we achieve the best possible outcomes for urban biodiversity. By working together, we can ensure our cities remain vibrant, diverse and nurturing places for people and biodiversity.

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10-OR1.2-06

IINDICATORS FOR EVALUATING SUSTAINABILITY TO REDUCE CARBON EMISSION IN URBAN GREEN AREAS: CASE STUDY ON CUT-SLOPE AREA

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In recent years, there has been an increasing interest in the study of carbon sinks associated with climate change. However, most studies with respect to carbon sinks have only focused on forests, and there is a general lack of research regarding the ability of urban green areas to reduce carbon emissions. Therefore, the assessment of sustainability in ability of urban green areas to reduce carbon emissions offers some important insights into urban park planning or urban ecological planning. These findings provide an important opportunity to advance the understanding the relationship between urban systems and the carbon cycle. Furthermore, high efficiency for reducing carbon emission should make an important contribution to urban resilience because carbon emission in urban area has increased due to the continuing urbanization. Therefore the aim of this research is to develop the indicators to assess sustainability to absorb and store carbon in urban green areas.

A literature review was conducted to select indicators for evaluating carbon absorption ability and the sustainability of carbon storage both soil and vegetation. From this literature, indicators were developed into a draft list to be validated and tested by experts. Experts provided suggestions and the draft list was reformulated to reflect the validation of indicators in urban green areas. The relative importance of the selected indicators was analyzed and the indicators were weighted by using AHP. Following this, the final set of indicators was identified for evaluating sustainability of carbon uptake in urban green areas.

As a result of our research, we were able to calculate sustainability into two parts: Soil and Vegetation. The contents of organic matter and soil respiration were selected as important indicators for soil. In one part of the survey on indicators for vegetation, experts selected two types of indicators to evaluate the sustainability of carbon storage. These were carbon stock and adaptation on disturbances. The key aspect of carbon stock was calculating current biomass of vegetation. The adaptation on disturbances was composed of three set of indicators: adaptation ability to climate change, human disturbances, and vegetation with high NPP (Net Primary Production). Indicators for adaptation ability on climate change were the following three indicators: tree survival rate under frozen conditions, water stress tolerance, and sensitivity to temperature change. The other type of indicator was human disturbances, such as the management of green areas.

The indicators identified in this study could be used in developing plans for a more resilient city when it comes to carbon mitigation because this study provides a standard of evaluation for the sustainability of reducing carbon emissions in urban green areas. Also we were able to provide an effective tool for evaluating the sustainability of restoration, which is conducted on various types of urban green areas. A further study could evaluate the validity of these indicators by applying it in actual practice.

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10-OR2.2-01

Effects of the upstream dam construction on the habitat alteration of the riparian zone in downstream urban area

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Subject to frequent floods, sediment bars and riparian area of a river channel are low in nutrients and are covered with coarse sediments. Thus, they are important habitats for pioneering species. However, the coarse sediment of the ground surface is maintained by a frequent supply of fresh sediments from the upstream mountainous reach at the time of floods. Construction of a dam substantially changes the sediment transport condition in the river channel and may affect the biodiversity of the downstream river channel, as all coarse sediments which are otherwise supplied to the downstream, are trapped at the dam in the upstream. Effects of the upstream dam construction on the habitat alteration in the downstream urban area were investigated with periodically taken aerial photos, field observations, chemical and physical analyses of sediment for Sagami River, which flows through urban area near Tokyo. The river was originally stony with active river channels, and it was a habitat for many pioneering species. Dams were constructed in the main stream and the largest tributary, which provided sediments for the reach,and, only tributaries which flow through urban area remain undammed. Then the morphology of the river channel became extremely stable. Bare areas of coarse sediment bars and Riparian Zone were started to invade by herbs and the woody plants converting the sediment bars and riparian zones in to thickly vegetated areas. Species which prefer stony habitats became extremely threatened with the changes of sediment characteristics and nutrient composition. Therefore the upstream river regulation by damming main channel and the largest tributary of Sagami River indicated a significant impact on habitat alteration in downstream reach.

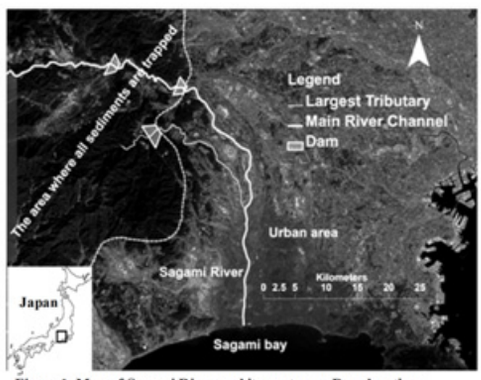

Figure 1. Map of Sagami River and its upstream Dam locations

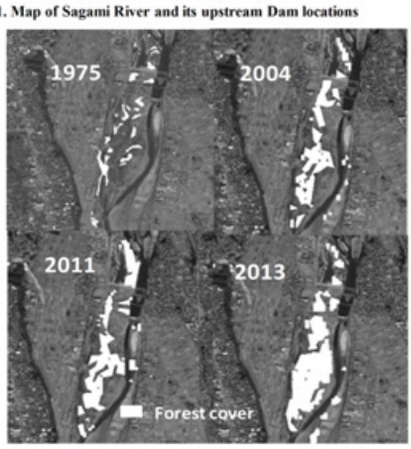

Figure 2. Forest invasion of a Mid-Stream sandbar in Sagami River from 1975 to 2013

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10-OR2.2-02

A STREAM RESTORATION PROJECT IN URBANIZING WATERSHED IN KYUSHU ISLAND, JAPAN

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A stream restoration project is going on in urbanizing area in Northern part of Kyushu Island, Japan. The project site, the Kamisaigo river, has repeated flood and often inflicted inundation damage on housings around the river. From this background, river improvement work has been conducted with restoring its river environment. The river construction work has been promoted according to a Japanese river restoration technical standard that is made by MLIT (Ministry of land, infrastructure, transportation and tourism). In addition in-stream restoration method is introduced. The introduced in-stream restoration methods are channel constructer, timber log structure, rock weir and spur dike. All the structures are aimed to rehabilitate healthy riffle and pool environments by restoring stream flow variety.

The effect of the river construction work has been evaluated by the fish sampling survey that compare the fish species richness between before construction and after.

From the result, species richness has been significantly increased that the environment for fish species is restored at a good rate. However, the construction has not spend enough period to stabilize the river environment. Therefore it is necessary to continue the monitoring survey.

10-OR2.2-03

EVALUATION OF FLOW REDUCTION IMPACT ON RIVERINE ECOSYSTEM CAUSED BY MYCRO HYDROPOWER GENERATION

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The present study evaluated the impact of micro-hydropower generation plants on physical and biological environment in rivers. Due to the recent energy problems in Japan, renewable energy, especially micro-hydropower generation has attracted much attention. Although micro-hydropower plants are expected to have low environmental loading, micro hydropower plants generally abstract water from rivers, which may influence on physical and biological environment. Though previous study has been conducted in New Zealand[1], no study about impact of micro-hydropower generation plants on riverine ecosystems in Japan was announced. In this study, we evaluated how water abstraction associated with micro-hydropower plants change the physical habitats and community structure of aquatic insects in streams, the Chūgoku region, Japan.

Field survey regarding physical environment and aquatic insects was conducted in the following two rivers which have micro hydropower plants: the Kaji River with 50% of flow reduction rate and the Kamo River with 70%. The reference reach and the impact reach were designed in each river. Each reach with 150m long was classified into five kinds of habitats (step, pool, cascade, rapid and slack) based on landscape characteristics and bed materials. Measurement of physical environment and sampling of aquatic insects were conducted in every habitat. Flow velocity and water depth were measured for physical environment data. Fauna and numbers of aquatic insects are investigated for biological data.

Results obtained from the field survey were as follows:

1. Significant difference on physical environment between the reference reach and impact reach was not identified in both rivers.
2. The number of families and density of aquatic insects between the reference reach and the impact reach don't have significant difference in the Kaji River.
3. From the result of cluster analysis based on aquatic insect composition in habitats, samplings were classified owing to habitat type rather than whether flow reduced.
4. In summary, the impact of water abstraction induced by micro-hydropower generation was so limited in physical environment and aquatic insect which is an important indicator of environmental change.
5. Additional investigations should be conducted in various rivers which have different flow reduction rates to define sustainable environmental flow when micro-hydropower plants are installed.

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10-OR2.2-04

HOW URBANIZED STREAM CAN AFFECT WATER TEMPERATURE REGIME OF WATERSHEDS

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Climate change effects have been critically affecting urban environment in various ways of raising air temperature of city and giving increased threat of heavy rainfall. These situation requested to urbanize streams running across a city both to provide more waterfronts and to secure the stream much resistant to water events. However, the urbanized stream could have different features from natural stream. Especially, water temperature will be directly affected by losing or weakening the synchronizing relation between air and stream temperatures due to increased residence time. However, the effects of urbanized stream on watersheds and further downstream have been little examined. This paper presents the temperature effects of an urbanized stream, Dongcheon River, which is running through Suncheon City. Temperature data loggers deployed into watersheds including Dongcheon River recorded water temperature every 10 minutes. In the watershed, three different types of streams were examined: natural (Sansacheon River), Dam-affected (Isacheon River), and urbanized. The temperature changes responding to air temperature were compared among three streams. Natural stream showed most closely synchronized temperature changes with air temperature. Dam-affected stream also indicated the synchronized, but week, changes. While, urbanized flow showed least synchronization of water temperature and had relatively steady temperature. These results highlight that an urbanized stream warmed by air due to slowly moving flow can work as a heat transporter to lead to increased water temperature downstream.

10-OR2.2-05

EVALUATION OF VALIDITY OF HABITAT SUITABILITY INDEX MODEL FOR HYNOBIUS NEBULOSUS AND ANALYSIS OF THE OTHER ENVIRONMENTAL FACTORS

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Many habitat suitability index (HSI) models have been constructed in Japan, as one of the quantitative evaluation methods for environmental impact assessments. However, in spite of their usability, they have sometimes been criticized because of the empirical construction method, lack of objectivity and a few case studies on the availability in the other area/time, etc. More discussion about the models to improve their generality and availability are needed. Therefore, we aimed at validating a HSI models for clouded salamander, *Hynobius nebulosus*, which inhabits small wetlands and forests, by applying it in Miki, Hyogo prefecture and in Kizugawa, Kyoto prefecture, each of them has different condition from that when the HSI model originally developed in terms of time or area, and tried to analyze the other environmental factors in order to construct a better alternative model.

Firstly, we obtained the data of four SI values of the HSI model, distance between forest and wetland (V1), average depth of the water from Feb. to Jul. (V2), average water temperature from Feb. to Jul. (V3), and area ratio of trees within 100m from perimeter of open water (V4) in Miki Disaster-Preparedness Park, Miki city, in 2003 (Kitamura 2003), 2012 and 2013, and in Kizu North Area, Kizugawa city, in 2013. Next, we applied them to the original HSI model and calculated HSI values in two units (paddy/pond unit and valley unit) in each field. We investigated the relationship between each HSI value and the numbers of egg clusters (NEC) in each unit by Spearman's rank correlation coefficient to evaluate the applicability of the models. Furthermore, we obtained the other environmental data through field survey and using GIS in Kizu, and analyzed the factors that affect the population density of *H. nebulosus* by Generalized Linear Modeling (GLM) with stepwise method based on AIC.

The results showed that Spearman's rank correlation coefficients between HSI or each SI value in paddy/pond unit and NEC were not statistically significant at Miki. On the other hand, coefficients between HSI in the both units and NEC showed statistical significance at Kizu. Although the original model was evaluated as an effective model in some cases, it was necessary to reconsider the inclusion of SI values except an average depth of the water (V2) on each site. In addition, the model was evaluated to be more appropriate to be applied in a large area unit such as valley than in a wetland. The results of GLM showed that some factors such as topographic wetness index (TWI), number of the other breeding wetlands within 100m from a water area, etc. were significant to explain the population density. We concluded that it is necessary to consider not only the original SI values but also indices such as soil moistures or closeness between breeding wetlands when an alternative HSI model is constructed.

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10-OR2.2-06

BUILDING URBAN STREAM TRANSDISCIPLINARITY FOR ANDEAN URBAN STREAM REHABILITATION. PRELIMINAR RESULTS FROM ZAMORA RIVER, LOJA, ECUADOR

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Rivers are a fundamental part of the ecological and social functions of urban systems (Findlay & Taylor, 2006; Francis, 2014). Despite this fact, waterways have suffered an intense degradation, constraining the ecosystem services they naturally provide to the public (Paul & Meyer, 2001).

The Zamora River originates in the Podocarpus National Park adjacent to the city of Loja, and immediately flows into urban space, crossing the length of the city. Like many rivers worldwide, during the twentieth century (Findlay & Taylor, 2006), the Zamora river was canalized, reducing the riparian ecosystems enclosed between roads, and turning the river corridor into another city street, and receiving sewage disposal. In consequence, the river has lost many of his ecological and social functions.

There is a lack of knowledge about urban streams in Latin America, just 9% of articles published (mainly in Brazil) address this region (Francis, 2012). Further, there are geographical differences among urban stream syndrome (Ramírez, De Jesús-Crespo, Martinó-Cardona, Martínez-Rivera, & Burgos-Caraballo, 2009) that have not been described, and Andean rivers remain underrepresented in the research literature.

Urban stream rehabilitation offers the challenge of integrating ecological and social sciences and urban design (Findlay & Taylor, 2006; Paul & Meyer, 2001). Urban river rehabilitation is not possible without the participation and contribution from a broad scope of disciplines (Komínková, 2012). Promoting restoration requires evidences from other study fields (i.e. medicine, psychology or human ecology).

This project aims to understand the ecological, social and spatial dynamics of the Zamora River in order to establish rehabilitation design criteria and determine indicators to monitoring ecosystem change. Data will be used to provide arguments to city managers and citizens to promote its rehabilitation.

To achieve this goal, we involved a multidisciplinary team of researchers including natural, social, technical scientists and artists from local universities, NGOs and government agencies. The study focuses on six key points along the river, from the entrance to the exit in the city. Data is being collected about water quality, richness and biodiversity of macro invertebrates, insects (biomass and moths as indicators), micro mammals (mustelid and chiroptera), botanical inventory, bryophytes and lichens and landscape cartography, in relation with the natural environment (Paul & Meyer, 2001). The spatial analysis also includes data from urban indicators and landscape assessment.

The success of any intervention to improve the ecological condition of urban streams depends broadly on human perceptions and behaviors, including the many conflicts between the recognition of urban streams and their protection. (Both, 2005) Thus, we are also studying the Zamora river ecosystem services and the relationship between health, recreation and river proximity and river social perception (Junker & Buchecker, 2008; Richardson, Pearce, Mitchell, & Kingham, 2013; Toftager et al., 2011).

Our research provides a unique opportunity to study urban streams in the region. Presented here are the

preliminary results that determine design guidelines for ecological and social rehabilitation of the Zamora River, and establish a pool of indicators for monitoring the changes in this Andean region.

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10-OR3.2-01

A NEW CERTIFICATION SYSTEM FOR SUSUTAINABLE LAND USE ENCOURAGES SUSTAINABLE URBAN DEVELOPMENT

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ABINC (Association for Business Innovation in harmony with Nature and Community) has established a certification system for sustainable land use of business facilities. ABINC board consists of authorities on ecology, landscape and business and biodiversity and is involved in a certification process. In January, 2014 ABINC issued the certifications for the first time to 9 office buildings and 2 shopping centers, which include not only facilities under development but also existing ones. Those green spaces can improve the quality of the regional ecosystems and contribute to the construction of ecological networks.

ABINC validates the conformity of facility's landscape documents to "Guidelines for sustainable business sites". The guidelines were developed and issued in April, 2011 by JBIB (Japan Business Initiative for Biodiversity) Sustainable Land-use Working Group members, co-working with Tohoku University.

JBIB was established in 2008 by 14 companies advanced in business and biodiversity. It now comprises more than 50 companies and is keen on development of tools in collaboration with universities or research institutes to encourage business sectors to promote their efforts toward biodiversity and thus contribute to society in a way that is beneficial for everyone. The guidelines were mentioned in the latest National Biodiversity Strategy of Japan and introduced in some Local Biodiversity Strategies.

In the JBIB guidelines biodiversity efforts in the business sites have been classified into 17 evaluation criteria in three categories, evaluated on a 100-point scale. The three categories are:

1. Creating an environment contributing to biodiversity conservation
   8 evaluation criteria involve the substantial aspects of corporate green space, such as the area and structure, aggregating and connecting features, and nativeness of vegetation, from the perspective of the development of green space in which many existing living organisms can thrive.
2. Promotion of the sustainable maintenance and management of corporate green space harmonizing with the natural cycle
   5 evaluation criteria include appropriate use of chemical substances, consideration of water cycle and material cycle and monitoring living organisms, from the perspective of the significance of maximum use of the natural cycle in the maintenance and management of irrigation, fertilization, pest control, weeding, pruning and disposal of fallen leaves, while considering the condition of the land use of surrounding areas of facilities.
3. Communication with Stakeholders
   4 evaluation criteria entail regional partnership, promotion of various awareness programs, employee participation and development of human resources who will take responsibilities of these efforts, from the perspective of the significance of cooperation with community and development of human resources to continue biodiversity efforts and maximize their effects.

So far, interviews with real estate firms or urban development companies suggest that this certification system can work well as the first trigger for them to proceed to sustainable land use. ABINC plans to apply the certification system to factories, apartment housings, hotels, distribution facilities and so on in a few years in cooperation with other green building systems.

JBIB guidelines and ABINC certification may become a remedy for problems arose from megacity expansion.

Certification logo

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10-OR3.2-02

JAPANESE BUSINESS INITIATIVE FOR SUSTAINABLE WATER USE AND ECOSYSTEM MANAGEMENT

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Under the impacts of climate change, risk management on water resources and aquatic environments in river basins is the urgent issue for the company's business continuity and sustainable water use. Working group on water and ecosystems in JBIB, Japanese Business Initiative for Biodiversity, has been developing the evaluation methods of company's water managements for avoiding, reducing and mitigating the impacts on water resources and aquatic environments at three levels and scales, 1) value chain of company's activity, 2) river basins in which company's business sites are located, and 3) water network around the business sites.

Targeting the water management in the whole value chain, we developed the tool for the calculation and mapping of water footprint inventories at each stage in the life-cycle of the company's products and services. In the case study on the life-cycle of manufacturing PET bottle for drinks, hotspots of the water use in the process were specified by calculating water footprint inventories at each manufacturing stage. When the target is limited to the business stages of the processing company, procurement of raw materials occupied much of their water consumption, while in the whole stages of their value chain, water consumption in the bottler's bottling process shared much of the total consumption. By quantifying and mapping water footprint inventories visually, companies can promote the development of new technologies for reducing water consumption and improving water use efficiency.

For the company's water management at the scale of the river basins in which their business sites are located, we developed the information framework to clarify the water resources and the aquatic environments related to their business activities in each river basin using public environmental data. This helps companies to evaluate the potentially affected regions by their local water use, and supports to set their policies and goals to achieve water neutrality or "no net loss" of the ecosystem impacts. Conservation measures such as the management of watershed conservation forests, the financial support to local farmers to sustain the cultivation of the groundwater, and the creation of biotopes utilizing regenerated water from factories, would be planned with the responsible region in the river basin.

At the scale of the water network around specific business site, we developed the assessment sheets to check the viewpoints and the requirements in the local water management, which had been specified by suspecting potential impacts on aquatic environments and ecosystems by the water use in the business site. As the items of assessment, not only the usual actions of withdrawal and drainage, but also the actions to control the impact and its area by the potential emergency or accident were added. By setting and monitoring the water management indices on water balance and ecosystem conservation for each item, it is expected for the business site to prevent the environmental impacts in surrounding water network.

These series of toolkits can be applied to the information disclosure on water use by companies in the social communication, visualizing their commitments to the conservation of water resources and biodiversity. From now on, we would like to create the progressive example of company's integrated management of water and ecosystems utilizing these toolkits at multi levels, and have study on the application method to promote the cooperated activities among companies.

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10-OR3.2-03

CAN GREEN ROOFS SUPPORT BIODIVERSITY CONSERVATION GOALS?

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Green roofs are novel ecosystems that are increasingly common in cities. While their hydrologic and energy saving benefits are well established, green roofs have also been proposed as having significant value for conserving biodiversity. However, the success of green roofs designed for biodiversity has rarely been evaluated and the claims of positive biodiversity outcomes could sometimes be criticised as a 'green wash' applied by building developers and architects. We evaluate six hypotheses that describe the purported biodiversity conservation benefits of green roofs. Evidence suggests that green roofs largely support generalist species particularly insects, but their conservation value for rare taxa, and other taxonomic groups especially vertebrates, is poorly documented. Further, their ability to replicate biotic communities in the context of ecological restoration is largely untested, as is their potential to connect ground level habitats. Given the available evidence green roof proponents should use restraint in claiming conservation benefits but ecologists need to become more involved in evaluating green roof biodiversity and help design green roofs based on ecological principles.

10-OR3.2-04

Barriers to the adoption of green buildings in India: A perceptive study using Analytic Hierarchy Process

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The Indian construction industry which is rapidly growing at a rate of growth of 10% compared to the world average of 5.2% could hold a huge potential in facilitating the shift to green building practices. Most of the commercial buildings in India have an Energy Performance Index (EPI) of 200-400 kWh/m^2/year and the improved design practices can reduce our EPI to 100- 150 kWh/m^2 /year. This paper applies Analytic Hierarchy Process (AHP) to examine and prioritize underlying barriers to adoption of green rating in commercial buildings in India by various stakeholders in construction sector. The stakeholders are divided into seven groups: builders, potential occupants, architects, engineers, project managers, contractors, government representatives. Despite of the win-win scenario, the stakeholders face barriers and disincentives when it comes for adopting green construction.Objective of this paper is to quantitatively identify, rank and prioritize the barriers to the adoption of green building. Research is designed as a perceptive study based on the barrier perceptions of these stakeholders with these two major assumptions:

a) There are non- economic factors like organisational and structural factors which influence the decision on investment in carbon saving technologies.

b) Barrier perceptions of every stakeholder in the commercial building sector vary.

On the basis of the findings of previous research and literature review, 20 barriers are identified and grouped into four categories: (1) Policy and Market Barriers; (PMB) (2) Financial and Economic Barriers (FEB); (3) Information, Promotion and Education Barriers (IPE) and (4) Managerial and Organizational Barriers (MOB). Then an AHP model is developed and a survey questionnaire was designed, tested, and the questionnaire was distributed to the representatives of seven categories of stakeholders.

Calculation of Global weight reveals the weightage among barrier categories: IPE fetch the highest global weight of 0.4408 and PMB follows behind with the global weight of 0.2679 whereas FEB and MOB lag much behind these two by having a global weightage of 0.1724 and 0.1169.

Local weights bring light into the most intense ones among the list of twenty barriers. LELC (Lack of expertise in application of Life Cycle Costing and other energy efficient techniques in construction sector), WEBC (Weak enforcement of Building Code) and AEC (Absence or misplacement of Economic Incentives) becomes the top three barriers with local weights of 0.2197, 0.13, and 0.08 respectively.

The study has been conducted among 105 stakeholders who are practicing in their profession in the metros of Mumbai, Delhi and Bangalore. The study looks how barrier perceptions differ from one stakeholder to another and also synthesises their judgements. The top barriers are identified and policy options are suggested to reduction/ removal of these most intense barriers.

10-OR3.2-05

INTRODUCTION OF AN IMPROVEMENT PROJECT, CALLED BY HOMETOWN'S RIVER, FOR JEONJU CHEON.

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Jeonju cheon was improved to close-to-natural stream. It has the engineering function of flood control and water utilization, and natural function of water-friendly park. Due to introducing same function into most streams and rivers in S. Korea, there aren't any specific, unique, and distinctive characteristics among them. In order to improve these problems and to obtain community consciousness and love of hometown by citizens, stories based on culture and history of Jeonju city are considered in designing Jeounju cheon.

In Jeonju city, there are various original, peculiar resources of stories which are based on history, ecology and culture. For example, in terms of ecology character, there are wild fish living in 1st class water quality such as Otter and Coreoleuciscus splendidus. Concerning history and culture, there are old downtown, Bibimbap food, traditional architecture style called Hanok and so on. Using these stories resources and considering them synthetically, we set up a theme of 『Jeonju cheon flowing with a traditional great taste and beauty』

By dividing total length (9.85km) into 3 sections, we established sectional maintenance conception considering their characteristics. In 1st section, from Girin Br. to Wansan Br., we set up an ecological friendly water section which blue wave is breathing. In 2nd section, from Wansan Br. to Hanbeok Br., we set up a various historic and cultural heritage section. In 3rd Section from Hanbeok Br. to Anjeok Br., we established a section for comfortable life with nature. We planned and designed a facility, greenway, and area according to sectional maintenance conception. At that time, we first decided major point and then minor point and area which can support conception.

I am sure Jeonju cheon will become a famous tourist attraction in our country and lead to an increase of local income from tourists. Finally, citizens living in this area can be wealthy and pursue pleasure and happy life as a result of Jeonju cheon improvement project.

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10-OR4.1-01

(for URBIO Incheon 2014)

TRADITION, EXPERCIENCE, AND ECOLOGY; URBAN FORESTRY FOR TOKYO'S MEIJI SHRINE

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To commemorate Japan's Meiji Emperor, who passed away in 1912, a new memorial shrine was set up in Tokyo. The essence of a Japanese shrine is in the buildings but also in the sacred, eternal forest around it. However, making such a forest anew was without precedent.

In April 1915 a committee of specialists was appointed, and among its members we find forestry specialists who had studied in Germany, where forestry aesthetics was blended with a thorough insight into technical aspects of sowing, planting, maintaining trees, and harvesting. Novel, Western science was imported to Japan, but there were in fact many vernacular and traditional elements in the project too. Extensive forestry politics and woodland management had formed part of society's realities already for centuries. The early nineteenth century had seen a serious degradation in forest land all over Japan. In the east and north of the country, in the mid nineteenth century, most intensive and high-grade management efforts in replanting forests were made not far from Tokyo. Besides, the woodland landscape outside Tokyo was lauded in literature of the times too: upland forests were seen as a meaningful and glorious landscape, within the lines of international literary naturalism.

Practically speaking, for the new shrine, the trees needed to stand the rather dry soil conditions, as the 73hectares site was on an upland plain. Not very demanding deciduous species were to be mixed with many evergreen conifers and broad-leaved trees, but also shrubs. It would result in deep shade and hardly any wind at ground level. Fallen leaves would not be blown away, but settle, decompose, and nourish the soil. Such was the vision for a sacred, eternal forest. In a process of trial and error, the design for the forest was set up as a system of plant layers. To the layers, dimensions of time were added. A pioneer, a formative, and a climax stage were foreseen in the development of the forest. The pioneer stage was planned for the first fifty years. The middle stage of forest was projected to be completed in a hundred years. The climax was foreseen at hundred and fifty years. The climax forest should be self-regenerating through natural seedlings and the accumulation of humus. In the planning, the size of the trees was important too. Pioneering pine trees should have a height of ten to twenty meters. Below the pines, *Chamaecyparis* had to be planted as trees of about eight meters. Low oaks and camphor trees for under-planting were anticipated to provide the last and climax stage after a century and a half. This climax group was again divided into two sub-layers as a set of trees of initially about four meters tall, and a lowest layer of saplings of a meter or so. This strategy is fully developed in 1921 as a sketch by Hongo Takanori proves.This is well before the activities of Reinhold Tüxen on plant sociology and planning of the 1930s that became epoch-making and influential in landscape architecture after the war.

Meiji Shrine has today an impressive urban *Stadtwald*, mostly including *Zelkova serrata, Quercus myrsinifolia*, and *Castanopsis sieboldii* in the top canopy; and *Eurya japonica* and *Aucuba japonica* in the lower layers. It's all rooted in traditional knowledge of the forest.

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10-OR4.1-02

UTILIZATION AND CHANGES IN PROCUREMENT OF PLANT RESOURCES IN KYOTO GION FESTIVAL

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<Background and Objectives>

Kyoto Gion festival is one of the oldest urban festivals in Japan, and also inscribed on the UNESCO Representative List of the Intangible Cultural Heritage of Humanity in 2009. This research is focusing on the float ceremony, "Yamahoko-Junko", the most highlighted event in this festival. Although it has been held for more than1100 years, people had been struggled for succession against many risks, such as large-scale urban fire, economic instability, war, and so on. In 21st century, difficulty of stable procurement of plant resources used in the Festival is becoming a problem.

There are some previous studies that are focusing on use of plant resources in other festivals. However, most of the researches and publications on Gion Festival are arranged only from a viewpoint of the humanities. Therefore, this research is the first research of Gion festival from a view of natural resource use. The purposes of this research are to clarify all the plant use in the float ceremony of Kyoto Gion Festival, and to disclose the present and past situation of procurement process through some cases.

<Methods>

We focused on the raw plants used for decoration of the floats. This is because they are more vulnerable to the changes of procurement process such as environmental changes, for they are perishable and can be used only for one period of the festival.

This research has two parts. First, we compiled a list of plant resources used in all the floats (N=33) by literature search, Google Images, and field survey (2013/07/13 – 07/16). Survey items are classification of shape of the float, name of the float, Japanese name of the plant, scientific name of the plant, size, quantity, used part in plant body, type of decoration (utilization). The second is investigation of the procurement process by literature search, semi-structured interviews with 9 members of preservation society and 5 procurers of the resources (2013/06 – 2013/12).

<Results and Discussion>

29 out of 33 festival floats used at least 1 plant resource for their decoration. 8 species (+ 4 imitation plants) were used, and all of them were common species around Kyoto city. Therefore, it is supposed that the procurement was not so difficult.

Procurement areas of Japanese red pine before 20th century were inside Kyoto city today (they were small villages around Kyoto at that time). In recent years, however, the area is expanding to other prefectures nearby. On the other hand, the procurement area of Japanese cedar was still inside Kyoto.

Change of characteristics/attributes of procurer was clarified in some cases. Before the modern era, people under the kind of contract supplied each plant resources, and they belonged to a group of people who have skills of plant resource procurement. For instance, some people had their own mountains and used it for timber production, hunting etc. Recently, in alternation of generation, some of them were replaced by new group of people, civic groups who are concerned with natural environment around Kyoto.

Two aspects of vulnerability were pointed out through the results. First one is environmental aspect. Procurement of some species is becoming difficult because of changing habitat and decreasing resources. Second is the social aspect. Characteristics of procurer are changing from "occupation-oriented type" to

“leisure-oriented type”. Although this change can be a new way for procurement process and maintenance of natural resources, we need to be kept aware of the concept of “role-sharing” that have long been generated the responsibility and resulting worthwhileness of procurers.

10-OR4.1-03

CONTRIBUTION OF SYMBIOTIC LIFESTYLE TO URBAN BIODIVERSITY AND ITS EVALUATION METHODS

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Introduction

The way of life of urban residents is often thought to negatively influence on original physical and ecological condition in urban area. For example, fragmentation by urban land development such as construction of buildings, houses and roads is one of the main causes of loss of urban biodiversity and decrease of the chance for the residents to interact with flora and fauna in urban area. In addition, social problems with the declining birth rate and aging population make it difficult that local experience and knowledge on urban ecology are inherited in generations. However, some of citizens in historical cities still may have kept their hypothetically positive *symbiotic lifestyle* that can maintain local biodiversity even after modern lifestyle and technology have been introduced. In this study, we aim to discuss on the evaluation methods of symbiotic lifestyle and to propose the concept of Symbiotic Lifestyle Model in historical cities.

Evaluation methods of symbiotic lifestyle

1) Identification of geographical distribution of target spaces

Historical cities have a long interaction between urban residents and urban spaces. The urban residents relate to private / semi-private / community / common spaces respectively upon their lifestyle in historical area. The spaces includes green space such as home gardens, water streams, shrines and temples, and sacred forest. First of all, we have to decide focal spaces where might support local biodiversity.

2) Record of daily management of the spaces by the residents

Urban residents and citizen groups often manage such spaces by daily maintenance, for example, cleaning, pruning and so on. Some events which symbolize local flora and fauna can be held in their managed places for area improvement. It is important to record how they contribute to conserve and form habitat for flora and fauna through their experience as same as what they face to difficulties and issues to continue their management and to inherit local biodiversity.

3) Recognition of flora and fauna in residential areas

In terms of local biodiversity, broad investigation on flora and fauna is necessary. Planted trees are common target. It is challenging survey to collect information about visiting birds, insects, spiders, land snails, amphibians and reptiles in addition to naturally grown shrubs and herbs, ferns, mosses and fungus. Information of flora and fauna is not only scientific terms but also daily observation by the residents.

4) Assessment of social effect

The spaces managed by the residents can have a role of nursery for local biodiversity. We need to assess on the relationship among three dimension, which is called as *symbiotic lifestyle* here, in terms of social effect including meanings of personal behavior and cultural ecosystem services. Such social effect can strongly support economic and touristic values and activities especially in historical cities because there is thought to be no similar characteristics in any other area.

Symbiotic Lifestyle Model in historical urban area

According to four points mentioned above, we summarize as “Symbiotic Lifestyle Model” which is cyclic flows composing of (1) sustainable existence of spaces contributing local biodiversity, (2) the relationship

between the spaces and management by the residents, (3) resident perception for flora and fauna, and finally (4) personal behavior and place attachment to flora and fauna and more direct economic value for the residents. If the flows work properly with solving difficulties and issues, local society can be involved. In conclusion, we are able to possess a structural tool that is applicable from individual scale to local society scale to assess positive contribution of the residents to urban biodiversity in historical cities.

10-OR4.1-04

THE TRANSITION OF THE VEGETATION COVER RATIO AND CONTINUITY OF THE GARDENS IN THE TRADITIONAL DOWNTOWN HOUSES IN ANCIENT CITY KYOTO

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1 Introduction

Many of Kyo-machiyas, traditional downtown houses in Kyoto, have various types of gardens. The sunlight and wind from the gardens was indispensable to live comfortably in humid climate of Kyoto. However, a lot of Kyo-machiyas have been demolished for last several decades as people's life style changed. From 1948 to 2000, in the central part of Kyoto city, demolition of about 70% of Kyo-machiyas have verified by the investigation based on aerial photograph interpretation (Kawasumi, 2003). But it is not clear how the gardens of Kyo-machiyas have changed with the rapid demolition of Kyo-machiyas and such private gardens have little researched from ecological point of view. Thus, we investigated the distribution change of the gardens of Kyo-machiyas in order to verify the transition of their quan-tity and connectivity.

2 Methods

The study area is "Touen school district" (Location: Central part of Kamigyo ward, Kyoto city, Area: about 0.25km^2). There remain a lot of Kyo-machiyas even nowand the percentage of pulling down of them is high at the same time (Hanaoka, 2009). Firstly, we used ArcGIS10.1 (ESRI) and polygonized all the green spaces in the district which were discernible from aerial photograph (1987& 2008, Geographical Survey Institute) by manual extraction and made a base map by referring to (1)city planning maps (Funaokayama and jurakumawari, 2000) and (2)fundamental geospatial data (building outline, 2010, Geographical Survey Institute). Secondly, we overlaid point data of the distribution of Kyo-machiyas in 1995-1996, 2003-2004, 2008-2009 (data partners: Kyoto city and Depertment of Geography, Ritsumeikan University) on the base map and add properties to all the polygons by using (4) housing map in Kamigyo ward (1987, 2008) as additional information. Thirdly, we calculated the transition of vegetation cover ratio (VCR) and connectivity of the gardens of Kyo-machiyas in the district. Lastly, we did a field survey and confirmed green spaces which cannot be classified from aerial photographs.

3 Results and discussion

From 1987 to 2008, VCR in Touen school district has decreased from 8.9% to 7.5% and it became clear that the VCR of the gardens of Kyo-machiyas decreased from 40.6% to 28.2%. From the fact that about 23.0% of Kyo-machiyas (84/382) has demolished from 1998 to 2008 in this school district, many old gardens and the connectivity of the gardens are disappeared with demolition of Kyo-machiyas. On the other hand, by comparing spatial positions of the gardens in 1987 with 2008, it became clear that about 25.6% of the total area of house gardens in 2008 (except for the gardens of Kyo-machiyas) used to be the gardens of Kyo-machiyas in 1987. This suggests that some gardens of Kyo-machiya are preserved or renovated at the same position even though the building parts have changed their appearance.

4 Conclusion

The result of this research showed that the VCR and connectivity of the gardens of Kyo-machiyas decreased due to the demolition of Kyo-machiyas but its quantity are still important now. These facts show the necessity to evaluate the gardens of Kyo-machiyas throughout the city from ecological point of view and consider the measure to preserve it.

10-OR4.1-05

IMPORTANCE OF AQUA ECOSYSTEMS IN HISTORICAL URBAN AREAS

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This research analyzes the responses of residents to a questionnaire regarding fish fauna. The questionnaire was implemented along the water system from Lake Biwa Canal in Kyoto city. The purpose of the questionnaire and analyses was to understand gap between actual environments and cognition of residents. We got 38 key word as witnessed fish in the questionnaire. Examples of fish that residents focus is a largemouth bass. Many residents have been evaluated as "unnecessary", but it has not been recognized as living in the surrounding area. However, largemouth bass have been identified in field survey actually.These suggest the possibility that not understood correctly damage caused by invasive species. By questionnaire, rare species of some that have not been confirmed in the field survey were raised. Questionnaire to the residents will help to understand the fish fauna of the past. However, experience and learning to the familiar nature is required to use effectively was suggested.

10-OR4.1-06

NATURE IN THE HISTORICAL CITIES AS A CORE OF RICH BIODIVERSITY AND THE IMPORTANCE OF THEIR CONNECTIVITY

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Cities with a long history were usually developed by natural process but in some cases constructed according to the detail plan. In both cases we can find important natural elements even in the present time. These natural elements are handed down in downtown areas and protected in some cases as sacred spaces, green spaces and so on adding to the urban fringe spaces of agriculture etc. Many cities also experienced the modernization in these various decades. Through the transition of urban landscape by such impacts the deterioration of nature, biodiversity and ecosystem of historical cities have been advanced.

Kyoto city had very long history as the capital of Japan about for 1200 years before the relocation of capital to Tokyo on 1868. Kyoto (former Heiankyo) was designed by the ideology of "fenshui" brought from China via Korea. Before the construction of capital Kyoto Basin was the wetland cultivated by some rivers and developed at first by the immigrants from Korea peninsula. Initial Heiankyo was difficult to develop according to the city plan because of such natural condition. Inside of planned area many large scale of lots were prepared for nobles. In these lots large gardens were designed according to the "fenshui" idea. But most of them decayed in a following few hundred years and many citizens became to occupy these lots for their daily lives. In the 18th century some merchants became wealthy and they began to keep their own gardens. Some of these gardens are thought to survive to present time and they are evaluated as important elements with high biodiversity now.

In Kyoto it is also easy to find the many sacred woodlands in the precincts area. These green spaces are also important because they have been protected for very long time, means these vegetation and ecosystems are indispensable living witnesses of downtown area to understand the ancient nature. Usually these vegetation is deteriorated by the pressure of urbanization of long time. But these spaces should be evaluated as the important spaces to understand the true natural condition areas and to reflect these knowledge to the present city plans. Recognition of these spaces as cores of urban ecosystems and challenge to construct a network with remaining nature will better the biodiversity of urban areas.

In addition we need to evaluate the green spaces planned after modernized period. These spaces are usually grasped statistically and are managed well in many cases. On the other hand the understanding and the support to private spaces from administrational organization is not enough because of the lack of information. We need to reconsider to evaluate these private open spaces to improve the connectivity of urban ecosystems.

In the world we can find many protected areas from the religious belief. In the urban areas there are also many open spaces with rich green especially in historical cities. In many cases these ecosystems have deteriorated but are important to understand the original ecosystem of each city. Especially, the private spaces, these are seriously endangered which should be evaluated again from the viewpoint of the conservation of ecosystem and biodiversity. Actually open spaces of many public spaces are considered as important spaces to keep the high quality of environment, but the quality of these spaces are usually deteriorate by the lack of enough budget. In addition these facts show the importance to regard the historical private spaces as indispensable existence to construct environmentally high-quality urban areas with the rich biodiversity.

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10-ORV.3-04

The present situation and application of biotope map in Seoul

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Seoul biotope map was published in 2000. The biotope map consists actual vegetation, land use, impervious paving status, biotope type, and evaluation of biotope map. The biotope map is updated every 5 years. The biotope map is composed of 9 categories(groups) and 65 types. The evaluation of biotope is divided into five stages according to the biotope conservation value assessment. The map has been used as a basis for the urban planning and permission of development. Looking at the status of biotope maps, Seoul consists 58% urban area and 42% natural area.

10-ORV.3-05

Biotope mapping and Application in Incheon, Korea

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1. The expansion of the city

According to the Incheon map made in 1916, the city was developed around the old town harbor. There was a vast tidal flat on the west and south side of the city. Then tidal flats have been buried for such industrial complex, port expansion, land development, airport construction, landfill composition and new towns.

2. The biotop mapping

The biotope mapping was finished in September 2014 to start in April 2010. The spatial extent was eight wards and the large-scale islands in Gangwa-Gun and Ongin-Gun

As results of elevation analysis, Gyeyangsan(396m) was the highest mountain in urban area. In Ganghwa area, there were at least 400m Manisan, Hyeolgusan, Goryeosan. Haemyeongsan was major forest in Seockmodo. And Hwagaesan was major forest Gyodongdo.

According to the land-use analysis, there was occupied the harbor, a large co-residential area, a large scale construction area, and large industrial areas in urban area. It was a small agricultural area of the Seo-Gu and Gyeyang-Gu, while the wide area of agriculture and forest in island area.

According to the analysis of existing vegetation, *Quercus mongolica* and *Robinia pseudo-acacia* forest was similar to the 3% in the urban area.

The rice paddy area was 23.5% and the main species of forest was *Quercus acutissima* in the island area.

Wild bird survey confirmed various protected species such as the raptors, spoonbill, cranes.

In the amphibian survey, two locations of gold frog were identified and toads, salamanders habitats was investigated.

The evaluation was conducted based on the survey and a number of excellent biotopes were proposed.

3. The biotope map application

You can create a variety of maps based on the biotope map. And you can establish the ecological plans through a biotope map. Therefore, there will be used as the basis for the sustainable development of the city.

You can do a variety of plans over a biotope map such as ecological network plans, ecological restoration plans, conservation plans, ecological welfare plans.

In addition, we proposed ecological landscape conservation areas from the excellent biotopes. And proposed to be managed in accordance with the law.

10-ORV.3-06

A Method for Establishing the Endangered Species Habitat in Urban Areas - Focused on the amphibians and reptiles -

Cho, Dong Gil

NEXUS Environmental Design Centre

The cities are the spaces to be imagined as having a low biodiversity in general. But the urban area is not only the space of opportunity for improving the biodiversity but also the space for the lives of the endangered species actually. In case of Korea, the legally defined species endangered in the cities are limited to the amphibians mainly. Most typical ones are the narrow-mouth frog(*Kaloula borealis*) and Seoul pond frog(*Pelophylax chosenicus* Okada). But these habitats have been endangered by other development projects and there are many cases of establishing alternative habitats.

In this context, it is very meaningful to develop the technology for restoring the habitats for the endangered species as a way of improving the ecological integrity in the urban area. For this matter, an HSI (Habitat Suitability Index) was developed for the reeve's turtle(*Chinemys reevesii*) and narrow-mouth frog(*Kaloula borealis*) through investigating the distribution and the ecological · behavioral characteristics in Korea. The habitat models are being established for making their habitats based on HSI in the urban area and the technology to adapt this technology is being developed.

Making efforts is required to restore · establish the habitats for the reeve's turtle(*Chinemys reevesii*) and narrow-mouth frog(*Kaloula borealis*) which had not bee well known till today shall be continued including the development of HSI. Moreover, the local governments shall make an effort to develop HSI and to restore the fields for the species of legal protection as well as the legal protection species such as the Seoul pond frog(*Pelophylax chosenicus* Okada) and etc.

The development of these technologies and experiment adapting them into the fields shall be reflected and utilized actively on the guidelines for establishing the alternative habitats and natural environment reservation projects performed by Ministry of Environment such as the small scale restoring projects in urban area (Project for returning the grant for the ecological system reservation) and natural outback and etc.

October 10

Poster presentation

10-PO1.1-01

ASSESSING THE STREET TREES' ENVIRONMENTAL BENEFITS IN KYOTO CITY, JAPAN

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It is important to evaluate environmental benefits of street trees. Since street trees, which are known as a part of urban greens, are expected to compose landscape and improve urban environment, plans and budgets for street trees have to be decided effectively from the point of its values. However, there is no case study that assesses environmental effects of street trees in Japan. Therefore, we aimed at quantifying size and growth condition of street trees and assessing their environmental effects in Kyoto as a case study. In order to estimate the environmental effects, an assessment model, i-Tree, developed by the United States Department of Agriculture, was used in this research. There are 49,084 tall trees and 896,734 shrubs that are managed as street trees by the Kyoto City Green Planning Section.

We sampled 433 street trees of the most frequently planted 10 species, and measured their size and growing condition: total height, crown height, crown width, diameter at breast height, percent canopy missing and dieback. From these data, environmental benefits of over 80 percents of the street trees in Kyoto were evaluated by the U.S assessment model. Because street trees in Japan are pruned heavily in general, we also obtained actual reference data of leaf area, fresh weight, dry weight, and ring width, from two street trees grown up in Kyoto City. Amount of growth were estimated by the stem analysis. Total aboveground biomass was estimated from dry weight. Amount of biomass and leaf area index used in the assessment model were compared with the actually measured values. We discussed whether the evaluated values by U.S. assessment model were biased

Total leaf area and leaf biomass, carbon sequestration, air pollution removal (CO, NO_2, O_3, PM10, PM2.5, SO_2) were estimated as street trees' environmental benefits. The comparative analysis of amount of biomass and leaf area index suggested that the U.S. model might be applicable to assess environmental benefits of street trees in Japan although we need to collect more actually measured data.

10-PO1.1-02

STRUCTURAL MODELING AND PSYCHOLOGICAL AND ECONOMIC VALUE ASSESSMENT OF RESIDENT AWARENESS REGARDING THE ENVIRONMENTAL VALUE OF URBAN RIVER RESTORATION

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In many countries, vegetation and water are coming to be seen as elements of urban infrastructure (green infrastructure), and urban environments are being restored. The utility of green infrastructure extends beyond the amelioration of environmental problems to also include the improvement of daily life for residents. It is therefore important in terms of future urban infrastructure development to analyze how citizens use green infrastructure and whether they are aware of its environmental value. In this study, we assessed residents' valuation of environmental benefits from the Cheonggyecheon Stream restoration project in downtown Seoul, in which an expressway covering the stream was removed and the underlying riparian environment was restored.

Cheonggyecheon Stream was divided into three zones from upstream to downstream for restoration (waterfront zone, buffer zone, and ecological zone). We surveyed Seoul residents to assess their awareness of the spatial morphology, behavioral effects, and environmental value of each zone. Environmental value was defined by selecting ecosystem services provided by water and vegetation that are related to daily life, including physical and mental health, natural environment, scenery, environmental improvements, and disaster prevention.

Based on the survey results, we created a structural equation model (SEM) of environmental value awareness among stream users based on the relations between spatial morphology, behavioral effects, and environmental value. We then assessed value using psychological and economic indices. The SEM model indicates that behavioral effects strongly influence the formation of environmental value, suggesting the need for value assessments that take behavior into account. The results also suggest that amenity, which is determined by the accessibility of water, affects environmental value in the waterfront zone, and naturalness, which is a unique feature of the area, affects environmental value in the ecological zone. In the value assessment, behavioral clustering revealed that for both psychological and economic indices, behavioral diversity increases environmental value. It follows that in urban river restoration projects, approaches that take both the uniqueness of the environment and behavioral diversity into consideration are effective in increasing environmental value for residents.

10-PO1.1-03

Environmental Assessment of Urban Agriculture

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All agricultural activities in urban area are defined as urban agriculture.Recently the urban heat island issues caused by lack of green space in summer come to incidence. The aim of this study is to evaluate the agricultural activities in context of environmental aspect. The evaluation resulted from rice and upland field crop products are each 1,573 KRW/m^2/day and 524.8 KRW/m^2/day for atmospheric cooling effect and retention of water. The results show that the urban agriculture not only offers us green space but also has high economic value in environmental aspect.

Table 1. Economic assessmentof theenvironmental valueofurbanagriculture.

Function	Basis	Crop	Value	Unit	Unit price (KRW*)	Amount of public value (KRW)
Atmospheric cooling effect	latent heat	Rice	0.4629	L/m^2/d	1,820	842.5
		Upland field crop	0.4014	L/m^2/d	1,820	730.5
Retention of water	water rate	Rice	1.0826	t/m^2	413	447.1
		Upland field crop	0.1881	t/m^2	413	77.7
Total						**2,097.8**

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10-PO1.1-04

The characteristics of urban heat island of Seoul in summer

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The city has different from rural in climate characteristics because of the high population, increase in traffic and energy consumption and decrease in green area. This study aims to find out the characteristics of urban heat island of Seoul in summer depending on land use. 7 heat island sites(park and forest area) and 9 cool Island sites (commercial business region and residential area) was selected as the sites. And records of temperature and humidity were collected every 20 minutes using a MicroLog Compact Data Logger from June 24 to August 28, 2009. The average temperature according to the land use was 36.0℃ in commercial business region, 33.6 7℃ in residential area, 31.42℃ in park area, 27.89℃ in forest area. And commercial business region and forest area showed a temperature difference of 8.11 ℃.

10-PO1.2-05

VEGETATION RECOVERY AFTER REMOVAL OF INVASIVE TRACHYCARPUS FORTUNEI IN AN URBAN SHRINE FOREST IN JAPAN

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In urban areas of Japan, shrine/temple forests function as urban green space (Ishii et al. 2010). In highly urbanized areas, however, it is difficult to maintain near-natural conditions considered ideal for shrine/temple forests. The Ebisunomori Forest in Nishinomiya Shrine, Nishinomiya City, is designated as a natural heritage by Hyogo Prefecture for the presense of large, old *Cinammomum camphora* trees and late-successional community structure. A vegetation survey was conducted in 2003 and it was found that non-native, *Trachycarpus fortunei* had invaded the stand comprising more than 600 individuals per ha. As a result, regeneration of native evergreen trees in the understory was being suppressed by this highly shade-tolerant invasive species. In 2005, all individuals of *T. forutnei* were removed from the stand in an effort to restore the natural forest vegetation (Ishii and Iwasaki 2008). Here, we report on the recovery of native vegetation following removal of the invasive *T. fortunei* and subsequent ecological restoration efforts.

In the five years following removal of *T. fortunei*, the abundance and basal area of native tree species, increased. Of these, *Cinnamomum tenuifolium* and *Ficus erecta* recruited the most. Late-successsional forest components, such as *Quercus glauca, Camellia japonica*, and *Ternstroemia gymnanthera* increased in basal area, while that of *C. camphora, Ilex rotunda*, and *Lingustrum japonicum* decreased.

Recruitment of bird-dispersed, non-native and ornamental species such as *Ligustrum lucidum* and *Euonymus japonicus* mainly ocurred along the forest edge. Invasion by *T. lucidum* is of some concern as it may cross-pollinate with the native *L. japonicum*. In areas of the forest where *T. fortunei* was most dominant, recovery of the native species was slow due to the lack of seedlings in the understory. In 2009, we planted native seedlings to advance vegetation recovery in these areas (Ishii and Ohsugi 2012). We also planted seedlings of *C. camphora* with the help of local school children. We are also continuing to monitor invasive and ornamental species with local citizen volunteers in an effort to sustainably manage this urban natural heritage.

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10-PO1.3-07

VEGETATIONAL CHANGE IN CONSTRUCTED WETLANDS DURING THE INITIAL FIVE YEARS

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To understand the initial process of vegetational change of artificial wetlands, two wetlands were constructed in Namyangju City, Gyeonggi Province, Korea (N 37° 35′ 01″ E 127° 14′ 16″) in 2009. Two wetlands were interconnected by water channel (10 cm wide, 2 m long, 10 cm deep), and maximum water depth was 90 cm at both wetlands. Sixteen species were planted in the one wetland with an area of 961 m^2 (planted wetland), and any species were not planted in the other wetland with an area of 930 m^2 (unplanted wetland). Both wetlands were allowed to be under natural succession, and the vegetational change was monitored during the initial five years after the construction. The water level remained constant during the five years. Among the planted species in the wetlands, seven species disappeared in five years, and six species were observed in both wetlands as a result of the expansion to the unplanted wetland. The second year after the construction showed the highest number of the species in both wetlands (planted wetland=95; unplanted wetland=94), and the number of appearance species had consistently decreased since then. In the fourth and fifth year, the number of appearance species was higher in the unplanted wetland than the planted wetland. The ratio of the number of species observed simultaneously in both wetlands to the total number of appearance species in two wetlands was 61.5% in the first year, and had increased to 87.7% in the fifth year. *Nelumbo nucifera* (lotus), *Typha angustifolia* (Cattail), and *Salix subfragilis* (willow) showed the highest increase rate of coverage during the period of monitoring and the coverage area of three species was 69.0% in the planted and 61.5% in the unplanted wetland in the fifth year. Lastly, the vegetational state was little different between the planted and unplanted wetland in the fifth year, and these results suggest that the vegetational process might change the originally proposed state at the time of wetlands construction. The vegetation structure of constructed wetlands was particularly simplified by the invasion of perennial macrophytes and woody plants such as *N. nucifera*, *T. angustifolia*, and *S. subfragilis*. Thus, the post management as well as the initial planting is necessary for the biodiversity enhancement in urban artificial wetlands. This study was supported by the Korea Ministry of Environment as “The Eco-Innovation project 416-111-010”.

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10-PO1.3-08

HABITAT AND GROWTH PROPERTIES OF NORTHERN RARE PLANT *POTENTILLA EGEDEI* VAR. *GROENLANDICA* (TRATT.) POLUNIN

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P. egedei var. *groenlandica* is a rare plant distributed in cool temperature of the northern hemisphere. In South Korea, *P. egedei* var. *groenlandica* is included in floristics special plant species grade Ⅳ, restrictively inhabits in some part of lagoons of the East Sea. Its natural habitats, however, are threatened by anthropogenic disturbances.As a preceding research for the conservation of the *P. egedei* var. *groenlandica* in South Korea, growth states and habitat properties of the *P. egedei* var. *groenlandica* were investigated in SongJiho and Hwajinpo, its natural habitats in Gangwon province.Vegetation was surveyed by the quadrats method in the *P. egedei* var. *groenlandica* inhabit regions of the two lagoons, and physic-chemical soil environment characteristics were analyzed.

In SongJiho and Hwajinpo, *P. egedei* var. *groenlandica* appeared around the waterway connected to the East Sea. At the flowering period, *P. egedei* var. *groenlandica* presented distinction in average height, 10 cm in SongJiho and 21 cm in Hwajinpo.In Hwajinpo, because of high density of the reeds inhabited in the same area, the reeds block out 70% of full sunlight. In June, however, height growth of *P. egedei* var. *groenlandica* in Hwajinpo was 147% compared with last month, superior to the 40% of that in SongJiho.Average concentration of NH_4-N and PO_4-P of the soil showed no significance differences between two lagoons, but concentration of NO_3-N of Hwajinpo was 23 times higher than that of SongJiho.In SongJiho, because the soil entangled with herbal detritus, water content of the soil was three times higher and the amount of organic matter was eight times higher than Hwajinpo.Soil pH of Hwajinpo was close to neutral while the soil of SongJiho had acidity partially (pH 5.6).SongJiho presented higher value than Hwajinpo in the conductivity and salinity of the soil

These results show that nutrients had greater influence in growth than the light.To find out what ecological strategy *P. egedei* var. *groenlandica* use to survive under saline circumstance, follow-up studies about germination, settlement, space occupation, salt tolerance mechanism and others will be needed.

This study was supported by the Korea Ministry of Environment as “The Eco-Innovation project, 416-111-010”.

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10-PO1.3-09

CONSERVATION OF *EURYALE FEROX* SALISB. IN JAPAN BASED ON GENETIC EVALUATION USING MICROSATELLITE MARKERS

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Euryale ferox Salisb. (Nymphaeaceae) is an annual aquatic herb with gigantic prickly floating leaves. In Japan, the species' distribution ranges from the northern part of Honshu to Kyushu and the species inhabits meso- and eutrophic water bodies at urban and suburban area. The number of populations has recently declined from about 300 to 80 in Japan because of habitat loss and degradation and the species is classified as "vulnerable" in the Red List of Threatened Plants of Japan (Ministry of the Environment of Japan 2012). Previous ecological research has revealed that *E. ferox* reproduces mainly by selfing (Kadono and Schineider 1987). This result suggests that *E. ferox* possesses a high level of population differentiation, requiring elucidation of the genetic condition of each population or individual for effective species conservation. Koren *et al*. (2012) studied *E. ferox* in the southern Russian Far East, and observed a low level of allozyme variation. The genetic diversity of this species has not been examined, however, with highly variable and informative genetic markers, such as microsatellite markers widely applied in other species. To obtain more accurate and useful information for the conservation of *E. ferox*, in the present study we used microsatellite markers to analyze its population genetic structure.

A total of 391 plants from 58 populations throughout Japan and four plants from China were sampled and genotyped using eight microsatellite markers (Imanishi *et al*. 2011).

Numbers of alleles per locus detected from all the samples were from two to three, even though microsatellites derived from genomic libraries used in the present study can detect high level of polymorphism. It is considered that *E. ferox* is a species that has intrinsically low genetic diversity, although the reason is unsure. Within- and among-population genetic diversity of *E. ferox* in Japan was basically low, with all eight microsatellite loci fixed to single alleles in many populations. However, multilocus genotypes including heterozygotes were detected from three populations; these populations had inbreeding coefficients (F_{IS}) not equal to 1.0 and were assumed to reproduce by outbreeding of genetically different individuals. Principal coordinate analysis (PCO) uncovered at least two genetically distinct groups within Japanese *E. ferox* populations, neither of which had a simple spatial pattern corresponding to geographical distribution. This complex genetic structure may be the result of genetic drift due to habitat loss, as well as gene flow among populations via seed dispersal.For effective conservation of remaining *E. ferox* genetic diversity,populations showing high genetic diversity and including rare MLGs should be given high priority.

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10-PO1.3-10

HABITAT CHARACTERISTICS OF BOG STAR, *PARNASSIA PALUSTRIS* L. AND RELATION WITH ACCOMPANYING SPECIES

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Parnassia palustris L. (Saxifragaceae) is perennial plant and occurs in damp areas of mountainous region. Because of climate change and habitats fragmentation, *P. palustris* is regarded as endangered species in some northern European countries and some states in US. We need to build ecological data about *P. palustris* because *P. palustris* populations in Korea also could be endangered like northern Europe and US. We investigated vegetation and physicochemical soil environment characteristics in two kinds of *P. palustris* habitats, where one site always has moist soil beside small stream on a mountain and the other is hill with relatively drier calcareous soil. In June (growing season), soil moisture contents varied ranging from 6% to 81.7%. The organic matter contents in soil ranged from 0.09% to 23.14%. Electric conductivity also showed a wide range from 26.7 μS/cm to 111.5 μS/cm and pH ranged from 6.6 to 8.86 (average 7.6). Average concentrations of NO_3-N, NH_4-N, PO_4-P was 4.07 ppm, 2.30 ppm, 0.87ppm respectively. Because all sites included calcareous soil, average of Ca^{2+} concentration(209ppm) was much higher than other cations like Na^{+}(2.24ppm), K^{+}(3.86ppm), Mg^{2+}(25.85ppm).

In relatively drier habitats, relative density of *P. palustris* and soil moisture content were positively correlated among the *P. palustris* appearance quadrats. However, as soil depth became deeper, *P. palustris* relative density decreased but coverage and height of accompanying species increased. The average of soil temperature in *P. palustris* appearance quadrats was 3℃ lower than quadrats without *P. palustris*. We also found that the growth of *P. palustris* increased with the coverage of Cyperaceae in quadrats with low soil depth. In the habitats beside a small stream on the mountain, we observed that *P. palustris* grew up on moss mats with 1～1.5cm depth. Based on the result of our investigations, we suggest that *P. palustris* avoid competition with other plants by inhabiting low soil depth that is hard for other plants to establish.

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10-PO1.3-11

Effects of water depth on germination, establishment and growth of *Sparganium erectum* L. seedlings

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Sparganium erectum L. is designated as a rare species by the Korea National Arboretum and is restrictively distributed in Korea. Few studies have investigated the life cycle of *S.erectum* for conservation in Korea. To conserve and restore habitats of this plant, we need to investigate the life cycle. Especially, growth from an early stage of seedling development is most important for establishment and plant colonization. The objective of this study is to investigate the effects of water depth as an important environmental factor for deciding habitat distribution on germination, establishment and growth of *S.erectum* seedlings. Seeds were collected during early September in Mangyeong-river, Bongdong-eup, Wanju-gun, Jeollabuk-do, Korea and stored wet at 4℃ for three months in a refrigerator. Seeds germinated in outdoors grew to 4 ± 1cm and planted in plastic pots (15 cm x 9cm) under 5 water levels(-5, 0, 5, 10, 20 cm). After two months, total leaf length was higher at 0 cm than at 5, -5, 10, 20 cm. Plant height was also higher at 0 cm than at 5, -5, 20, 10 cm. But survival rate was the greatest at 10 cm. The 0 cm water level was good condition for seedling growth but survival rate is under 10%, so it wasn't the best environmental condition for seedling survival and growing. In other words, environmental conditions of *S.erectum* for population expansion and establishment were limited. It means that the possibility exists that the natural habitats and population of *S.erectum* may continuously reduce(ECO-innovation, 416-111-010).

10-PO1.3-12

POLLEN DISPERSAL PATTERNS OF INSECT-POLLINATED *CASTANOPSIS SPECIES* IN AN URBAN AREA WITH ISOLATED GREEN SPACES AND EFFECTS OF LANDSCAPE ELEMENTS ON THE POLLEN DISPERSAL

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Anthropogenic disturbances could influence plant reproductive success and population viability. In urban areas, land-use change and habitat fragmentation may alter plant pollen dispersal patterns and consequently may influence genetic diversity of plant populations. Therefore it is important to examine pollen dispersal patterns and effects of landscape elements on pollen movements in urban areas.

We investigated pollen dispersal patterns of the insect-pollinated *Castanopsis* species by paternity analysis, neighborhood model analysis and TwoGener analysis using genotypes at eight microsatellite loci of 470 seeds from 21 seed parents growing in isolated green spaces and surrounding other spaces within an urban area in Atsuta, Nagoya, Japan. In addition, we investigated effects of landscape elements on the pollen movement inferred by the paternity analysis.

The results could be summarized as follows. Firstly, 8% of pollen movements occurred between the green spaces, while the remaining 92% did within each green space. Secondly, pollen dispersal distance was up to 1460 m and long distance dispersal occurred with a low frequency. Thirdly, pollen dispersal was limited by distance but the other factors may have influenced it. Fourthly, the pollen movement probably by insects between green spaces tended to occur on the spaces with arbors but not on the spaces with roadside arbors and shrubs. These results indicate that although the frequency of pollen dispersal between green spaces was low in the urban area, it may have been maintained stochastically and facilitated by trees other than roadside trees.

Based on the findings of this study, we suggest that it is important to increase trees in private houses and small squares for facilitating insect movements and then pollen movements by the insects.

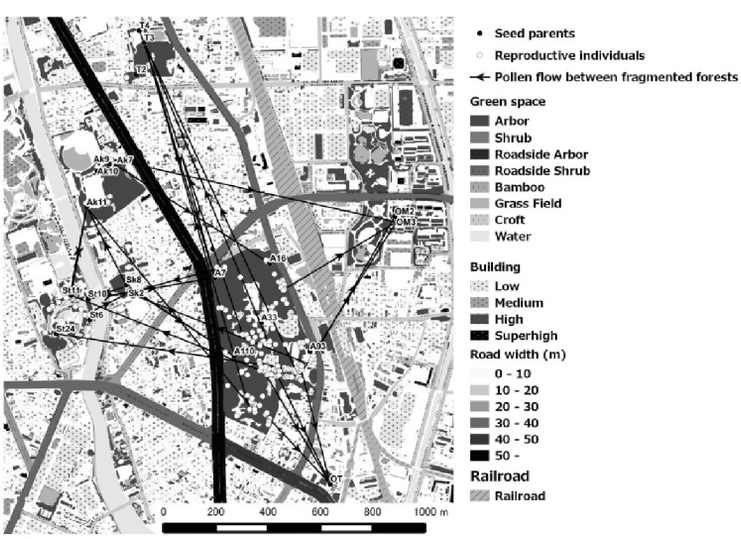

Fig. Pollen movement of insect-pollinated *Castanopsis* trees between isolated green spaces within the urban area in Atsuta, Nagoya, Japan

10-PO1.3-13

EFFECTS OF MICRO-TOPOGRAPHY ON VEGETATION TYPE -A CASE STUDY AT DUNCHON-DONG WETLAND-

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To investigate the effect of micro-topography on vegetation type, changes in water level and vegetation type were monitored at Dunchon-dong wetland which was designated as an ecosystem conservation area with high ecological values in urban. Depending on the relative elevation, the study area was divided into 4 sectors. The relative areas of each sector were 11%, 10%, 18% and 24%, respectively in ascending order. Average water pH, electric conductivity, PO_4-P, NO_3-N, and NH_4-N concentration were 6.10(±0.13), 51.5 (±6.0)㎲/cm, 0.04 (±0.02)mg/L, 0.14 (±0.07)mg/L, and less than 0.01mg/L, respectively. Water level at lowest sector was very changeable in dry season because of the relatively small area compared to other sectors. This characteristic increased the effect of difference of accumulated precipitation from March to April in 2007 and 2008 to plant community composition in lower sectors. Annual plants were major dominant species in the study site but dominated plant guilds were differentat each sector. This study suggested that the small elevation gradients are necessary to create the habitats for various plant guilds in wetlands where water level change is high. The study was supported by the Basic Science Research Program through the National Research Foundation of Korea (NRF-2007-313-C00735 and 2012-R1A1A2001007).

10-PO1.3-14

The Characteristics of Vegetation in Seoul City Wall

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Seoul city wall entered UNESCO's tentative list of world heritage in 2012 surrounds Hanyang (now Seoul), formerly the capital of Joseon Dynasty (1392-1910). About 18km-long Seoul City Wall was built along the ridge of Seoul's four inner mountains (i.e., Baegaksan, Naksan, Namsan,, and Inwangsan). After completion of construction the wall had been damaged during the Japanese colonial period but from 1970s continuous restoration project made a present appearance of the wall. The vegetation of Seoul's four inner mountains was damaged constantly in Japanese colonial period and Korean war and while managing carelessly a cultural landscape of red pine was disappear and oak trees began to flourish. Also forest landscape was changed by introducing various species for afforestation (i.e., Robinia pseudoacacia) besides outbreaks of pine leaf gall midges made red pine damaged from 1970s and forest have declined by environmental pollution such as acid rain. Currently, however, major species of canopy layer in four inner mountains are *Pinus densiflora*, *Quercus mongolica*, *Robinia pseudoacacia*. Mostly *Pinus densiflora* have grown on the ridge, *Quercus mongolica* on hillside, *Robinia pseudoacacia* on edge of forest and in a nearby town. The stand of *Pinus densiflora* was widest area among all species. Because the government was promoting an extensive red pine silviculture for conservation of pine tree on Namsan, soil climax was due to topographical environment on Inwangsan. Baegaksan as the background mountain of the Korean presidential residence had been protected by off limits for ordinary people over a long period of time, then they preserved red pine forest and the tree growth of the forest is fine. There are large area of oak forests on Namsan,the rear garden of Changdeok palace, north-south side of Baegaksan. Particular native vegetation of theses moutains are the deciduous broadleaf forest of north-south side of Namsan and *Zelkova serrata* forest of Namsan.

10-PO1.3-15

The characteristics of biotope type in Seoul

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Biotope map has been used in the various ways after made by Seoul in the early 2000s. The purpose of this study is to examine the types of Seoul biotope and provide basic material to control integrated environmental based on this. The result of analyzing Seoul biotope types was divided 9 biotope groups and 69 detailed groups. The ratio of Biotope was divided into 4 groups in large picture. Multi-unit dwelling Biotope takes possession with 17.42%, a natural forest of Oak Biotope takes possession with 9.43%, artificially planted Deciduous broadleaf tree Biotope takes possession with 8.20% and the surface of the water biotope takes possession with 5.57%. The results of evaluating Biotope type was that the first class occupied 24.67%, second class was 9.12%, third 3class was 13.31%, fourth class was 12.06%, and the fifth class occupied 28.00% of the total area. the results of evaluating individual biotope(Natural and Semi-natural form) was that Total area was the first class occupied 13.31%, second class was 18.20%, and the third class occupied 2.85% of total area.

10-PO1.3-16

The Designation Characteristics of Ecological Scenery Conservation Areas in Seoul

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Many natural ecosystem and scenery in cities have been damaged by the rapid urbanization. To solve this problem, Seoul city appointments and manages the ecological scenery conservation area which follows the Natural Environmental Conservation Act of Korea. This study is conducted to understand the designation characteristics of 17 ecological scenery conservation areas which are managed and appointed since 2013 in Seoul. 17 ecological scenery conservation areas could be roughly categorized into three: wetlands area, forest area, and natural scenery area. 10 areas were in wetlands area (58.8%), 6 areas were in forest area (35.5%), and 1 area was in natural scenery area (5.9%). Therefore, efficient management and proper installation of facilities for protection based on well grasp of designation characteristics in ecological scenery conservation areas are needed to conserve the deficient natural ecosystem in the city. For this, proceeding inquiry reservation system or nature rest year system after discussion with experts could be a solution.

10-PO1.3-45

Biology and temperature effects on development on *Parnassius bremeri* Bremer (Lepidoptera: Papilionidae) cocoon

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The Red-spotted Apollo Butterfly (*Parnassius bremeri*) is one of the most endangered insect around the world and recorded in IUCN Red List of Threatened Animals and Appendix II in CITES. This study was conducted to investigate biology from 2005 to 2014 and the temperature effects on adult emergence of *Parnassius bremeri* cocoon at five different constant temperatures (17.5, 20, 22.5, 25 and 27.5°C) with photoperiod 10:14(L:D) and relative humidity 60%, 2014 in Holoce Ecosystem Conservation Research Institution (HECRI). Sampling of biology was implemented by using breeding captivity. The females lay eggs in mid June and hatch in winter(known overwinter as egg and hatch in spring the following year according to Wikipedia and Arkive). Eggs estivated as pharate first instar from summer to fall for 193.2±.0.9 days (Mean±SE). Developmental period from egg to adult was 363.7±2.1days(Mean±SE). Larvae feed on stonecrop *Sedum* species-*Sedum kamtschaticum, S. ussuriensis, S. ishida*. When the larva is fully-grown it will pupate on the ground, forming a loose cocoon. The lower developmental thresholds of female, male and both sexes combined were 12.40, 13.06, and 12.77°C, respectively. Developmental period of cocoon to adults decreased with increasing temperature from 17.5 to 27.5°C. Especially survival rate of 17.5°C constant temperature was the highest. Thermal constants of female, male and both sexes combined were 168.85, 143.56, and 153.01DD, respectively. The relationship between the developmental rate and temperature was fitted by linear. The development variation of cocoon was described by the two-parameter Weibull distribution model. The adult emergence of *Parnassius bremeri* cocoon can be explained and predicted by using developmental rate models and developmental distribution model.

Key words: *Parnassius bremeri,* Lepidoptera, Papilionidae, HECRI,Red-spotted Apollo Butterfly, Weibull distribution, Lower developmental thresholds, Thermal constants.

10-PO1.4-17

A FRAMEWORK FOR THE CONSERVATION AND ENHANCEMENT OF ECOSYSTEM SERVICES

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Ecosystem Services include all ecosystem functions and processes people and society benefit from in economic terms or related to their quality of life. These benefits from water and climate regulation, over biodiversity and pollination, to aesthetic and recreational services. The role of cities in maintaining biodiversity for functional ecosystems is becoming an important topic on the global agenda. In particular urban green spaces – that is forests, trees, parks, allotments or cemeteries – provide a whole range of ecosystem services for the residents of a city. Recreation and climate moderation are highly valued Ecosystem Services. An increase of built-up land by urban sprawl and densification in the inner parts of a city reduces the much needed Ecosystem Services. This paper includes the concept and definitions of Ecosystem Services, Importance of Ecosystem Services and its role in sustainable urban development, best practices and few examples giving understanding of how can a focus on ecosystem services help city authorities? Some facts and figure about land degradation, over exploitation, climate change, Impact of landuse change on ecosystem services, cities impact on environment etc. have been globally understood related to Ecosystem Services. Case studies explains the importance of Ecosystem Services and suggestsvarious parameters for evaluating Ecosystem Services. Therefore this paper giving detail framework for conservation and enhancement of Ecosystem Services in Nagpur city. The scope of this study is to integrate Ecosystem Services into urban policy making process. The study involves Evaluating Role of Vegetation for Ecosystem Services i.e. Provisioning Services (Food, Raw Material, Medicinal Resource), Regulating Services (Air Quality), Cultural services. (Aesthetic Recreational and Educational).The study doesn't deal with Habitat Services and Supporting Services. Selection of study area within the Nagpur city based on Six parameters i.e. Tree category, Plant Species Diversity, Land use, Air Quality, structure of parks/ open spaces, lakes water Quality Index For comparing current trends and drivers of change for Ecosystem Services. Valuation Assessment Methods of Ecosystem Services Adopted for household survey i.e. Participatory Environmental Valuation which gives Qualitative and Participatory Approach in order to understand what people think the most important ESs for the well-being and how they value them for marketed and no marketed services.

Key words : Ecosystem Services, Conservation, Enhancement, Vegetation, Sustainable Urban Development, Tree category, Plant Species Diversity, Land use, Air Quality, structure of parks/ open spaces, lakes water Quality Index.

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10-PO1.4-18

HEALTH WARNING OF SUBURBAN RIVER BY USING RIVER LANDSCAPE HEALTH ASSESSMENT INDICATOR SYSTEM

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Rivers serve many societal functions and belong to the most intensively human influenced ecosystems worldwide. In recent years, most current development or construction projects do not meet EIA (Environmental Impact Assessment) regulations. However, inadequate project supervision can lead to serious degradation of both river ecology and surrounding landscape. This paper applied the concepts of "Landscape health" from the literature review with integration in depth-interview, using the Fuzzy Delphi, Fuzzy Analytic Network Process to develop the "River Landscape Health Assessment Indicator System (RLHAIS)". This assessment indicator system includes the indicators of "physical and chemical environment", "landscape change", "ecological environment" in 3 aspects. Within this system, 14 indexes were used to show the quantity and quality of the assessed environment, such as "River Pollution Index", "Pollutant Standard Index", "Soil Environmental Quality Index", "Shannon's Evenness Index", "Euclidian Nearest Neighbor Index", "Patch Density", "CONTAG", "Normalize Landscape Shape Index", "Mean Fractal Dimension", "Shannon-Wiener index", "Pielou's Evenness Index", "Species Richness Index", "Fish Tolerant Index", "Simpson's Diversity Index". These 14 indexes were then applied to the RLHAIS to analyze the recent 4 years landscape health for the Dezikou River Upstream and Downstream in Yilan County. The results showed that the healthy level nearly fell into the "Degraded" state. The system can assist the county governments in understanding the spatial characteristics of river impacts and their vulnerabilities, capacities for rivers. By comparing these indexes, the system can also be the important references for central and local governments to enhance future river healthy management tasks.

Key words：River Landscape Health Assessment Indicator System (RLHAIS), Landscape Health, Environmental Impact Assessment

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10-PO1.4-19

PATTERN DOES MATTERS:THE EFFECT OF LANDSCPE STRUCTURE ON CITY RESIDENT'S HEALTH

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In recent years, urbanization in Taiwan has become a serious problem. There are fewer and fewer natural elements because of the inner city population growth and urban development. The purpose of this study is to find a way to make landscape changes, to increase supportive environments, and to improve physical activity and human health. In order to explore the relationship between environment, physical activity and human health, we try to understand how the landscape metrics affect people to promote exercise and human health.

This study used seven cities for the study area, which are Keelung, Taipei, Hsinchu, Taichung, Chiayi, Tainan, and Kaohsiung. For this study data from two different datasets were combined. The first part is about the environment. The correspondent landscape structure of parks and green spaces in seven cities were adopted as the indicators of the environment. It's from National Land Surveying and Mapping Center, and the data was collected during 1993 to 1995. The second part is about exercise and self health perception items (SF-36). It's from the National Health Interview Survey Information System, by the Bureau of Health Promotion, Department of Health of Taiwan. The healthy indicators and the environmental indicators awee compared to depict their relationships.

A total of 5,367 valid samples were distributed, and the total districts in seven cities are fifty. We used multiple regression to examine the relationship between environment, physical activity and human health. The results show that an increase in the percentage of total greenspace area increased people's willingness of exercise, but the greenspace edge density decreased people's willingness of exercise. The increase in the exercise times, the percentage of total greenspace area, and the Euclidean Nearest-Neighbor Distance (ENN) of greenspace increased the Physical Component Summary (PCS) in SF-36. The Mental Component Summary (MCS) in SF-36 increased by exercise times, the percentage of total greenspace area, the greenspace edge density, and the Euclidean Nearest-Neighbor Distance (ENN) of greenspace. However, there is no relationship among landscape metrics, exercise, and Body Mass Index (BMI).

According to the results, further research could explore: how far into the future does the environment impact human health? How far away does the greenspace affect people to do physical activity? What kind of physical activity will indeed affect human health? In landscape planning, we suggest that we should increase the area and numbers of urban parks and greenspace, and the accessibility of greenspace will be improved, too. In order to improve our environment, we are looking forward to the Landscape Act in Taiwan.

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10-PO1.4-20

The characteristics of urban agriculture in Seoul

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In 2012, Seoul was enacted on the development and support of urban agriculture. Urban agriculture is divided into housing farm type, neighborhood living area type, farmland and park type, school garden type. Survey was conducted about awareness of urban agriculture to city farmer on farmland and park type. This study analyzed frequency analysis, cross analysis, multiple response analysis using SPSS 20.0. The most of city farmers lived near their farm within 30 minutes(87.4%) and some of them visited their farm 3 times a week(76.3%). There were the positive effects of urban agriculture which are an increase in family conversation(77.1%) and in meeting with neighbors(67.9%). The respondents answered that they want to have more farmland(59.6%) and get improvements in facilities(40.9%) for activating urban agriculture in Seoul. 93.1% of respondents had positive awareness in increasing urban agriculture in Seoul. So from now on, supporting business which reflects citizen's requests and needs and expansion of the space of urban agriculture will be needed for recovering community.

10-PO2.1-21

ANALYSIS OF RUNOFF REDUCTION ACCORDING TO GREEN SPACE PATTERN: CASE STUDY OF GWANAK

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The mixing of natural and urban areas is characteristic of a Korean city. Yet due to dramatically increasing urbanization, the runoff from urban storm water has affected the quality of surface water and groundwater. Recently, some studies have observed reservoir size and its effect on decreasing runoff.

Large rainwater recycling facilities have been created as LID(Low impact development) methods to prevent flooding. Various studies about LID techniques have been conducted. However, there is a lack of study considering the green space location and type.

Gwanak is one of the cities that suffer from frequent local flooding damage. Therefore, it is necessary to accurately measure storm water runoff. To accurately calculate storm water flow, Hec-HMS, suitable for natural watershed runoff simulation, and SWMM, suitable for urbanization runoff hydrologic models were used.

The stream flow gradually decreases when the size of park increases. When the park was increased by 4%, the stream flow was 58.481 10^3ton. Then, when the park was increased by 10%, the stream flow was 57.084 10^3ton. Lastly, when the park was increased by 20%, the stream flow was 54.016. The outflow of various small parks and one large park was compared. As a result, the various small parks should be more effective than large park.

Actual flood damage happened by heavy rain on September 18-22, 2012 was used as input data for the simulation. Modeling results may differ from the value of the measured values of the monitoring will be needed later.

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10-PO2.1-22

ANNUAL CHANGE OF RAINWATER RUNOFF CONTROL CAPABILITY ON GRASSLAND

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In recent years, grassland has been used as a tool for solving rainwater runoff problem in urban area. This paper focuses on the effort of rainwater runoff control on grassland and its influential factors in field. A 0.5m^2 grassland at the entrance of Nagoya University campus was chosen for the runoff observation within a set of apparatus designed by Shimizu Lab. Two groups of field experiments were conducted for this study. In the first group, to observe the annual change of runoff rate, experiments were carried out on the grassland for 36 times within 1 year, utilizing the same simulated rainfall model. In the second group, after an extraordinary simulated rainfall, runoff control capability of the grassland was found limited under saturated seepage condition. The results of this study indicate that grassland in summer has good infiltration capacity that is shown to be a reliable tool for reducing rainfall runoff. However, in winter, just 25% of simulated rainfall can be infiltrated in grassland. Therefore, in order to provide a great effect on runoff control in winter, other drainage facilities should be jointly utilized with grassland.

10-PO2.1-23

THE COMPARISON OF ENVIRONMENT CONDITION IN POND WETLAND AT AGRICULTURAL AND URBAN LANDSCAPE, KOREA

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Pond wetland provides a variety of ecosystem services. Pond wetland is commonly used for creating urban landscape. However, as it has been constructed with the focus on design, aspects of biodiversity is not considered. Urban ponds have similar forms of those in rural areas. Rural ponds were created for the irrigation use in the past. However, it is being maintained very close to the natural state. Rural pond can be a target of urban pond. Thus, in this study, environment conditions in urban and rural ponds are compared.

Four urban artificial ponds were selected as study sites and four rural natural pond wetlands which could be targets for restoration were selected. Forms of using land in urban and rural areas were examined with Land use value of Tilton et al.(2001). For water quality, pH, EC, DO, BOD, COD, SS, T-P and T-N were analyzed. For soil chemical properties, soil property, pH, EC, organic matter, available phosphate, K^+, Ca^{2+}, Mg^{2+} and Na^+ were analyzed.

Land use value of urban areas with radius of 100 m was 1.05~2.26 and that of rural areas was 2.56~3.00. For main types of land use, roads and residential areas were distributed in urban areas. On the other hands, rice paddy and mountains were distributed in rural areas. As the result of water quality, pH in all selected sites in both rural and urban areas satisfied the standards of MOE(2014). DO was the average of 5.89(2.03~8.01) mg/L and 4.78(4.12~5.38)mg/L in urban and rural areas, respectively. COD was 5.41~12.41mg/L and 10.85~14.25 mg/L in urban and rural areas, respectively. BOD and SS were the same. It was analyzed that urban wetlands were better than rural wetlands because of circulation of artificial influent and effluent. As the result of analysis on soil environment, pH was the average of 7.3(6.84~7.55) and 5.4(4.80~6.20) in urban and rural areas, respectively. It was thought that water circulation was not made and it was stuck and became acidified in rural areas. EC was 0.91dS/m and 0.60dS/m in urban and rural areas, respectively. Those values were equivalent to the intermediate levels. It was found that OM, Av.P205 and TN in urban areas were substantially lower than those in rural areas. Organic matters were very important for the development of the vegetation. It was thought that the contents of organic matters were low in urban areas due to the use of artificial materials.

It is necessary to leave the dead plants in autumn to evolve urban wetland into one close to nature like rural one. The reason is that it is decomposed and then converted into soil organic matters. However, if too much is decomposed, it results in eutrophication. We shall find appropriate contents in water quality and soils in wetlands through further study.

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10-PO2.1-24

A STUDY ON THE SELECTION OF APPROPRIATE PLANTS FOR VEGETATION-BASED LOW-IMPACT DEVELOPMENT FACILITIES

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In vegetation-based low-impact development (LID) facilities, excessive moisture and dehydration are often observed because the water level rises when there is an inflow of rainwater and then drops after drainage. Accordingly, unlike plants grown in natural soil, plants grown in the LID facility are affected by various growth disorder factors. Hence, to cultivate plant growth in vegetation-based LID facilities, it is crucial to select plants that exhibit an excellent adaptation capacity even under adverse environmental conditions. In this study, vegetated trench-type experimental zones were installed for five types of plants: Phragmites communis TRIN, Miscanthus sinensis var. purpurascens, Pennisetum alopecuroides (L.) Spreng, Iris setosa Pallas, and Acorus calamus L., which were deemed appropriate for the LID facility. The growth conditions and nitrogen and phosphorus adsorption capacities of each plant were analyzed through comparison, with the following results:

1) Measuring the orthotropism (plant length) of each plant indicated that the growth conditions were excellent for Pennisetum alopecuroides (L.) Spreng, Miscanthus sinensis var. purpurascens, and Phragmites communis TRIN, whereas Iris setosa Pallas and Acorus calamus L. showed relatively poor growth conditions.
2) Measuring the plagiotropism (leaf width) of each plant confirmed that the growth conditions of Miscanthus sinensis var. purpurascens, Pennisetum alopecuroides (L.) Spreng, Phragmites communis TRIN, and Iris setosa Pallas were excellent, whereas those of Acorus calamus L. were relatively poor.
3) Analysis of the coverage ratio of each experimental zone showed that experimental zones in which Pennisetum alopecuroides (L.) Spreng and Miscanthus sinensis var. purpurascens grew exhibited relatively excellent coverage ratios, whereas the other planting zones showed a decrease in the coverage ratios.

The above results indicate that Pennisetum alopecuroides (L.) Spreng, Miscanthus sinensis var. purpurascens, and Phragmites communis TRIN showed relatively outstanding growth conditions in the LID facility in which flooding and dehydration repeatedly occur, whereas Acorus calamus L. and Iris setosa Pallas showed poor growth conditions.

Subsequently, the results of analyzing N and P adsorption capacities of each plant are as follows:

1) The level of N was found to be high in Acorus calamus L., Phragmites communis TRIN, and Iris setosa Pallas.
2) The level of P was found to be high in Acorus calamus L., Iris setosa Pallas, Pennisetum alopecuroides (L.) Spreng, and Phragmites communis TRIN; Miscanthus sinensis var. purpurascens showed the lowest adsorption capacity.

The results of measuring the N and P adsorption capacities of each plant verified that Acorus calamus L. exhibited the highest adsorption capacity, while Iris setosa Pallas and Phragmites communis TRIN showed average adsorption capacity; the adsorption capacity of Miscanthus sinensis var. purpurascens and Pennisetum alopecuroides (L.) Spreng was the lowest compared to the other plants. Because the growth conditions of Acorus calamus L. and Iris setosa Pallas were found to be poor, methods to improve their growth conditions should be considered before using these plants for water purification.

The results of investigating the degree of invasion of exotic species in each experimental zone are as follows:

1) The degree of invasion of exotic species was significantly low in the cultivating zones of Miscanthus sinensis var. purpurascens and Pennisetum alopecuroides (L.) Spreng, whereas it was high for Phragmites communis TRIN, Iris setosa Pallas, and Acorus calamus L.
2) In particular, the cultivating zones of Iris setosa Pallas and Acorus calamus L. were occupied by exotic

species such as Setaria viridis, Echinochloa crusgalli var., and Glycine soja, thereby showing poor conditions of growth and plagiotropism.

Acknowledgement

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10-PO2.1-25

Urban wetlands land pattern changers and its impact to water resources- Case study in Sri Jayawardenaa Kotte, Sri Lanka

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Urban wetland areas are complex ecosystem of interacting with social, economic, and natural components, dominated by human activities in the surrounding areas. The present research study was conducted to identify to identify urban wetland areas land use pattern changes over past 30 years and its impact to the water environment in the Sri Jayawardenaa Kotte administrative capital of Sri Lanka. The studied urban wet land been located in 250 km away to the Sri Lankan parliament. An interconnected canal system was built between wetlands connecting them to nearby rivers in order to flush excess water to sea. Furthermore, it estimated the variation and spatial distribution of surface water and ground water characteristics of the area using GIS mapping . Data collection was done mostly in the field (study site) and analysis of collected samples was done in the laboratories. Water samples were collected from 20 locations in wetland twice a month from November 2013 to January 2014 while ground water samples were collected from 4 points. pH, EC, Cl-, NO_3- $PO_4$3- and SO_4^{2-}were measured as major parameters and correlation among parameters were statistically analyzed. Using the Arc View GIS 3.2 software maps were developed to indicate land use patter changers, distribution and variation of physical and chemical parameters in the study area. The results revealed that the cultivated area has been reduced to 0%, from 43% in 1982 while manmade creations have been increased up to about 40% during past 30 years. The further results revealed that the study area shows the characteristics of urbanization during past 30 years' time period. pH and EC had a significant negative correlation in surface water concluding that ion concentration significantly affects for pH level. Ground water showed greater amounts of SO_4^{2-} than in surface water proving that wetlands are sulphate sinks.

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10-PO2.1-26

THE CHARICTERSTIC OF VEGETATION DIVERSITY IN POND WETLAND AT AGRICULTURAL AND URBAN LANDSCAPE, KOREA

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Pond wetland is the ecosystem rich in biodiversity. For this reason, many ponds are created to increase biodiversity in urban landscape. Urban ponds have the same forms of rural ponds. In the past, there were limitations for agriculture because of lack of water in rural areas. Rural ponds were created for the irrigation use. These sites are not recently used and maintained very close to the natural state. Rural pond can be a target of urban ponds. Thus, in this study, pond vegetation diversity in urban and rural ponds is compared.

Four urban artificial ponds were selected as study sites and four rural natural pond wetlands which could be targets for restoration were selected. The survey of vegetation was conducted at the study sites on the basis of Lee(2006a) and Lee(2006b) standard in September, 2013. In addition, naturalized plants were analyzed. Results of vegetation analysis were compared with those of wetland function assessment of Tilton et al. (2001).

It was found that flora emerging in surveyed sites had a total of 71 taxa in 37 families, 60 genera, 59 species, 12 varieties and a total of 143 taxa in 56 families, 121 genera, 122 species, 20 varieties, 1 subspecies in urban wetlands and semi-natural wetlands of rural areas, respectively. Rural areas showed about twice as many vegetation diversities as urban areas did. Naturalization rate was the average of 25.01(15.08~30.80)% and 9.07(5.70~15.40)% in urban and rural areas, respectively. Naturalization rate of urban wetlands was higher than that of rural semi-natural wetlands. Urbanization index was analyzed as 1.9~2.5% and 0.9~2.5% in urban and rural areas, respectively. With RAM wetland assessment method, distance to other wetlands, number of plant community, degree of mixture, size of wetlands, surrounding land use and wildlife crossing were assessed. As the results, the average of urban areas was 1.62(1.50~1.83)%, which was low. The average of rural areas was 2.58(2.33~2.67)%, which was high. Wetlands of urban areas were evaluated lower than those in rural areas. The main reason was that items in surrounding land use and connection to other habitats were evaluated low in urban areas.

It needs to aim at rural wetlands in order to increase the diversity of urban wetlands. It is necessary to connect to surrounding habitat for vegetation diversity in urban wetlands. In addition, the proportion of naturalized plants shall be lowered and that of native species shall be increased. It is necessary to examine the relationship with habitat environment to increase vegetation diversity in the future.

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10-PO2.1-27

STUDY ON CHANGE OF THE WETLAND ENVIRONMENT NEAR BANGKOK AND ASIAN OPENBILL'S INHABITATS

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This study aims at examining the spatial relationships between various types of wetlands and distribution of Asian Openbills. For this purpose, we selected MinBuri, LadKrabang and Nong Chok Districts in the suburban industrial-dominated area of Bangkok as case study areas. This case study area is located in continental flat delta and urbanization has been proceeding using fill. The fill material was gotten by digging the ponds in nearer rice plots. Therefore, in this area, there are various wetlands including inherent irrigation channel, paddy field in various cultivation stages, fishponds, just water pool for getting fill materials, and recreational ponds inside subdivision development. These wetlands have each ecosystem services, in particular providing habitats for water birds represented by Asian Openbills. To investigate the relationships and possible balances between wetlands patterns and distribution of Asian Openbills, we conducted; a) mapping of these wetlands patterns and process by aerial photograph (as a time series) interpretations and field validations, b) interval line census for Asian Openbills in the field, c) overlay analysis of a and b using GIS. As the result, we found that the ponds had increased from 1980 to 1999, and then decreased from 1999 to 2012. Extracted ponds were mainly used as fishponds, and these ponds were replaced by paddy fields. Coconuts, bananas, mangos and other trees were planted around the fishponds. Asian Openbills well fed in the paddy fields whose rice grew as tall as the height of them. We found resting Asian Openbills on the top of dead coconut trees in the several fishponds with surrounding trees and low floating grasses. They did not inhabit in completely artificial deep water pool just for digging fill materials. However, we sometimes observed Asian Openbills in the shallow ponds with some surrounding vegetation inside subdivision and industrial estates, and interestingly at the pylons standing around rice fields and fishponds. These results suggested that urbanization-induced various wetland mosaic and various forms of agricultural fields in their land use and cultivation calendars can support Asian Openbills inhabitation, and better pond-fill development combination can promote further Asian Openbills inhabitation.

Keywords: Wetland, Biodiversity, Suburbs of Bangkok, Asian Openbill, Geographic Information System

10-PO2.2-28

CHARACTERISTICS COMMUNITIES STRUCTURE OF BENTHIC MACROINVERTERATES AT CONSTRUCTED SMALL PONDS

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Ecological functions of small ponds constructed for irrigation were well known fact that important for biodiversity conservation in agricultural ecosystems. However, many small ponds had been destructed with changes of agricultural environment. The objective of this study is to appreciate the importance of ecological functions of constructed small pond. Furthermore, it presented to useful information for restorations of the small pond from analyses of correlations between benthic macroinvertebrate communities and locational factors of the small ponds. Benthic macroinvertebrate sampling was conducted from 2010 to 2012 at 15 study ponds. Comparisons of benthic macroinvertebrate diversity approached species richness and density, and statistical analyses were performed using independent t-test. A total of 131 species and 137,118 individuals of benthic macroinvertebrates were recorded during study period. Dominant taxa of benthic macroinvertebrates included Coleoptera, Hemiptera, and Odonata. Generally, benthic macroinvertebrate diversity in mountain region and existing ponds were showed higher than open field and created ponds, respectively. DCA ordination showed that benthic macroinvertebrate community was most correlated with locational characteristics of small pond, and it correlated with bank type and age of pond. In conclusions, in order to restore ecological small pond, it is necessary to consider environmental factors such as locational characteristics and bank types.

<Table 1> Comparison of diversity (Mean ± S.E.) of benthic macroinvertebrates according to different locational type of small ponds and benthic macroinvertebrate taxonomic groups

Locational type		Platyhelminthes	Mollusca	Annelida	Crustacea	Aquatic insects
Species richness	Mountain region	0.00±0.00	4.00±0.29	0.65±0.14	0.19±0.06	22.19±0.78
	Open field region	0.02±0.02	3.96±0.29	0.50±0.11	0.21±0.07	16.77±0.73
p-value		N.S.	N.S.	N.S.	N.S.	p<0.001
Density	Mountain region	0.00±0.00	417.53±37.42	5.86±2.41	28.37±10.71	1233.53±82.33
	Open field region	0.56±0.56	282.65±26.52	12.92±4.15	32.00±11.49	915.13±60.99
p-value		N.S.	p<0.001	N.S.	N.S.	p<0.001

*Bold letters: significant difference by independent t-test between mountain region and open field region, N.S. means that not significant difference by independent t-test

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10-PO2.2-29

ECO-FRIENDLY RESTORATION TECHNOLOGY OF ERODED FLIMSY GROUNDS ON RAPID STREAMS AND RIVERS

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The recent climate changes throughout the world have been causing such abnormal events as washed-away river banks, loss of sand dunes by coastal erosion, landslips of slopes of roads and cutting areas, and landslides, the results of which are so huge that it could rock the entire economy of a country. But even those advanced countries have no particular preventive measures reasoning that they are just natural disasters because the engineering technology to protect the banks and slopes, the loss of which certainly leads floods and landslides, has not yet invented. And the currently used civil engineering and materials require strong foundation, so they cannot be used in places where strong foundation cannot be constructed or the existing foundation could be easily damaged. But the fact is that the places vulnerable to natural disasters have almost no possibility that the strong foundation could be constructed, which makes it hard to use the traditional engineering. So it is urgent that new engineering which can be adapted for the environmental attributes of the places likely to be damaged by natural disasters be invented.

From that this technology has been invented to protect the slopes of the rivers and streams from floods and landslips by combining 25 × 25cm blocks in the form of "S" which embraces the blocks from four sides, and with a half block to make a vertical combination makes all the elements one structure, which offers structural stability and prevents uneven settlement through a vertical buffering effect of the blocks.

Those places which are most severely damaged are the ones where the river banks burst due to increased speed of the water and floods. The quantity and speed of flow in South Korea has a huge difference between in the dry season and raining season, so the ecofriendly engineering cannot be used in places where the speed of flow is over 4m/s, and for those rivers which have over 4m/s speed of the flow and where even the never ecofriendly concrete breast walls would collapse.

If this engineering is used for these places, the blocks which are combined into one structure could sustain even the fastest flow, so the loss of slopes could be prevented, and in the space between the blocks and through various formations of them plants can grow and habitats for aquatic creatures could be formed, which ultimately fulfills the two objectives of protecting the slopes and restoring the wild life. And these features can be applied to those places where the dependable foundation cannot be constructed due to rapid flows and flimsy grounds.

For rivers and streams, these structures with the limitless possibility of the formation can be used to those concave and convex lines as well as straight parts, which offers habitats, shelters and spawning places for aquatic animals. And the hole in the center of the block can be filled with dirt, which increases the weight of the structure and consequently improve the stability. In the forestation space with fillers for planting, plants and trees can be grown, which is in itself the ecofriendly restoration of the slopes.

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10-PO2.2-46

STUDY ON ECOLOGICAL SAFETY EVALUATION AND WARNING OF WETLANDS IN TUMEN RIVER WATERSHED BASED ON 3S TECHNOLOGY

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Abstract：Tumen river is one of the key international rivers in China. The region has already entered into multinational cooperation in developmental stages with the Chinese economy rising rapidly. The environment has been getting interfered with and destroyed in different degrees. This study can provide a scientific basis for sustainable development of ecological environment of the Tumen river basin. In this study, we used the Tumen river watershed wetland ecological security for the purpose built wetland ecology safety evaluation system based on Pressure-Status-Response (PSR) concept model, and got landscape dates of 1976, 1990, 2000 and 2010 by using 3S technology. We used experts' evaluation index combined with AHP evaluation to give the weight and got the final comprehensive evaluation in the use of the logistical growth curve model for each index based on the assessment of a single index. The study finally got the ecological secure values that were respectively 0.650,0.620 in 1976 and 1990, the ecological system was in a safe state; the ecological secure values were respectively 0.536 and 0.454 in 2000 and 2010, which shows that the ecological system was in a state of early warning. The wetland ecological system should be immediately protected. Based on this, we used the grey prediction model to build a wetland ecological safety prediction model and did accuracy testing for the model. The Simulation error, correlation and the mean square error ratio, and the small error probability were primary concerns but the model accuracy was high enough for the Tumen river wetland ecological safety prediction. Finally this study made a prediction for the Tumen river basin wetland ecological safety for 40 years, the results were respectively 0.3903, 0.3345, 0.2866 and 0.2456. The wetland ecological system was in a moderate warning state and the trend of the situation continued to become more severe. Ecological security threat is very serious and this area needs more protection and management for the wetland ecosystem to survive.

Key words: wetland; ecological safety evaluation; warning; grey prediction;Tumen river basin

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10-PO2.3-30

LANDSCAPE DESIGN AND MANAGEMENT PRACTICES FOR URBAN BIODIVERSITY

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Landscape management is an integral part of natural conservation, food security and biodiversity; provides livelihoods and influences the climatic factors like humidity, temperature, precipitation and wind, and acts as an important component of disaster risk reduction. Landscapes provide safety against adverse conditions like cyclones, storms, droughts and floods etc. Undulated surface keeps the natural systems moving and provides increased surface area. Nature has its own laws and change is universal; still human often governs the natural systems and their biased activities accelerated the changes including landscape. With rapid industrialization, urbanization and road transportation systems etc., many changes have occurred and most of the natural systems are being disturbed. Thus, climate change effects have accentuated the disasters like cyclones, tornadoes, tidal surges, floods, droughts and erosion etc. The landscape and the soil phases of the great Ganges, Brahmaputra and Meghna basins have been changed due to expansion of flatland irrigation-dependent agriculture destroying hills and hill forests, wet bodies; construction of dams and embankments, roads and highways across the floodplains and natural flows of streams and rivers etc. Traditional floodplain management systems were also destroyed for irrigating crop during and after the Green Revolution. The ponds were common in every home and the houses were built on the raised land and there were a nice synchronization for livelihoods and survival. With the increase of population, a large number of people have been accumulating in the cities especially in the capital Dhaka. Three enclosed coastal megacities viz. Dhaka, Chittagong and Khulna are growing very fast and creating serious problems for transportation, infrastructure and day to day livelihoods including food. Unplanned city growth dominated with high-rise buildings and extended concrete structures and thus little places are left for greeneries for food and recreation. The unique Sal Forest of periurban Dhaka which was considered as the lung of Dhaka has been destroyed due to urban industrial pressure only within 25 years and has lost thousands of flora and fauna. A huge accumulation of sand gravels and concrete in the urban construction and mega-structure, the current demand is around 18 million tons a year and for each ton of cement, the building industry needs about six to seven times additional tons of sand and gravels. Furthermore, the volume being extracted is having a major impact on rivers, deltas and coastal and marine ecosystems, results in loss of land through river or coastal erosion, lowering of the water table and decreases in the amount of sediment supply. Extraction has an impact on biodiversity, water turbidity, water-table levels and landscape and on climate through carbon dioxide emissions from transportation.

Therefore, to secure the lives, livelihoods it needs to manage natural systems wisely and logically. It is essential to conserve and maintain the significant or characteristic features of the landscape, which is greatly valued on account of its distinctive natural or cultural configuration. This paper reflects the related issues ahead to achieve an effective landscape design and management policy for adoption of appropriate city planning for a comprehensive disaster risk reduction strategy.

10-PO2.3-31

Sacred grove as conservation tools in riparian landscapes: case of Mai Ki Bagiya in Amarkantak

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Sacred groves represent an ancient Indian conservation tradition, protected by local people out of reverence and respect, fear and sentiment. They are the home of the local flora and fauna, a veritable gene pool and a mini-biosphere reserve. Within these groves are locked ancient secrets of herbs and traditional medicine, primitive practices of sorcery and magic. Sacred natural sites such as forest groves, mountains and rivers are arguably the world's oldest form of protected areas. These sites can be found in almost every country and culture, and they play a vital role in the informal conservation of both biological and cultural diversity. Although these sacred groves were on average only partially representative of forest vegetation, their stronger sustainability compared with unprotected tree stands may be important to consider in detail for conservation. The study documents the sacred grove known as 'Mai ki bagiya' at the inception of river Narmada, a vital river flowing through central India. The ecology of the river is greatly dependent on this grove. As the water flow and quality are many aspects which are affected by this grove.

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10-PO2.3-33

Options for Groundwater management in Tamil Nadu: A review of the existing system and way forward

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Abstract

Groundwater management is one of the most fundamental challenges facing South Asia in the 21st century.The share of groundwater in the net irrigated area has been increasing Of the addition to net irrigated area of about29.75 million hectares between 1970 and 2007, groundwater accounted for 24.02 million hectares (80%)(Shankar, Kulkarni and Krishnan, 2011).Tamil Nadu being one of the water starved states of India, the surface water potential has been fully tapped and increasing the pressure on groundwater exploitation. Given the background of water conflict in Tamil Nadu(Janakrajan.,1986., Srinivasan et al.,2014), the proposed study focusses on the issues of poor governance and options for an institutional framework for community-based groundwater management. Community engagement in the governance of water resources is not an option but a fundamentally necessary human response to the natural, physical conditions and by which we receive water from nature (Vani.,2009).Moenech(2006) emphasized that groundwater management solutions are to be `locale specific' and should incorporate range of physical, social, economic, and institutional characteristics of the locality. The theoretical framework developed by Schlager and Ostrom(1992) on property rights would be a used as a lens to examine issues related to management and governance of ground water in Tamil Nadu. The study would highlight the 'success 'and 'failures' of legislative measures in tacking issues relating to groundwater depletion. Case studies would be conducted to analyse the degree of efficacy of community-based local groundwater management in Tamil Nadu and would be substantiated with household surveys in the context of small lake/ tank in rural areas, and in water supply systems in urban areas. The study seeks to contribute and provoke further academic and policy discourse on groundwater governance in Tamil Nadu.

Key Words: Groundwater, Tamil Nadu, Institutions, Community-based management

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10-PO3.2-34

Study of the introduction of "the solar sharing" to the farmland in the suburbs of the city

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The farmland that abandoned cultivation is increasing in the suburbs of the city in Japan. Such renounced farmlands became ruined, and biological diversity decreases. In this study, we examined the effect of "the solar sharing" farmland that is cultivated crops at the same time in the bottom while installing the solar generation panel on farmland, and getting a generation income while contributing to biological diversity maintenance and cultivation. Test field was 70 square meters of vegetable-yards in Kainan-shi, Wakayama, Japan. In the spring of 2013, we plowed the field and installed 26 pieces of 315w solar generation panels. The generation output was 8 kW. The structure to put the panels on reduced the use of concrete to prevent the soil damage. After setting the panels, we made furrows in the field, and separate to 3 blocks; bright, dark and middle condition. Next, we planted seedlings of Japanese ginger (*Zingiber mioga*) in the treated furrows. After, we sowed the seeds of spinach according to the treatments of the light as the Japanese ginger. The cultivation density of the test crops was the same as a common method. In addition, there were no sprinkling of the artificial manure and the pesticide. Measurement of the following six items were further conducted, 1) necessity time for cultivation, 2) light condition, 3) air temperature 4) soil condition 5) crop weight and 6) growth of weeds. The results are as follows. (A) Because a small machine could be used, the work man-hours necessary for planting did not increase. (B) There was no decrease of the harvest until the condition of the middle light level. (C) Drying of the soil surface was controlled under shading. (D) Germination and the growth of the weed were controlled under shading, and labor of the weeding decreased. (E) Because the number of times of the weeding decreased, the maintenance of the period that the habitat of species depended on the weeds became longer. Those result in this study, as for "the solar sharing" to cultivate the crops at the same time in the bottom, there were few problems on the cultivation under the small intensive agriculture in the suburbs of the city such as this experiment, and possibility to contribute to maintenance of the biological diversity was recognized while getting some income by solar generation.

Keyword：renounced farmland, maintenance of the farmland, the suburbs of the city, solar generation, solar sharing

10-PO3.2-35

The influence that the introduction of the natural energy in the rural districts gives to primary industry

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After World War 2, decrease of farming continued in Japan. As Japan developed economically, Japanese farmers couldn't farm because of increase in production cost of farm products and the increase of inexpensive farm products imported from abroad. Combined with the issue of aging farmers and the lack of successors have become serious. Recently, abandonment of cultivation land has increased. It causes farm land to turn into unusable environments. Farmlands have long been used for production of food and preservation of landscape and disaster prevention. Also, farmland contributed to maintenance of the biodiversity in Japan. There were many animals and plants that live in farmland. But this ecosystem was destroyed by changing of farms.Recultivation of the abandoned farmland is becoming a problem for the future of Japans farmlands. But the recultivation of the abandoned farmland is facing many problems. Abandoned farmlands cannot produce enough profit to support the maintenance of these farmlands in comparison to other profitable farmlands. If there are more farmers, abandonment of farmlands will not increase. Therefore it is necessary to increase the profitability of current farmlands.

The author suggests natural energy power generation using farmland in this study. In addition to farming, power generation will increase farmer's income. For example, solar-sharing is gradually expanding along farmers. Solar-sharing is a method where solar cells are placed above currently used farmlands on high footstools. However, there is difficulty to calculate the initial cost and the payoff period. The author considers researching a specific farmland's solar power generation potential if farmers in that region introduce solar power generation in their farms. Nachikatsuura town Ota area was set as the research area. The author calculated the each farmland one by one using Google Earth Pro. Next, the state of farmlands was classified into short-term, middle-term and long-term cultivation abandonment accordingly. The author researched solar power generation potential in this area using solar power generation simulation in SHARP. Next, the author calculated the income by selling electricity in Ota area. Finally, if the benefit by selling electricity can support farm, this method could be available as answer to farmland maintenance in Japan.Farmland maintenance is good for maintenance of biodiversity.

Keyword：abandonment of cultivation land, farmland maintenance, natural energy power generation, solar-sharing

10-PO3.2-36

IMPROVING PRODUCTION METHODS OF CONTAINER TREES AS URBAN GREENING MATERIALS*

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Greenspace play an important role in urban biodiversity with various environmental functions and trees are essential to establishing greenspace. However, withering to death of transplant trees caused by root pruning in the process of transplanting could result in a demand of extra-cost for replanting as well as a limit of greenspace functions. Container trees can take advantage of a higher transplant survivability and early establishment through fibrous root systems. At the pretest of transplanting container trees at Suppro Nursery in Gangjin, Jeollanam-do Province, the survival rate was 98% for *Magnolia kobus,* 95% for *Photinia glabra,* and 94% for *Cinnamomum camphora*, respectively. This study is aimed at providing measures to improve container tree production by researching and analyzing its production systems in comparison with advanced landscape countries, including Canada, the U.S, and Japan.

As for issues with landscape tree production in Korea, the method of container cultivation is not systemized yet. Since containers that can produce mid-sized and large trees have not been developed, there arelittle tall trees containerized. In advanced countries, container cultivation technique has already been adopted and used actively with continuous research to develop cultivation methods. In Byland Nurseries Ltd. of Canada, landscape trees are produced using containers at facilities and outdoors, and mature trees are produced using rectangular containers of up to 170L. In the U.S, a 4-step production system using 'Whitcomb System' is in place, and mature trees are produced in containers of up to 225L. In Japan, landscape trees of around 1.5m are produced and distributed using containers, which has higher price competitiveness compared to field cultivation.

The following measures are suggested to solve the issues. First of all, seedlings with excellent root development should be produced from the early stage of container production. Roots have to develop significantly for transplant into containers of higher volume to produce mid-sized and large trees. It is essential to develop containers that can produce trees with excellent root development by creating a robust root system from seedlings to mid-sized and large trees. Research and development on mid-sized and large containers appropriate for Korea should be conducted. Further studies should be conducted on tree species-specific container production systems to supply various species as greening materials.

* This subject is supported by Korea Ministry of Environment (Project # 2014000130009).

10-PO4.1-37

A LONGITUDINAL ANALYSIS OF LAND USE CHANGE IN AN ENVIRONMENTAL RESTORATION-ORIENTED COMMUNITY, MATAIAN, HUALIEN, TAIWAN

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The MataianCommunity, a traditional Amis tribe, is located at Guangfu Township, Hualien County, Taiwan. There is an inland wetland which is the largest one in Hualien and Taitung area. Different stages of agricultural styles were developed because of the special environment. However, harmonious living space for human and the natural wetland has formed, and ecological environmental restoration has become the main developing purpose of the community recently. The community utilizes the biodiversity of the wetland and makes it become the tourism resource. This community was elected as one of the top ten rural villages in 2007 in the category of classical ecology, and it could be the representative of rural communities with the development style of environmental restoration. This research focuses on the landuse change of the wetland area along the living space of the community and the Fudeng Stream Watershed which is the main water source of the wetland. The total area is 249.185 hectares. Orthophotos of 2002, 2008, and 2010 of that area are used to explore the landuse change and the landscape metric is used in the analysis of landscape ecology.

The main result shows that total number of patches (NP) and patch density(PD) of six landuse patterns increased up to 134% from 2002 to 2010. The NP of grass-covered land and water area of the community also rose dramatically. The NP of water area even grew nearly 3 times.Although grass-covered landarea increased 14% from 2002 to 2010, the water area decreased 15.2% and the agricultural area decreased 36.9%. It shows that landscape diversity decreased and the different types of patch area tend to be similar because of 5.2% drop of Shannon diversity index (SHDI). The Shannon evenness index (SHEI) decreased from 0.7666 of 2002 to 0.7224 of 2008, and it was 0.7267 in 2010. It shows that the even distribution of landscape patch decreased and became stable. The above landuse change process was helpful for development of environmental restoration of the community. However, the built areadecreased 15.6% from 2002 to 2008 but increased 6.7% from 2008 to 2010. Therefore, the regulation of farmhouses along farmland and overnight accommodation built for tourists should be restricted in the future in consideration of sustainability of rural village's environmental resources and reasonable utilization of land. This could avoid severe farmland and wetland fragmentation and loss of soil fertility, and those preservativefarmlands could be used as the ecological buffer zone for wetland conservation areas.

Key words：Environmental Restoration, Land Use Change, Landscape Metric, Biodiversity

10-PO4.3-38

EFFECTS OF LEAF SHAPES ON RAINFALL INTERCEPTION CAPACITY OF LITTER LAYERS

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Rainfall interception by a litter layer is a major source of water loss in water cycle on a forest watershed. A litter layer over the soil consists of undecayed and mostly decayed organic matters, such as woods, branches, stems, and leaves. The presence of a litter on a soil influences water exchange between the soil and the air, by capturing a significant fraction of rain water. Morphological characteristics of leaves can affect the amount of rainfall interception on a forest floor, but their contributions have rarely been investigated.

The purpose of this study is to experimentally analyze the storage capacity of rainfall intercepted by the litter layer. The experiments were conducted to measure the water moisture variations of litter layers in given conditions. An artificial rainfall simulator was installed to apply the uniform, and controlled rainfall input. Broadleaves and needle leaves were tested to quantitatively examine the influences of leaf shapes on the interception storage capacity of leaf layers. Different thickness depths of the layer were also employed for an experiment variable.

Experiments revealed the rainfall interception processes occurred on forest floor. A larger interception was occurred at the beginning stage of rain, and became nearly constant after about 2 minutes of raining. When rain ceased, the water moisture contents in the layer declined exponentially. The storage capacity of litter layers was linearly increased as leaf area dimension increased. The results also demonstrated that a little difference was found in the intercepted rain water between broadleaves and needle leaves litters.

These limited results provided foresters with useful information on water cycle study. But, more detailed experiments are needed to accurately quantify the fraction of rain water to be stored in the litter layers.

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10-PO4.3-44

DIFFERENCES IN THE MICRO-CLIMATES OF A GREEN ROOF AND A BARE ROOF IN AN IDENTICAL THERMAL CLIMATE ZONE

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Urban green spaces have been known to mitigate urban heat islands(UHI). A few previous works have shown that urban heat at a microscopic level can be managed with small green spaces on roofs and walls of buildings. Moreover conventional studies on green roofs, as an UHI mitigation factor, have focused on effects on heating and cooling budgets in each of the buildings more than effects on UHI mitigation in urban boundary climate level. The purpose of this study was to clarify the degree of thermal mitigation derived from green roofs, in both individual buildings and in urban blocks, within particular thermal climate zones. A green roof and a bare roof, both located on the Gangnam-gu Office, Seoul, Republic of Korea, were selected due to their identical micro-climatic conditions such as height, area and land use, and the short distance between the two with roofs. Measurements of air temperature and relative humidity were made, with two Testo 174H instruments on each of the buildings which has a green roof or a bare roof, every minute, for six and a half days during the summer in 2012. With the exclusion of two rainy days, 13,022 data points were obtained and these were converted to 41 data points representing, hourly, measurements taken over the course of four days. The data were analyzed statistically with a paired sample test and regression analysis.

The results showed that the green roof could effectively mitigate urban heat on the upper side of the urban boundary layer. The green roof's air temperature was lower than that of the bare roof, ranging 5°C to 20°C, while the relative humidity on the green roof was higher as compared to the bare roof, showing a range of 5% to 25% over the course of a day. The air temperature and relative humidity differences between the green roof and bare roof were greater during the daytime (07h to 18h) than at night (19h to 06h). From the pair sample test results, the averaged air temperature of the green roof was found to be 36°C during the daytime and 28°Cat night, with a difference of 8°C **, while that of bare roof was 47.4°C and 29°C during the daytime and at night, respectively, with a difference of 18.4°C **. The averaged air temperature differences between the bare roof and the green roof were 11°C ** during the daytime and 1°C ** at night. Values of averaged relative humidity from the green roof were 44% during the daytime and 66% at night, with a difference of 22%**, while those of the bare roof were 27.4% and 62% during the daytime and at night, respectively, showing a difference of 34.6%**. The averaged relative humidity differences between the green roof and the bare roof were 17%** during the daytime and 4%** at night. From the regression analysis, two equations were obtained. One was a cubic function of air temperature (Y_1) versus time in hours (X_1) on the green roof ($Y_{11} = -0.007X_{11}^3 + 0.174X_{11}^2 - 0.198X_{11} + 25.668$ (R^2=72.1%)), and the bare roof ($Y_{12} = -0.008X_{12}^3 + 0.086X_{12}^2 + 2.189X_{12} + 22.244$ (R^2=60%)). Another function concerned the relationship between relative humidity (Y_2) and time in hours (X_2) on the green roof ($Y_{21} = 0.023X_{21}^3 - 0.586X_{21}^2 + 1.688X_{21} + 70.852$ (R^2=64.5%)),and the bare roof ($Y_{22} = 0.006X_{22}^3 + 0.154X_{22}^2 - 7.736X_{22} + 87.939$ (R^2=63.3%)).

Our results, which highlight the differences in thermal mitigation between the two roof types, should aid in mitigating heat in the upper boundary climate layer, which means roofs of buildings in an urban block which is highly developed and required for thermal mitigation with multilateral small green spaces on the ground and roofs and walls on buildings. In addition, the findings of our study suggest that the use of green roofs is an effective strategy towards UHI mitigation.

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10-PO4.4-39

EVALUATING BIRD HABITAT SUITABILITY TO INCREASE URBAN BIODIVERSITY -FOCUS ON VEGETATION STRUCTURE-

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Urban biodiversity provides ecosystem services to urban residents and plays an important role in the conservation of decreasing forest-dwelling species. Urban park is important biodiversity hotspot in the city because vegetation structure of urban park provides habitat and resting area to wildlife. Furthermore, urban park has great portion in urban green network which is important to increase urban biodiversity.

Meanwhile, using birds to increase urban biodiversity has proven to be more effective than using mammals, for birds have a better permeability to the inner city. Therefore, in this research, we analyzed the relationship between the vegetation structure of urban parks and the birds' suitability for inhabitation in order to increase urban biodiversity.

We focused on an urban park in Seongnam City, which has rapidly urbanized since the 1970s. We selected several bird species, which is frequently found in Seongnam City, as our study target. Based on the selected species habitat requirement, we made equations to evaluate habitat suitability for each of the habitat variables. Habitat variable data was established using direct research, and based on this data, we evaluated the suitability for inhabitation of each park. Conclusively, we found that the percent of plot covered by tree canopy and the number of dead trees were the key influencing factors for habitat suitability of the parks in Sungnam City.

Also, the bird species frequently found in the inner city were affected by the surrounding forest, yet each species had different requirements for inhabitation. Therefore, in order to increase urban biodiversity, the percent of plot covered by tree canopy and the number of dead trees in a park must be considered and managed. Furthermore, if the species possibility for migration and the location of the park is also taken into consideration, a more realistic conclusion can be made.

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10-PO4.4-40

DEVELOPMENT OF HABITAT RESTORATION MODEL USING HSI OF *KALOULA BOREALIS*

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Kaloula borealis is classifiedas amphibian species (only *Kaloula* species in Korea) (Ko *et al*., 2011), which was used to be observed in all areas excluding Gangwon-do in the past(NIBR, 2012). However, the population and habitat of *Kaloula* species has rapidly decreased due to various environmental issues associated with the indiscriminate development, excessive uses of agricultural chemicals, and destruction and fragmentation of habitat (Yang *et al*., 2001; NIBR, 2011).

Accordingly, the Ministry of Environment has designated and managed them as endangered species II to prevent the extinction of the species, in accordance with 「Act on Protection and Management of Wildlife」; furthermore, a study on ecological restoration of *Kaloula borealis* is absolutely required.

Therefore this study is to develop a habitat restoration model for *Kaloula borealis* to prevent the extinction of the species and improve the biodiversity in the urban areas with the limited area and small-scale budget.

The variable and standard of *Kaloula borealis* HSI, which was proposed in other studies (Shim *et al*., 2014) was considered to propose a habitat restoration model for *Kaloula borealis*; therefore, the floor plan and cross-sectional drawing of model has been proposed.

The distance from wetland, grassland, farm, stream and rice paddy, and altitude of spawning pond were proposed for spatial consideration among the HSI variables for its further drawings (floor plan and cross-sectional drawing, etc.). Regarding the aspect of feed, the bed structure of forest and low-rise grassland were proposed. Stones, between the stones and soil quality were considered for their shelter. The area of wetland for mapping, the ratio of open water(coverage of emerged plants) and water depth were considered for breeding. The distances from street or pollutants were proposed as threatening factor.

The model proposed in this study is highly considered to develop the technology restoring the habitat for endangered species to secure the biodiversity, as well as to make contribution to secure the Ecosystem integrity in urban areas. Therefore, the restoration model is to be improved through a continuous monitoring even after restoring the habitat.

* This study was conducted as one of technology R&D project (Developing Restoration Techniques of Endangered Species Habitat for Ecosystem Integrity in Urban areas) supported by KEITI in 2014.

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10-POV.2-41

A Study on the Irrigation System of Greenwell Using Ultrasonic Mist Fogger System

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Ultrasonic mist fogger and the fan were used for investigating the availability of fog circulation system in greenwall and the potential growing ability of the plant. The mist caused by ultrasonic mist fogger was circulated by the fan through the pipeline and supplied to the pots containing plants.

Moisture content of the 3 different soils was measured at different irrigation time points. The moisture content of 15-26% in PP and Co soil was maintained at irrigation of 24H, 18H, 12H in a day.

Proper growth condition was found in Ardisiapusilla and Hostaplantaginea at the height of L level after 1 month of growth when the plants were irrigated by the fog circulation system. The results suggest that the fog circulation, by ultrasonic mist fogger to the green walls is system of choice for suppling moisture to plants.

Key Words：Vertical garden, Aeroponic System, 3 Dimensional greenery system, Plant growing, Native plant

10-POV.2-42

A STUDY ON THE SPATIAL LOCATION OF DEVELOPMENT PROJECTS CAUSED BY THE ENVIRONMENTAL IMPACT ASSESSMENT SYSTEM MANAGEMENT OF INDIVIDUAL PROJECT UNITS

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The purpose of this study is to analyze tendencies of spatial location in development projects, by drawing out problems which occur due to the evaluations made by individual projects in the EIA system.

For this, we analyzed the current situations of the development projects in the capital area, per year, project type and local area; the characteristics of the development projects per city(Incheon Metropolitan City, Yongin City and Hwaseong City); and the characteristics of the locations and the EIA; and reviewed the environmental impacts of the developments. The study results through these processes may be summarized as follows:

Firstly, projects tend to concentrate on a specific region and period, so their environmental impacts are very likely to be accelerated in a short time. Even a small-scaled project will be exposed to drastic environmental changes and damage the environment, when it occurs in junction with others, so measures need be suggested to predict and reduce the environmental impacts, in consideration of the connectivity of the previous, present and follow-up projects, when a development project is located.

Secondly, accumulated impacts of a development need be examined by reviewing the extent of the adjacency with previously developed areas, and the directions and patterns of the development per project type, before pushing forward a development project. Particularly, in case of the development projects for roads and for cities, other projects are likely to be continually located nearby, with the urbanization expanded, so such environmental impacts should be taken into consideration.

Thirdly, when the development project occurs in junction with others, so measures need be suggested to predict and reduce the environmental impacts, in consideration of the connectivity of the previous, and follow-up projects, when a development project is located.

Fourthly, in many cities with development projects, rural-typed land utilization(fields, paddies and forests) tends to diminish, while urban-typed land utilization(sites, others, etc.) tends to continuously increase. As the increase of the urban land utilization will very likely cause the increase in the vulnerability to the natural disasters, the lowering of the biodiversity, the changes in microclimates, etc., the reviews on the impacts of the changes of the land categories and others should be made in advance.

Fifthly, the EIA performed per unit project may occur in the capital area regional green network and thus cause damages to it.In case of a construction of athletic facilities, for example, as they can be placed within or around a forest, problems, such as a direct damage to the regional green network and indirect damages by the increase of the people using the facilities, are expected, leading to the lowering of the connectability of the green network, as a result.

These results could make use of reviewing the environmental impacts and tendencies of problems onto the whole region.

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10-POV.2-43

ECOLOGICAL RESTORATION METHODS DEVELOPMENT USING NATIVE SPECIES IN DMZ VICINITIES

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DMZ area has the natural resources where the unspoiled natural ecology remains. However, it has been damaged by natural disasters and development activities in some areas and ecological health has been threatened with invasive species and imported vegetation due to the indiscreet greening constructions.

Moreover, despite of the importance of maintaining ecological stability, invasive plants and imported materials have been used thoughtlessly for the restoration projects in damaged areas of DMZ, National Parks and ecological landscape conservation area. Therefore, ecological restoration projects in these damaged areas do not restore the original vegetation suited to the local environment and ecological connectivity is able to be threatened with indiscreet restoration constructions.

In this sense, the mission of this research project is to develop technologies/ manuals for the environmental restoration in the naturally/ artificially damaged areas and future-expected damaged areas of DMZ, DMZ vicinities and National Parks. It includes collecting seeds of plants that grow wild in the DMZ, developing a technology to incubate plant seeds and to restore the damaged area ecologically with those plants and local natural resources including local soil.

Accordingly, with technology development including selection of local seeds, dormancy breaking of the selected seeds and testing the germination capacity of each seed in early stages, the research is in progress for the development of local seed identification technology by DNA Marker.

In addition, by presenting classification and evaluation indicators according to each type of damaged areas and each restoration technology applied to the areas, the final goal of this project is aimed to achieve ecological restoration with secured ecological health when developed ecological restoration technologies utilizing natural resources including local seeds of naturally-grown plant are applied to the damaged areas.

October 11

Keynote lecture

Urban Biodiversity in the Environmental Law System

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I. Urban Biodiversity

1. Background

Although cities occupy just 2 percent of the Earth's surface, their inhabitants use 75% of the planet's natural resources.[34] Cities draw on their surrounding ecosystems for goods and services, and their products and emissions can affect regional and even global ecosystems. Healthy ecosystems and biological diversity are vital for cities to function properly.[35] Urban Biodiversity(URBIO) is one of the main topics at the 2014 URBIO Conference concurring the CBD-COP 12 in Korea. As the cities are getting more and more developed, URBIO is also getting more important theme. The full implement of URBIO is not sufficient by way of doing programmes by some local governments or citizens who are concerned about biodiversity. For the purpose of sustainability of such programmes, URBIO need to be institutionalization and also to be supported by financing system under the law and regulation. Sometimes, the hard law system in terms of command and control should be changed into the soft law system for the voluntary participation by business firms and individuals. This presentation is going to deal with problems and issues on the environmental or levy laws and regulations relating to biodiversity and URBIO in respect of acceleration of URBIO. The subject of cooperation for URBIO between the central government and the local government which manages the city is also going to be dealt with in this presentation.

2. Basic Concept

"Biological diversity" means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.[36] In Korean legal system, the term "biological diversity (or biodiversity)" means diversity among living things originating from all sources, such as terrestrial and aquatic ecosystems (excluding marine ecosystems), and the ecological complexes of all these, and includes diversity within species, between species and of ecosystems.[37] The term "ecosystem" means the material world or functional world in which the community of living things in a particular region is intertwined with the inorganic environment by which the community is maintained.[38] Qualitative, quantitative, spatial and monetary approaches can assess the benefits that flow from ecosystem: provisioning services, regulating services and cultural & social services.

3. Strategic Plan for Biodiversity

In decision X/2, the tenth meeting of the Conference of the Parties, held from 18 to 29 October 2010, in Nagoya, Aichi Prefecture, Japan, adopted a revised and updated Strategic Plan for Biodiversity, including the Aichi Biodiversity Targets, for the 2011-2020 period.[39] This plan provides an overarching framework on biodiversity, not only for the biodiversity-related conventions, but for the entire United Nations system and all other partners engaged in biodiversity management and policy development.[40] Parties agreed to translate this

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34) http://www.unep.org/urban_environment/issues/biodiversity.asp (2014.8.31)

35) *Ibid*.

36) Article(§)2. Use of Terms, **Convention on Biological Diversity** which was opened for signature on 5 June 1992 at the United Nations Conference on Environment and Development (the Rio "Earth Summit")

37) Para 7 of §2, Natural Environment Conservation Act(2008) in Korea

38) Para 5 of §2, Natural Environment Conservation Act(2008) in Korea

39) http://www.cbd.int/sp (September 1, 2014)

overarching international framework into revised and updated national biodiversity strategies and action plans within two years.[41] Additionally, in decision X/10, the Conference of the Parties decided that the fifth national reports, due by 31 March 2014, should focus on the implementation of the 2011-2020 Strategic Plan and progress achieved towards the Aichi Biodiversity Targets.[42]

The mission of the new plan is to "take effective and urgent action to halt the loss of biodiversity in order to ensure that by 2020 ecosystems are resilient and continue to provide essential services, thereby securing the planet's variety of life, and contributing to human well-being, and poverty eradication. To ensure this, pressures on biodiversity are reduced, ecosystems are restored, biological resources are sustainably used and benefits arising out of utilization of genetic resources are shared in a fair and equitable manner; adequate financial resources are provided, capacities are enhanced, biodiversity issues and values mainstreamed, appropriate policies are effectively implemented, and decision-making is based on sound science and the precautionary approach."[43]

Enhancing the benefits to all from biodiversity and ecosystem services is "Strategic Goal D" of the Aichi Biodiversity Targets. Such Goal D is composed of three targets relating to the biodiversity and ecosystem services.[44] "By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities, and the poor and vulnerable"(Target 14). "By 2020, ecosystem resilience and the contribution of biodiversity to carbon stocks has been enhanced, through conservation and restoration, including restoration of at least 15 per cent of degraded ecosystems, thereby contributing to climate change mitigation and adaptation and to combating desertification"(Target 15). "By 2015, the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization is in force and operational, consistent with **national legislation**"(Target 16).

4. Methodology

1) Ecosystem Management Programme

UNEP's Ecosystem Management Programme works towards assisting countries and regions to integrate an ecosystem approach into development and planning processes, acquire and improve the capacity to use ecosystem management tools, realign the environmental programmes, and finance priority ecosystem service s.[45] Ecosystem services have no standardized definition but might broadly be called "the benefits of nature to households, communities, and economies"[46] or, more simply, "the good things nature does."[47] Using an ecosystem approach, natural resource managers can identify and analyse the drivers operating on an ecosystem and design appropriate actions. Generally speaking, the *integrated management* includes improving site management, regulation, land use planning, property rights, and improving the distribution of cost and benefits. Once this analysis is complete, implementation may begin. Using this framework, authorities at local, national and regional levels will be able to launch assessments of their ecosystems. Successful implementation should involve four steps[48]: (1)making the case; (2)generating knowledge; (3)turning knowledge to action; (4)monitoring, evaluation and feedback.

2) Bibliograph

The importance of urban biodiversity is debated by many in the conservation community. According to the result of study which was accomplished by Charles H. Nilon, Urban biodiversity and the importance of management and conservation, *Landscape and Ecological Engineering* Volume 7, Number 1 45-52 1860-1871 SCI(E), some researchers and managers focus on threats to biodiversity associated with

40) *Ibid.*
41) *Ibid.*
42) *Ibid.*
43) http://www.cbd.int/sp/elements/default.shtml (September 1, 2014)
44) http://www.cbd.int/sp/targets/default.shtml (September 1, 2014)
45) http://www.unep.org/ecosystemmanagement/Methodology/tabid/314/language/en-US/Default.aspx
46) James Boyd and Spencer Banzhaf, What Are Ecosystem Services? The Need for Standardized Environmental Accounting Units.
47) "Mother Nature's Sum". Psmag.com. 2008-09-24. Retrieved 2012-07-09.
48) http://www.unep.org/ecosystemmanagement/Methodology/tabid/314/language/en-US/Default.aspx

urbanization and land use change. In contrast to such approach, "people who live in, study, or care about cities - ecologists, wildlife managers, conservation biologists, planners, and local residents - have debated what biodiversity means in urban settings." "Recent literature on biodiversity in cities notes the range of ecological, social, and cultural meanings of urban biodiversity and stresses the importance of defining the setting and scales at which biodiversity is being assessed." Nilon's such approach to urban biodiversity has documented the importance of conservation of rare species and habitats but also the importance of managing the range of habitats in and around where people live, work, and play.

II. Policies in Environmental Law

Biodiversity - the diversity among living organisms - plays an essential role in ensuring the survival of life on earth. Clean water, foodstuffs, medicines and quality of life are just a few of the services which biodiversity offers to cities.[49] Recognizing the importance of biodiversity and healthy ecosystems for their survival, cities today undertake many initiatives to utilize and conserve their surroundings efficiently. These actions can reach far beyond the boundaries of the city, affecting biodiversity on a global scale.[50]

1. National Biodiversity Strategy

The Act for Preservation and Use of Biodiversity of 2011 in Korea introduced the system of National Biodiversity Strategy. §7(Establishment of National Biodiversity Strategy) thereof describes (1) the government shall establish the strategy for national biodiversity conservation and the sustainable use of its components (hereinafter referred to as "national biodiversity strategy") in every five years ; (2) the national biodiversity strategy shall contain the following matters：

1. The status, objectives and principal directions
2. The protection and management of components of biodiversity and biodiversity itself
3. The sustainable use of components of biodiversity
4. Response to the threats to biodiversity
5. Research, technical developments, education, public relations and international cooperation relating to biodiversity
6. Other matters necessary for the conservation and use of biodiversity

2. National Action Plan

The Act for Preservation and Use of Biodiversity in Korea introduced the National Biodiversity Strategy Action Plan. §8(Establishment and Implementation of National Biodiversity Strategy Action Plan) thereof describes (1) the head of related central administrative agencies shall establish and implement the national biodiversity action plan relating to its responsible areas according to the national biodiversity strategy (hereinafter referred to as "action plan") ; (2) the head of related central administrative agencies shall notify implementation outcomes of the previous year's action plan and the action plan of the current year to the Minister of Environment, which is prescribed by Presidential Decree ; (3) the necessary matters required to establishment, implementation, etc. of the action plan will be designated by Presidential Decree.

3. Cities, ecosystems and biodiversity

Studies of the ''ecological footprint'' of cities – the area of land needed to provide a city with the resources it requires to function and to remove its wastes – show that cities affect a geographic area vastly greater than their own surface area. A city's ecological footprint contributes significantly to biodiversity loss, both locally and at the global level.[51] Urban interests have had a detrimental effect on the ecosystems around the cities, damaging the biodiversity of the surrounding areas, and in turn threatening the viability of the cities themselves. While damaged ecosystems negatively affect urban residents, healthy ecosystems provide cities with a range

49) http://www.unep.org/urban_environment/issues/biodiversity.asp (2014.8.31)

50) *Ibid.*

51) *Ecosystems and Biodiversity*: The Role of Cities, published by UNEP and UN-HABITAT (2014.8.31). This brochure offers useful information on global initiatives and the support mechanisms available for cities to protect biodiversity.

of services which are essential for their economic, social and environmental sustainability.[52)]

4. Urban Solutions

Just as the ecological footprint of a city can have a negative impact far beyond the boundaries of the city, certain urban actions can also have a far-reaching positive impact. According to the UNEP, there are many solutions[53)] for such goal[54)]: (1)the **arrangement of green areas** in a city and their connection with the surrounding countryside are critical to sustainability; (2)small towns and big cities can make up **watersheds** – an area of land that catches precipitation and drains or seeps into a marsh, stream, river, lake or groundwater; (3)local authorities recognize that appropriate **ecosystem management** can save cities large sums of money, often avoiding the necessity for mechanical intervention in areas such as water quality; (4)urban **planning and building** regulations can prevent construction on vulnerable land such as wetlands; (5)urban measures to increase **energy efficiency** can also benefit biodiversity; (6)urban **parks**, green median strips and tree planting offer urban residents more pleasant surroundings, and provide a refuge for wildlife; (7)urban **protected areas**, such as parks, nature reserves and greenbelts, are often particularly important in urban settings for wildlife and for people; and (8)urban **agriculture** can contribute to soil conservation, urban hydrology, microclimate improvement and urban biodiversity.

Ⅲ. Institutionalization and Payment for Ecosystem Service

Changes in institutional and environmental governance frameworks are sometimes required to create the enabling conditions for effective management of ecosystems, while in other cases existing institutions could meet these needs but face significant barriers.[55)] Many existing institutions at both the global and the national level have the mandate to address the degradation of ecosystem services but face a variety of challenges in doing so related in part to the need for greater cooperation across sectors and the need for coordinated responses at multiple scales.[56)]

Payments for ecosystem services(PES), also known as payments for environmental services (or benefits), are incentives offered to farmers or landowners in exchange for managing their land to provide some sort of ecological service. They have been defined as "a transparent system for the additional provision of environmental services through conditional payments to voluntary providers."[57)] These programmes promote the conservation of natural resources in the marketplace.

Ecosystem services are the benefits people obtain from ecosystems. Ecosystems provide three main kinds of services to the city: provisioning of food, fibre and fuels; regulating through purification, detoxification and mitigation of droughts and floods; and enriching the spiritual, aesthetic and social life of urban dwellers.[58)] Many of the services listed here are highly interlinked(primary production, photosynthesis, nutrient cycling, and water cycling, for example, all involve different aspects of the same biological processes).[59)]

Some PES programs involve contracts between consumers of ecosystem services and the suppliers of these services. However, the majority of the PES programs are funded by governments and involve intermediaries, such as non-government organisations. The party supplying the environmental services normally holds the property rights over an environmental good that provides a flow of benefits to the demanding party in return for compensation.[60)]

In the case of private contracts, the beneficiaries of the ecosystem services are willing to pay a price that can be expected to be lower than their welfare gain due to the services. The providers of the ecosystem services can be expected to be willing to accept a payment that is greater than the cost of providing the services.[61)]

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52) *Ibid.*
53) For example, http://www.unep.org/urban_environment/events/Bonn-briefcase.asp
54) *Ecosystems and Biodiversity*: The Role of Cities, published by UNEP and UN-HABITAT (2014.8.31)
55) *Ibid*., p.20
56) *Ibid.*
57) Tacconi, L. (2012). Redefining payments for environmental services. Ecological Economics, 73(1): 29-36.
58) http://www.unep.org/urban_environment/issues/biodiversity.asp (2014.8.31)
59) Millennium Ecosystem Assessment, 2005. *Ecosystems and Human Well-being: Synthesis.* Island Press, Washington, DC., p.40
60) http://en.wikipedia.org/wiki/Payment_for_ecosystem_services (2014.8.31)

1. Hard Law System

1) Water-levy for Use: Water Use Charge

Korea enacted the Act for Purification and Assistance to the Residents in the Han-river Watershed of 1999. §19(Levying and Collection of Water Use Charges) thereof describes: (1) In order to raise funds for programs for supporting residents and water quality improvement projects, each waterworks business operator shall levy and collect a charge in proportion to water consumption (hereinafter referred to as "**water use charge**"), as prescribed by Presidential Decree, from each end user to whom raw water drawn from public waters specified by Presidential Decree is supplied as is or as purified and shall transfer the charge to the Han River Basin Management Fund under Article 20: *Provided*, That the foregoing shall not apply to any of the following cases: 1. Where an end user resides in a water-source management area; 2. Where such water is used for maintaining the water level of a river ;

(2) A person under any of the following subparagraphs shall, when he/she draws water from public waters specified by Presidential Decree, pay the water use charge directly to the Han River Basin Management Fund under Article 20 in proportion to the volume of raw water he/she draws, as prescribed by Presidential Decree: 1. A person who has exclusive waterworks installed pursuant to subparagraph 11 of Article 3 of the Water Supply and Waterworks Installation Act; 2. A person who uses water from a river under Article 50 (1) of the River Act ; (3) Notwithstanding paragraph (2) 2, a person falling under any of the following subparagraphs shall be exempted from the levying of the water use charge: 1. An electric source developer under Article 3 of the Electric Source Development Promotion Act who operates a dam for power generation; 2. A person who uses, for agriculture, water from a river ;

(4) Each waterworks business operator shall submit data necessary for the calculation and forecasting of the water use charge, such as intake volume, supplied volume, and loss rate, to the Committee for the Management of the Han River Basin under Article 24, as prescribed by Presidential Decree ; (5) Necessary matters concerning the methods for the calculation, levying, and collection of the water use charge and the payment procedure shall be prescribed by Presidential Decree ; (6) A person who uses water from a river under paragraph (2) 2 may have the water use charge abated or exempted, as prescribed by Presidential Decree ;

(7) If a person obligated to pay the water use charge fails to pay the water use charge, the competent waterworks business operator may collect the charge in the same manner as delinquent local taxes are collected. In such cases, if a waterworks business operator is not a local government, collection may be entrusted to the head of the local government having the jurisdiction over the area, as prescribed by Presidential Decree ; (8) If a person under any subparagraph of paragraph (2) fails to pay the water use charge to the Han River Basin Management Fund under Article 20, the Minister of Environment may collect the charge in the same manner as delinquent national taxes are collected ;

(9) The Minister of Environment shall transfer the water use charges collected pursuant to paragraph (8) to the Han River Basin Management Fund under Article 20 ; (10) As to the compulsory collection of water use charge under paragraph (7), Article 68 (2) and (3) of the Water Supply and Waterworks Installation Act shall apply mutatis mutandis ; (11) As to the areas subject to the levying and collection of water use charges, Articles 9, 10, and 11 of the Water Supply and Waterworks Installation Act shall not apply.

2) Management Contract for Biodiversity

Korea enacted the Act for Preservation and Use of Biodiversity of 2011. §16(Making a Management Contract for Biodiversity) thereof describes: (1) the Minister of Environment can make a contract(hereinafter referred to as "Management Contract for Biodiversity") or advise to the head of related central agencies or local governments for making such contract which aims for preservation of areas necessary to protect the endangered species, to enhance the biological diversity, or areas where the biodiversity is remarkable or excellent with the owners, occupier or manager about change of cultivation, mitigation of chemicals, fostering wetland, or management of land ; (2) where the Minister of Environment, the head of related central agencies or local governments makes a Management Contract for Biodiversity should pay for real expenses to the person whose income on the land from implementing such contract has been decreased, according to the criteria under the presidential decree.

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61) *Ibid.*

3) Cap and Trade System of Carbon Emissions

Korea enacted The Framework Act on Low Carbon And Green Growth of 2011. §46(Introduction of Cap and Trade System) thereof describes: (1) The Government may operate a system for trading emissions of greenhouse gases by utilizing market functions in order to accomplish the State's target of reduction of greenhouse gases ; (2) The system under paragraph (1) shall include a system for setting a cap on emission of greenhouse gases and for trading emissions and other internationally recognized trading system ; (3) The Government shall, when it implements the systems under paragraph (2), consider international negotiations related to climate change and may take necessary measures in relation to controlled entities under Article 42 (5), if international competitiveness is likely to be degraded significantly ; (4) The method of allocation of the allowable quantity of emission, the methods of registration and management, and the establishment and operation of an exchange for implementing the system under paragraph (2) shall be provided by another Act separately. In Korea, according to §46 of the Framework Act on Low Carbon And Green Growth, the Act of Allocation and Trade of Greenhouse Gas Emissions of 2012 was enacted of which effective date is January 1, 2015.

2. Soft Law System

1) Voluntary Carbon Offset

In Korea, the Act for Maintenance and Enhance of Carbon Absorption Sources was enacted in 2013 for voluntary carbon offset. §19(Forest Carbon Offset) thereof describes (1) the Minister of the Korea Forest Service shall build an infrastructure for forest carbon offset in order to utilize forest carbon stock that is additionally secured by the heads of local governments or business entities through activities aimed at managing and improving carbon sinks under Articles 9, 10, 13, and 15 through 18, for the following purposes:

1. Forest carbon offset based on reductions[62]: Internationally accepted standards shall apply so that the heads of local governments or business entities, who are obligated to reduce greenhouse gas emissions under any other Act or regulation, can use forest carbon stock to offset their required greenhouse gas emissions reduction target;
2. Forest carbon offset based on social contributions[63]: Relaxed standards prescribed by Presidential Decree shall apply where the heads of local governments or business entities intend to manage and improve forest carbon sinks voluntarily to contribute to society ;

(2) The heads of local governments or business entities, who intend to implement forest carbon offset under paragraph (1), shall prepare a project design document, and other relevant documents specified by Ordinance of the Ministry of Agriculture, Food and Rural Affairs and shall submit them to the head of the Forest Carbon Center established under Article 23 (hereinafter referred to as the "head of the Forest Carbon Center"). (3) Where a project is found feasible after the head of the Forest Carbon Center examines a project design document, etc., he/she shall register the project in the forest carbon registry under Article 24 ; (4) Where a project registered pursuant to paragraph (3) falls under any of the following, the head of the Forest Carbon Center shall revoke such registration and shall, without delay, give notice to the head of local governments or business entities:

1. Where details of the project design document are falsely stated;
2. Where details of a monitoring report prepared by business entities in accordance with Article 20 are falsely stated;
3. Other cases where any registered project cannot be performed due to extenuating circumstances as prescribed by Presidential Decree.

2) National Trust

"The National Trust shall be established for the purpose of promoting the permanent preservation for the benefit of the nation of lands and tenements (including buildings) of beauty or historic interest and as regards lands for the preservation (so far as is practicable) of their natural aspect, features and animal and plant life."[64]

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62) Such module is a so-called governmental model of carbon offsetting based on the duty of reduction. Korean Government is going to abolish this sub-article of §19, because of efficiency in the field of forest.

63) Such module is really a voluntary carbon offsetting.

In Korea, the term "national trust" means the voluntary preservation and management of cultural heritage and natural environment assets in the private sector, so as to improve the quality of the life of the current generation, as well as future generations, by the acquisition of cultural heritage and natural environment assets, which are worthy of being protected, by the national trust corporation under Article 3, with property and dues, which are contributed, donated or entrusted by nationals, companies and organizations, etc., and the preservation and management of such heritages, etc.[65)]

Korea enacted the National Trust Act and introduced the national trust system under such Act in 2006, most of which was taking after the National Trust Act of 1907 in the UK. The purpose of this Act is to prescribe matters concerning the establishment and operation, etc. of a national trust of cultural heritage and the national trust of the national environment, and support for such matters by the State and local governments, thereby promoting the voluntary preservation and management of cultural heritage and the natural environment by the private sector(§1).

The National Nature Trust in Korea established in 2007 under the National Trust Act(§3) of 2006 has begun to manage natural and cultural heritage in trust, restore lost heritage through buying, and make a trust community. A trusted heritage becomes common property owned by the Trust and managed for the purpose of national interest and future generations. The first model by community system and the second model by trust system are two key legal bases compared with the government model in the conservation and use of natural heritage in Korea. The most characteristic aspect of trust model in management of natural heritage is spontaneity. The trust system contracted between land owners and non-governmental trust agency can mitigate conflicts among owners of lands comprising the ground of natural heritages.

§19 of the National Trust Act in Korea describes the **Preservation Contract** System among trustor, trustee and beneficiary. According to the para(1) of §19, the National Nature Trust may make a contract with owners or possessors of cultural heritage and natural environment assets or the agents thereof, provide necessary support to them to help them faithfully preserve and manage the relevant cultural heritage and natural environments assets and be directly engaged in activities to preserve them by borrowing the relevant cultural heritage and environment assets, for the efficient preservation and management of cultural heritage and natural environment assets. Necessary matters concerning the provisions of preservation contract or methods and procedures of concluding such contract shall be prescribed by the articles of the National Trust corporation(para 2 of §19).

The National Trust is in itself a charity trust and so may raise fund for nature preservation activities. According to the §22 of the Act, the National Trust corporation may raise funds by obtaining approval from the heads of the relevant central administrative agencies, when it is deemed necessary to purchase, preserve or manage cultural heritage and natural environment assets(para 1 of §22). The National Trust is not allowed to use contributions for purposes, other than the purposes of collecting contributions. When it ceases to or completes collecting contributions, it shall disclose the results thereof(para 2 of §22). Where the national trust corporation requests for approval under paragraph (1), necessary matters concerning necessary documents and procedures, etc., shall be prescribed by Presidential Decree(para 3 of §22).

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64) Section 4.1 National Trust Act of 1907, the United Kingdom

65) Para 2 of Section 2, the Act on the National Trust of Cultural Heritages and National Environment Assets in Korea of which popular title is the **National Trust Act.**

Example of the Preservation Contract

Nature Preservation Contract[66)]

The Carthusian Monastery in South Korea (designated as "Carthusian" hereafter) and the National Nature Trust (designated as "NNT" hereafter) shall make a conservation contract under the section 19 of *the Act on the National Trust of Cultural Heritage and Natural Environment Assets* (Act No.7912, Mar.24, 2006) as followings：

Section 1 (**purpose**) This contract has a purpose to conserve and manage the forest at San(Mt.) 45-1 Ban-gye-ri, Mo-dong-myun, Sang-ju City, Gyong-buk Province, Korea (designated as "project site" hereafter) which is owned by *St. Benedict Waegwan Abbey* and occupied by *Carthusian*.

Section 2 (**contents of contract**) The contents of conservation and management prescribed by this contract are as followings：

1. The first project site as mentioned above shall be 10 ha at San(Mt.) 45-1, which might be designated by *Carthusian* in the attached map or drawing, and shall be conserved and managed by NNT without surrender of ownership, which areas (including second site) might be enlarged hereafter according to the agreement between contracting parties.
2. This contract shall continue in effect during 20 years after effective date and might be extended to or renewed hereafter according to the agreement between contracting parties.
3. *Carthusian* shall give NNT the right to use the land of mountain at the project site as mentioned above, and shall not change the inherited character of the project site and shall not make a development or a building encroaching on environment of the project site.
4. NNT shall conserve ecosystem and landscape at the project site, shall try to enhance the proper function of its soil and forest, and shall make activities relating to eco education, carbon offset and conservation of biodiversity at the project site.

Section 3 (Method of Management) ① NNT shall burden the cost of conservation and management including afforestation, renovation of trees or cultivation of forest at the project site ; might perform relevant programs ; might change of the character of land and establish facilities necessary for such conservation and management under the consent of *Carthusian*.

② *Carthusian* shall allow the establishment of land mark which explains the honour of member or donator of NNT who takes part in the conservation or management of the project site.

③ NNT shall report to and consult with *Carthusian* every 5 year about conservation and management of the project site.

Section 4 (operation of assets) ① The timbers produced from trees grown up before making this contract at the project site might be owned or used according to the intention or directive of Carthusian.

② The biomass except for timber according to the subsection 1, and the carbon-offsets produced at the project site might be owned or used according to the intention or directive of NNT.

③ When NNT is going to do forestry in the project site by its own investment, NNT shall consult with *Carthusian* relating to the disposal and calculation of products according to such forestry.

Section 5 (inevitable circumstances) ① When there will be inevitable circumstances including natural disaster, the contracting parties might revise some conditions of this contract according to the new agreement.

② This contract might be terminated by way of consultation between contracting parties, when the surrender of ownership for the project site or the change of situations will make the effective conservation or management of the project site impossible.

Section 6 (legal resources) The Act on the National Trust of Cultural Heritage and Natural Environment Assets, the Presidential-decree of such Act, the Articles of NNT and the bylaws of NNT shall be applied to the legal contexts in addition to this contract.

Supplementary Provision

Article 1 (effectuation) This contract shall be come into effect on the date of January 1, 2012.

Article 2 (attached documents) The letter of authorization by *St. Benedict Waegwan Abbey* and the map or drawing which defines the project site shall be the attached documents of this contract.

December 13, 2011

Owner: St. Benedict Waegwan Abbey

Wae-gwan-ri 134-1, Wae-gwan-eub, Chil-gog-county, Gyong-buk Province, Korea

Occupier: Carthusian Monastery in Korea

San(Mt.) 45-1 Ban-gye-ri, Mo-dong-myun, Sang-ju City, Gyong-buk Province, Korea
Chief Order, Galichet Jean Michel *under the authority of St. Benedict Waegwan Abbey*

Conservator: National Nature Trust in Korea

Acropalace #302, Gwanyang-dong 1594, Anyang City, Gyong-gi-do Province, Korea
CEO, Dr. Chun Jae-kyong

66) Registration No. NCC 20111201(A) on the Register 2011 of National Nature Trust in Korea

11-PL-02

Respect of the urban green and the techniques to connect green

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Abstract

Nature in urban areas isgenerally considered to be already destroyed. However in the urban areas it is not impossible to find the remnant nature kept for a long period of time. Itgenerally hasbeen remained as religious woodlands, riparian forests etc. Addition to such nature we create new green spaces according to the change of the city structure by new city plans. The elaborate considering of these plans make it possible to restore the deteriorated ecological network of urban green. To realize it incessantly developing techniques for re-vegetation are suitable.

Introduction

Generallynature of urban areas is considered to have already been destroyed. As is known, to find the primeval nature there is difficult, but the pieces of them are found especially in the historical cities.These cities have been developed in the long history naturally in some cases and by elaborate city plan in other cases. In eastern Asia traditional idea about the city planning considering the location of mountains, rivers and water bodieshad been adopted mainly under the influence of Chinese culture.

Moreover these cities also experienced the modernization later. In the process of modernization a lot of changes of the city structure are recognized. At the same time urban areas extended toward the urban fringe areas. This change usually means the loss of neighboring agricultural areas.

Within the downtown areas the pieces of the primeval nature are found mainly at sacred spaces like temples and shrines which have been protected by the religious reasons.In addition, in the modernized urban areas local governments construct the city planswith street trees, parks and green spaces. These plans are usually important and useful when we consider the improvement of the peculiar city climate.

When we plan to maintain these green spaces it is important to keep them in good condition and to create more spaces for green not only to keep the good environment but also to improve the quality of biodiversity. Furthermore the importance of the application of the techniques to keep/create the connectivity of fragmented and isolated green spaces in urban areas must be kept in mind.

Persistence of the historical urban green

Considering the green historically kept it is easy to image some spaces like sacred woodlands, river banks, etc. These greenspaces have been preservedby the understanding of importance of their existence. The vegetation of sacred spaces is easy to protect.

In Kyoto, Japan having long history as the capital of Japan for more than 1000 years, quite inverse two types of the change of trees can be found according to the Japanese animistic feeling to nature. During the trees young theyare usually treated like a kind of weed. These trees will be cut. But in some cases they survive by chance. If these trees luckily grow up large they are regarded as the animistic god of the local area. On the latter case Japanese people stretch the taboo-rope on the trunk and construct small shrine in front of the tree. The size and the location is important turning point for each tree.

On the other hand these religiously important trees and woodlands are decreasing by the change of feeling to nature. The change of feeling from traditional respect for nature to logically clear solution occurred drastically in these several decades.

Deterioration of green by modernization

Modernization of urban areas brings the deterioration of urban ecosystem because of the fragmentation and/or isolation of the remaining nature. Sakamoto(1988) reported the deterioration in downtown of Kyoto City of the 20th century. As a result, sacred woodlands had been protected for a long time. These woodlands are expected as the cores of the city green. But in the process of modernization these woodlands deteriorate, reduce the area and finally become very small woods consist of a few trees or an isolated tree. In some cases all trees will be cut down as the traffic obstructs in the city plan. Such a deterioration and disappearance of trees and woodlands causes the reduction of the network of vulnerable urban ecosystem. At present it is difficult to stop this kind of deterioration because of thechange of feeling to nature of citizens.Meanwhile, the possibility of appearance of new individuals after the natural death of an isolated tree will become ecologically difficult because of too long distance from mother trees.

However we need to evaluate again the importance of nature with long history. In UK some researchers found the ecological importance of woodlands with long history even in small woodlands. Peterken (1992) showed the high biodiversity in the coppiced woodlands with the history of continuity more than several hundred years. Concerning to the coppiced woodlands he said that "the coppice fauna and flora still includes many species associated with mature, stable woodland, which appear in the modern landscape as 'ancient woodland indicators' ". Even in the urban areas the similar tendency can be expected when the sacred spaces have been preserved for a long period of time.

Connectivity of the urban nature with the surrounding nature

Urban areas are usually surrounded by the secondary nature like farmlands, woodlands and so on and connecting with these nature by rivers and streams. In addition, cities had always been keeping woodlands or forests to gain the important resources like firewood, timber and so on around the urban fringe areas. This is popular landscape all around the world. Akasaka (1984) surveyed the transition of the forest of Eilenriede nearbythe old Hannover, Germany. This forest has long history as the financial sources of city economy and the recreation space for citizens and so on. In the long history urban areas of Hannover has been expanding and urbanized areas and Eilenriede are contact closely witheach other at present. However the role of this forest is constant and unchanged, and the management of this forest is still be kept for the same purposes by the excellent management.

Especially in the developing countries it is important to keep the forest resources in close places from urban areas. However the urbanization and the expansion of urban area sometimes destroy the superior relationship between downtown and woodlands around the urban fringe areas.These urban fringe areas are important when we consider the connectivity of ecosystems as the existence supplying the ecological sources. And rivers and streams function as the ecological corridor.

However, the expansion of urban areas changes urban fringe areas that have been functioned as buffer zone. In Japan most of the flat landshave been urbanized and the distance between natural/semi-natural areas and urban areas becomes too close. These changes cause the friction between wild animals and residential people. The loss of semi-natural urban fringe areas by urbanization causes the deterioration of connectivity of neighboring ecosystems. As urbanization of urban fringe areas is generally recognized as an indiscriminate development it is difficult to expect the preservation of the ecological connectivity.

Necessity to connect the deteriorated greenand ecosystem to consider the biodiversity

In urban areas fragmented and isolated woodlands will deteriorate by the occurrence of local extinction of species by the loss of the satisfactory network with circumjacent ecosystems. Isolated ecosystems are impossible to supply enough natural replacement of species.

When we plan to restore the deteriorated nature most important purpose is to stop the deterioration of important nature in urban areas as a core of network first of all. Next important purpose is to restore or to create the ecological corridors and networks. Even in the greenspacesregarded as important cores some extinct species are sometimes found and the niches of them are replaced by other invader species, means thatcareful construction plan is required. Theoretically the distribution of open spaces is discussed. But practically ecological consideration concerning to the invader species is important.

To realize above things we need to plan the construction of green networks effectively using remnant urban nature and the newly planned green. Not only about the distribution of them but also the management systems to keep the quality are required.

On occasion roof top planting and wall greening are recommended in urban areas because of the lack of enough spaces for plantation. But when we consider about the connectivity of the green more cautious planning is required. For instance small insects like butterfly will not be able to fly over the lined skyscrapers, means the roof top planting is not useful for them. It is similar for the wall greening.Most important is the enough discussion and practice with the viewpoint of ecological characteristics of target species.

Importance of techniques to keep and create connectivity of the urban green

At present we have a lot of techniques for greening and re-vegetation. However some techniques are not applied because of the high cost and ineffectiveness results. To restore the connectivity of the green in urban area most important matter is the elaborate planning based on the sufficient ecological data.

Historical greenspaces should be cores of urban ecosystem. And whenit deteriorates we need to apply the techniques to restore them. To realize it soil improvement by fertilizing, aeration etc. and progression of light condition by tree thinning etc. will be carried out expecting the natural regeneration of vegetation in future. High quality core vegetation will function well for the restoration of the green network.

Trials to revive or create the green network more densely are also required. This will be forced mainly by the initiatives of government. Street trees plantation, preparation of parks and green spaces and restoration of riparian spaces are considered as effective practices. Understandably these green should be managed well. We also have enough knowledge and techniques concerning to fertilizing, pruning and so on. For instance, even in the case that we can't find enough natural soil, we can prepare high quality artificial soilinstead of the degraded soil.

As is known river bank is also regarded as important component to keep the ecological networks. This space are generally maintained as recreation spaces for citizen. But some of them change to the huge gutter or ditch hardened by concrete without any ecological function. Restoration of natural water stream and natural vegetation should be encouraged using restoration techniques.

In some citieslocal governments encouragethe citizens to keep their private gardens in good condition by subsidy. Especially in the downtown areasprivate gardens with long history keeping higher quality have been found. These gardens are important parts of urban ecosystems. But the evaluation of these greens is not yet enough.

Estimation of the green and the application of techniques to restore the deteriorated green and ecosystem in urban areasare inseparable. Through the elaborate city planning these can be consistent. However when we consider about the ecologically superior urban green retaining the high biodiversity, thorough monitoring activity and persistent efforts to develop techniques are required.

Conclusion

Many citizens understand the importance of green and ecosystem with high biodiversity. However, conversely, we can't accept the wild animals and insects especially like mosquito, cockroach because they are not our pets in spite that they are also the member of ecosystems. Especially in tropical areas there are many harmful organisms. We also need to consider the steps to coexist with them using developing techniques.

At all urban areas in the world we can find the superior nature even in urban areas and we have nature-friendly techniques to solve the problems. We should not forget the respect for relationship with nature in the urban areas.

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Towards a Global Research Agenda on Urban Biodiversity, Ecosystem Services and Design

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1 The Urban Challenge

We have now entered the urban age. Over half of humanity lives in towns and cities and by 2050 almost 3 billion additional people will inhabit the world's cities.In all of human history the world will have undergone the largest and fastest period of urban expansion. Consequently, urban growth will impact the provision of many ecosystem services and the benefits humans derive from nature, and the demands of cities will reshape most rural landscapes in the coming decadesWithout adequate consideration of the coming urbanization, many of the goals of the Convention on Biological Diversity, as well as the Millennium Development Goals for providing clean water for consumption and sanitation and the UNFCC goals for mitigating and adapting to climate change, are unlikely to be met. A sustainable urbanization will be necessary for achieving goals of a more sustainable planet.

2 The consideration within the Convention on Biological Diversity

Until 2007 the opportunities cities and other local authorities offer in terms of implementation of the Convention on Biological Diversity (CBD)had received little consideration within the CBD.No thematic program, mayor group and cross cutting issues focused on this topic. In March of that year, howeverrepresentatives of host cities of CBD meetings and other cities showing leadership on biodiversity issues, met in Curitiba (Brazil) to lay the foundation for a "Global Partnership on Local and Subnational Action for Biodiversity".

At the 9thmeeting of the Parties to the CBD (COP 9)in Bonn(Germany) in May 2008, the Parties discussed the role of Local Authorities in the implementation of the Convention and, for the first time ever and adopted a decision on cities and biodiversity (Decision IX/28). This decision encourages the 194 Parties to the Convention to recognize the role of cities in national strategies and plans, and invites Parties to support and assist cities and other local authorities in implementing the Convention at local level.This event emerged in the establishmentof the Mayor Group "Local Authorities" within theCBDs programs.

At the 10th meeting of the Parties in October 2010 in Nagoya, Japan (COP 10) wherethe "Strategic PlanBiodiversity for Biodiversity 2011 – 2020" with the "Biodiversity Aichi Targets" (Decision X 2) were adopted the "Plan of Action on Subnational Governments, Cities and Other Local Authorities for Biodiversity 2011- 2020" (Decision X/22) was decided.The "Plan of Action" laid out options for national governments and their partners in supporting and promoting the subnational implementation of the Aichi Targets.

At the 12thmeeting of the Parties (COP 12) in October 2012 in Hyderabad, India "The Plan of Action" Decision X/22 was complemented with additional considerations (Decision XI/8). The Parties wereencouraged to develop with their local and subnational governments strategies and plans to implement the "Aichi Targets" at all levels.

3 The "Global Partnership on Local and Subnational Action for Biodiversity"

The journey towards a consideration of local authorities within the CBD and the foundation of the "Global Partnership on Local and Subnational Action for Biodiversity" (former "Global Partnership on Cities and Biodiversity") started in early 2006 at the General Assembly of ICLEI (International Council for Local Environmental Initiatives) in Cape Town, South Africa. Here more than 300 local authorities' member to ICLEI called for the establishment of a pilot project on Local Action for Biodiversity (LAB) where 21 cities

representing 52 million people have worked together with ICLEI and IUCN's Countdown 2010 initiative. At the initiative of the mayor of Curitiba (Brazil)and the Secretariat of the CBD, a meeting was held in Curitiba, on 26-27 March 2007. Over 34 mayors and representatives attended, and participants adopted the Curitiba Declaration on Cities and Biodiversity. The Declaration reaffirms the mayor's commitment to contribute actively to the implementation of the three objectives of the CBD and to the achievement of the 2010 biodiversity target. A task force was established with the Secretariat of the CBD, ICLEI, IUCN,UN-and Scientific organizations and the mayors of Curitiba, Bonn, Nagoya, Montreal and Singapore.

"The Global Partnership on Local and Subnational Action for Biodiversity" was launched during COP 9 in 2008 with the goal of bringing together all the relevant networks and initiatives involved, in implementing the Convention on Biological Diversity. Today it includes UN Agencies (UNESCCO, UNEP, UN-Habitat), international NGOs (ICLEI, IUCN), selected Parties and Scientific networks (Stockholm Resilience Centre, URBIO Urban Biodiversity &Design, WRF The World Resources Forum, Nature of Cities blog) and City governments (represented by the Advisory Committee on Cities) and Subnational governments (represented by the Advisory Committee on Subnational Governments).

http://www.cbd.int/en/subnational/partners-and-initiatives/global-partnership

Since 2008 each of the COP meetings has been complemented by parallel meetings of the "Global Partnership". URBIO organized scientific conferences prior the COP meetings and ICLEIorganized "Biodiversity Summits for Cities and Subnational Governments". At COP 10 and COP 11 these were the largest and arguably most high-profile events in parallel with the COP, attended by governors, ministers and the Executive Secretary of the CBD and helping to raise the profile of subnational implementation of the Convention.

4. Partners and instruments

In order to support local authorities the partners within the "Global Partnership" have developed several initiatives and instruments. Prominent examples are in chronological order:

4.1 ICLEI and IUCN program "Local Action for Biodiversity" (LAB)

This flagship biodiversity program is coordinated in partnership between ICLEI and IUCN. LAB's approach is action oriented and customized for local and regional authorities and their partners around the world, with the goal of improving biodiversity management at the local level. LAB is a key component of, and contributor to, the CBD's "Global Partnership on Local and Sub-national Action for Biodiversity". The program began in 2006 with a select group of 21 pioneering local and regional authorities from around the world, representing 54 million citizens. The initiative has since expanded to include many more cities and has branched into thematic streams, including LAB Pioneers, Climate Change and Biodiversity and Biodiversity and CEPA. The program focuses on implementation, and is comprised of a three-year, five-step peer learning process, a local biodiversity and ecosystem services assessment report, workshops, forums, a knowledge bank, networks and various strategic projects that address specific local and national needs. In 2010 emerged the manual "Local Action for Biodiversity Guidebook" (2010), documenting cities contributions to biodiversity conservation with guidelines for replication.

Since the foundation of the "Global Partnership", the driving force of the Major group "Local authorities" is ICLEIs Cities Biodiversity center and its"Biodiversity Summit for cities and subnational governments" organized on the COP meetings.

http://www.cbd.int/en/subnational/partners-and-initiatives/iclei

ICLEI (ed.) 2013: Local Biodiversity Strategy and Action Plan Guidelines: Biodiversity and Municipal Planning

Laros MT and Jones FE (Eds) 2010: ICLEI – Local Governments for Sustainability Local Action for Biodiversity Guidebook: Biodiversity Management for Local Governments.

4.2 URBIO platform and scientific conferences

URBIO is an open worldwide scientific network for education and research, which was founded during COP 9 with the aim to promote the work of the "Global Partnership".

Already in 2005 scientistsof the European "Competence Network Urban Ecology" requested to raise the implementation of the CBD in urban areas and to support this by an International conference during COP 9 in Germany. This was the foundation of the international scientific network URBIO.Its aimsareto foster scientific research related to urban biodiversity, ecosystem services and sustainable landscape design and the exchange with the other partners of the Global Partnership". As clearing mechanism a website is hold and a newsletter is distributed. Prior to the COP meetings scientific conferences are hold as side events and thematic workshops. The coordinating work of the headquarters in Erfurt (Germany) has been funded by the German Government from 2007 - 2014. The following thematic conferences were organized by URBIO:

Urban biodiversity and design – implementing the CBD in towns and cities (Germany2008)

Urban biodiversity in the ecological network (Japan2010)

Urban biodiversity and climate change – adaptation and mitigation (India 2012)

Cities and water – conservation, restoration and biodiversity(Korea 2014)

http://www.cbd.int/en/subnational/partners-and-initiatives/urbio

http://www.fh-erfurt.de/urbio

4.3 The "Singapore Index"

In 2008 - during COP 9 - Singapore proposed the development of the city biodiversity index – a self-assessment tool to evaluate biodiversity conservation efforts of cities. Within expert workshops of the Global Partnership a set of 23 indicators were developed and presented as "Singapore Index" during COP 10.

Until today over 60Cities have applied the Singapore Index as diagnostic and decision-making tool.

http://www.cbd.int/en/subnational/partners-and-initiatives/city-biodiversity-index

4.4 TEEB – "The Economics of Ecosystems and Biodiversity for Local and Regional Policy Makers"

The Economics of Ecosystems and Biodiversity(TEEB) is a global initiative focused on drawing attention to the economic benefits of biodiversity. Its objective is to highlight the growing cost of biodiversity loss and ecosystem degradation. TEEB presents an approach that can help decision-makers recognize, demonstrate and capture the values of ecosystems &biodiversity, including how to incorporate these values into decision-making. In 2010 a 200 page sourcebook "The Economics of Ecosystems and Biodiversity for Local and Regional Policy Makers" were published to support subnational and local authorities especially (TEEB 2010).

TEEB 2010: A Quick Guide to the Economics of Ecosystems and Biodiversity for Local and Regional Policy Makers 8 p.

4.5The "Cities and Biodiversity Outlook"

The "Cities and Biodiversity Outlook" (CBO) is a global assessment of the links between urbanization, biodiversity and ecosystem services prepared under leadership of the Secretary of the CBD and the Stockholm Resilience Centre and with contributions of over almost 200 scientists and practitioners.

Part I of the CBO – "Action and Policy" - provides the summary of the assessment drawing on contributions from more than 120 scientists and policy-makers from around the world. It presents 10 key messages for strengthening conservation and sustainable use of natural resources in an urban context and was launched during COP 11 in Hyderabad (2012).

http://www.cbd.int/en/subnational/partners-and-initiatives/cbo

Part II of the CBO – "Urbanization, Biodiversity, and Ecosystems – Challenges and Opportunities" is a more detailed scientific analysis and assessment of the links between urbanization, biodiversity and ecosystem services and was published in 2013. Besides 15 principle papers it provides 18 regional and local case study assessments (Elmqvist et al 2013).

Elmqvist, T. et al. (eds.) Urbanization, Biodiversity and Ecosystem Services: Challenges and Opportunities: A Global Assessment. Springer, New York open access

4.6 The "Nature of Cities" Forum

The "Nature of Cities" is a virtual magazine and discussion site on cities as ecosystems since 2012 on the web. It is a global collective of contributors, an essay and discussion site devoted to cities as social-ecological spaces, ecosystems of people, buildings, open spaces, and nature. City design with nature at the center is key

to urban resilience, sustainability, and livability.

http://www.thenatureofcities.com

4.7 Further partners and activities

UN-HABITAT and the CBD Secretariat worked together to develop in 2010the manual:

Supporting Local Action for Biodiversity: The Role of National Governments

http://www.cbd.int/en/subnational/partners-and-initiatives/un-habitat

The Network of Regional Governments for Sustainable Development (nrg4SD) is a non-profit international organization representing subnational governments and associations of subnational governments at global level.

http://www.cbd.int/en/subnational/partners-and-initiatives/nrg4sd

5 Global Research Agenda on Urban Biodiversity, Ecosystem Services and Design

Subsequently, in following up of the abovestatedwork of the "Global Partnership"the Scientific Network URBIO was invited by the SCBD to determine the necessary scientific fields and skills most needed by local governments to implement the "Plan of Action". This "Research Agenda on Urban Biodiversity, Ecosystem Services and Design" should be based on existing studies on urban biodiversity and the needs of local governments.An initiating workshop was organized at the URBIO Headquarters in Erfurt in July 2013 together with ICLEI and the SCBD.Here representatives from URBIO, ICLEI , the SCBD and contributors to the CBO attended and drafted a first roadmap. The driving questions of the workshop were:

- What information do decision makers &managers in governments and other sectors need to support biodiversity, expand ecosystem services &apply ecologically-sophisticated design?
- What knowledge is currently available in the cities &what are critical knowledge gaps?
- How can basic research support the specific need of cities?
- How can we communicate knowledge to decision-makers?
- What should next steps be to develop this agenda?

Following up this event an online survey was held to determine the most urgent research questions from the view of the URBIO community.

In twosubsequent sessions of the URBIO 2014 conference the dialogue between city representatives and researchers will continue and closed by panel discussion with the audience.

Withthe Incheon URBIO2014 Declaration the progress of the "Research Agenda" will be brought tothe "Biodiversity Summit for cities and subnational governments" a COP 12 in Pyeongchang.

6 Outlook

The "Global Research Agenda on Urban Biodiversity, Ecosystem Services and Design"is a further instrument within the "Global Partnership" to support local authorities. To face the urban challenge a better understanding what local authorities need, will be important for researcher as well as to produce applied research which can be implemented immediately will be essential for practitioners. Therefore collaborative forms of research (e. g. Ives &Lunch 2014) and new communication platforms like the "Cities of nature" forumwill be good toolswithin this instrument.

http://www.thenatureofcities.com/

Ives Ch., & Lynch Y. 2014: Untapping the Potential of Science-Government Partnerships to Benefit Urban Nature. Nature of Cities Blog http://www.thenatureofcities.com Posted on August 31, 2014

October 11

Oral presentation

14:00–15:30

11–OR1.3(Rm.306)

11–OR2.3(Rm.202)

11–OR3.4(Rm.101)

11–OR4.3(Rm.102)

11-OR1.3-01

Woody Species Composition of Gardens, Hedges and Parks in Tottori Prefecture, Japan

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1. Introduction

Gardens,hedges and parksare familiar and important elements of living environment. Trees and shrubs in these places have been made urban and rural landscapes. However, for the last few decades, various kinds of introduced woody species have been planted due to easy maintenance and/or ornamental beauty. Introduced species may be harmful to ecosystem and landscapethrough ecological mechanism such as introgressive hybridization and niche occupation as well as tree scape replacement. In this study, the authors surveyed planted woody species of gardens, hedges and small parks in Tottori Prefecture, Japan in order to clarify species composition of such places.

2. Methods and Materials

93 block parks, hedges of 19 residential areas and 94 privately own gardens of two towns were selected as sample area, and all woody species were identified and number/amountof each specieswere recorded.

3. Results and Discussion

Species compositions of woody plants are shown on the table 1.In the block parks, very low ratios of native species are used, while high ratios of natives arenaturally grown in shrines. Also, in the new towns, small number and low ratio of native species were planted. This tendency is almost same as in rural areas. Approximately, half of hedge's lengths were natives in the old hedges; however, more than 85% were nonnativesin the new hedges. Biodiversity oriented revegetation must be promoted to conserve/rebuild original landscape.

Table1 Species Composition of Woody Species in Tottori Prefecture, Japan

		Native		Non Native		Total Number
		Number/Length	Ratio	Number/Length	Ratio	
Parks	Block Parks	1332	18.1%	6007	81.9%	7339
	Shrains	830	74.3%	287	25.7%	1117
Gardens	Tsunoi NT	324	25.6%	941	74.4%	1265
	Nichinan Town＊	872	27.3%	2320	72.7%	3192
Hedges (Length:m)	After 1960	584	14.1%	3559	85.9%	4143
	Before 1960	2804	48.7%	2953	51.3%	5757

＊Nicinan town is located in mountainous rural area

11-OR1.3-02

A MULTI-SCALE ANALYSIS OF RESOURCE SELECTION BY AN ANCIENT TAXON (ONYCOPHORA) IN A MODERN URBAN LANDSCAPE

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Invertebrates are a neglected but important component of urban ecosystems. Although cities are a heterogeneous landscape most studies of urban invertebrates focus on specific habitat fragment types. We modeled resource selection of an undescribed species of Onychophora - the Dunedin peripatus - at micro-and macro-scales within selected parks and habitat fragments using resource selection probability functions (RSPF), and using maximum entropy (Maxent) models at the landscape-scale, across an urban gradient in the city of Dunedin, New Zealand. We aimed to identify habitat variables that influence the presence of the species in a modified urban environment, to assist in management strategies focused on conserving Onychophora as a phylum. We identified twelve relevant environmental variables within habitat fragments and the surrounding urban matrix. The Dunedin peripatus was positively associated with shaded, moist sites with an abundance of large decayed cover objects, including living native tree fuchsia (*Fuchsia excorticata*) and downed woody material. Dunedin peripatus persisted in fragments dominated by exotic vegetation and a history of disturbance, including urban gardens and forest plantations. Our results highlight the importance of studying habitat use at multiple scales within urban areas for biodiversity conservation proposes, even for relatively sessile invertebrates such as onychophorans. We also demonstrate the need for researching and conserving Onychophora populations in terrain that is traditionally discounted as being inhospitable due to disturbance.

11-OR1.3-03

Key factors in reaching the "tūī tipping point" in Hamilton City, New Zealand

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New Zealand's 20 largest urban centres vary considerably in their indigenous biodiversity resource (e.g. <1% to 9% native vegetation cover), and their approach to protecting and enhancing it. Focusing restoration efforts on well-known, charismatic species can gather support and build momentum that benefits both the target species and many interconnected aspects of biodiversity. In Hamilton City, the focal species has been tūī (*Prosthemadera novaeseelandiae*). In an uncontrolled and uncoordinated experiment, different Waikato agencies, institutions and community groups have been working directly, or indirectly to restore urban tūī populations. The vision to return tūī was formalised in 1989 with the establishment of the community group Tui 2000 Inc. Gully habitat enhancement had begun as early as the 1960s with the pioneering work of Dr A.J. Seeley and was followed by the Gully Restoration Programme (established 2000) and pest animal control by Hamilton City Council. These efforts were complemented by many small-scale private restoration projects and as habitat expanded and improved, and pest numbers reduced, the scene was set for Hamilton City to reach the "tūī tipping point". This milestone was achieved around 2010 after the Hamilton Halo programme (established 2007) undertook intensive pest control in 2,000 hectares of forest patches within a 20 km radius of the City. A dramatic increase in Hamilton tūī sightings has since been reported in 5-minute bird counts (mean abundance increased 16 fold from 2004 - 2012) and very widely throughout social and traditional media. These are significant achievements but questions remain as to the relative importance of different initiatives and whether tūī could have been brought back sooner. Coordinated approaches which span urban and periurban zones are likely to give the best results for bringing nature back into New Zealand cities similar to Hamilton.

11-OR1.3-04

COMPARISON OF THE AVIFAUNA ON URBAN FORESTS, PARKS, AND CITY CENTERS, THE CITY OF SEOUL, KOREA

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It is well known that bird diversity increases with increasing green patch size in urban environment (Island biogeography theory). However, the theory does not consider different type of habitats among green patches such as forests and parks. For example, urban parks play an important role in urban biodiversity conservation (Cornelis and Hermy 2004). However, species composition can be different in urban forests and parks (Gavareski 1976). We here aimed to compare environment and avifauna characteristics among 3 habitat types (forests, parks, and city centers) in the city of Seoul, Korea.

Vegetation structure and birds were surveyed at 22 points each in forests, parks, and city centers during Jun-Nov 2013. Vegetation cover of ground, 0-2m, 2-5m, 5-10m, and over 10m height were measured and trees were counted within 10m of each point center. Birds were counted for 5 minutes within a 50m radius of each point. One-way ANOVA were employed to analyze number of species, species diversity, and abundance among 3 habitat types.

There are significant differences in vegetation structure among 3 habitat types. Vegetation cover was highest in forests, followed by parks and city centers. The number of trees was 3 times higher in forests than parks and city centers. Total 35, 37, and 18 bird species (non-waterbirds) were recorded at forests, parks, and city centers each. Average numbers of species were similar between forests and parks with lower value of city centers. Species diversity was highest in forests. Bird abundance was highest in parks; but similar to forests when abundances of common urban dwellers (*Columba livia*, *Passer montanus*, and *Pica pica*) were not included for analysis. Number of species, species diversity, and abundances of city centers were lowest. The abundances of *C. livia* and *P. montanus* which feed on artificial foods were higher in city centers than other two habitats. In urban parks, more open canopy birds were found than in urban forests and city centers such as *Streptopelia orientalis*, *Phoenicurus auroreus*, *Paradoxomis webbianus*, and *P. pica*. Forest preferring species are 3 primary cavity nesters (*Dendrocopos kizuki*, *D. major* and *Sitta europaea*), 3 secondary cavity nesters (*Parus varius*, *P. major*, and *P. ater*) and other 3 birds (*Cuculus* canorus, *Hypsipetes amaurotis*, and *Garrulus glandarius*).

We could find that urban parks support high diversity of avian fauna, but different bird composition comparing to urban forests. More open canopy preferring birds and less cavity nesters occupied urban parks than urban forests. To improve bird diversity in urban ecosystem, following managements are required. (1) Conserving urban forests, (2) more tree planting in urban parks and city centers with diverse foliage layers, and (3) nest box supply in urban parks and city centers for nesting resources of cavity nesters.

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11-OR1.3-05

THE MOST DISTRIBUTED URBAN PLANTS IN THE WORLD - WHAT DO THEY SAY US?

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The working group "Urban Biota" gathered and analyzed data lists of plant species from more than 100 cities of the world (Aronson et al. 2014). As one result of its work the group produced a list of the top hundred plant species, which have been found in cities around the world. In some other publications, the most frequently plant species in urban areas were identified for several cities, especially in Europe (e. g. Kelcey & Müller 2011). Both data bases give us an impression, which are the most distributed urban plants species on the earth.

Using the data bank Floraweb (Federal Agency for Nature Conservation, Germany) and an own databank of the ecological features of plant species, which was built up to save data of urban biotope mappings in Germany, I analyzed and started to characterize the traits of these most distributed urban plants. In my presentation I will show some results of my investigations. At last I will summarize the results and finish with the answer of the question "What do the most distributed urban plants say us".

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11-OR2.3-01

INVASTIGATING LOCAL ECOSYSTEM: AN APPROACH FOR THE GENERAL PUBLIC

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A planning project which takes biodiversity into account requires indicators of ecosystems, such as conditions of species or formations of landscape structures. Planning based on biodiversity is not easy for the general public unless there is clear operational guideline. Birds are popular ecological indicators for they are easier to sample and observe (Canterbury et al. 2000; O'Connell et al. 2000), and their distributions are associated with habitat structures (Askins and Philbrick 1987; O'Connell et al. 2000). This study is aiming to develop a suitable planning scale for biodiversity using birds and landscape structures as indicators, and the results may assist general public to make planning decision in the future. To achieve this, the current study examined the relation between bird biodiversity and landscape structure at different spatial scales.

This study measured three indices of bird biodiversity, species richness (SR), species capita (SC, i.e. the total number of each species) and species diversity (Shannon-Wiener, H'). In addition, this study measured two landscape structure metrics of each land cover type employed in this study: the number of patches (NP) and area percentage of landscape (PLAND). Since people need to find out a suitable scale to observe bird communities, this study adopted 4 extents (100 m, 130 m, 165 m and 200 m) and 4 grain sizes (0.5 m, 5 m, 10 m, 30 m) as analyzing scales to examine the relationship between landscape structure and bird biodiversity.

In our sampling sites, 3 effective scales, with 100 m extent/10 m grain size, 165 m extent/5 m grain size, and 200 m extent/10 m grain size were used to describe bird biodiversity. Among them, the optimum spatial scale was 100 m extent/10 m grain size. This finding somehow represented the general features of local bird communities and their reaction to landscape structure. Furthermore, The negative correlation between B_PLAND and bird H' agreed with previous research findings regarding the impact of rural buildings (McKenzie et al. 2011), whereas the positive correlation between B_PLAND and bird SC was associated with the potential benefits of human settlement, such as tolerance to human disturbance (Fernández-Juricic et al. 2001). The results not only successfully pointed out important ecological features but also provided an ideal spatial scale for future biodiversity planning. Responding to our research question, the guideline we developed provided an operational and useful tool-oriented model for public participation in biodiversity planning.

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11-OR2.3-02

THE BIODIVERSITY BENEFIT OF URBAN GREEN SPACES: A CASE STUDY FROM MELBOURNE, AUSTRALIA

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Urban green spaces contain large areas of vegetation within cities and subsequently can make a big difference to the retention of urban biodiversity. These green spaces are important to people for a range of social and ecological reasons. Infill development of existing suburbs and increasing urban sprawl is putting pressure on large green spaces in particular, such as urban golf courses, which are increasingly being sold off and replaced by residential and commercial development. Managed green spaces in urban areas may offer suitable habitat for fauna including a range of invertebrates, native birds and insectivorous bats, however, the value of this habitat may change according to the management strategy and site attributes of those green spaces. To understand how fauna diversity changes with urban green space type, we collected data on birds and insectivorous bats from 39 green space sites in south-east Melbourne, Australia. Sites were stratified by type (golf course, urban park and residential garden) and time since establishment. Plots within golf courses were stratified by plant structural complexity and management intensity. These urban green spaces supported a diverse bird and bat community, as we recorded up to 106 species of birds and 14 species of bats. Bird and bat species richness was strongly influenced by vegetation management and the presence of key attributes, such as large trees for nesting and patches of dense understory up to 0.5m in height. Our study suggests that golf courses are providing huge biodiversity benefits in comparison to nearby urban parks and the matrix of residential gardens, and that simple interventions such as reduced mowing height and frequency can have a large positive impact on the value of these green spaces for biodiversity. The study provides private and public green space managers with a detailed understanding of the biodiversity values they can influence through simple vegetation management decisions. The study also makes recommendations for how to restore biodiversity habitat in the urban landscape, not only in large spaces like golf courses and urban parks, but also within residential suburbs. Large urban green spaces can be mutually managed for amenity, recreation and biodiversity conservation if strategic decisions and priorities are considered.

11-OR2.3-03

IS GREEN SIMPLY ENOUGH? COMPLEX ECOSYSTEMS V.S. GOLFCOURSES: A DESIGN BATTLE

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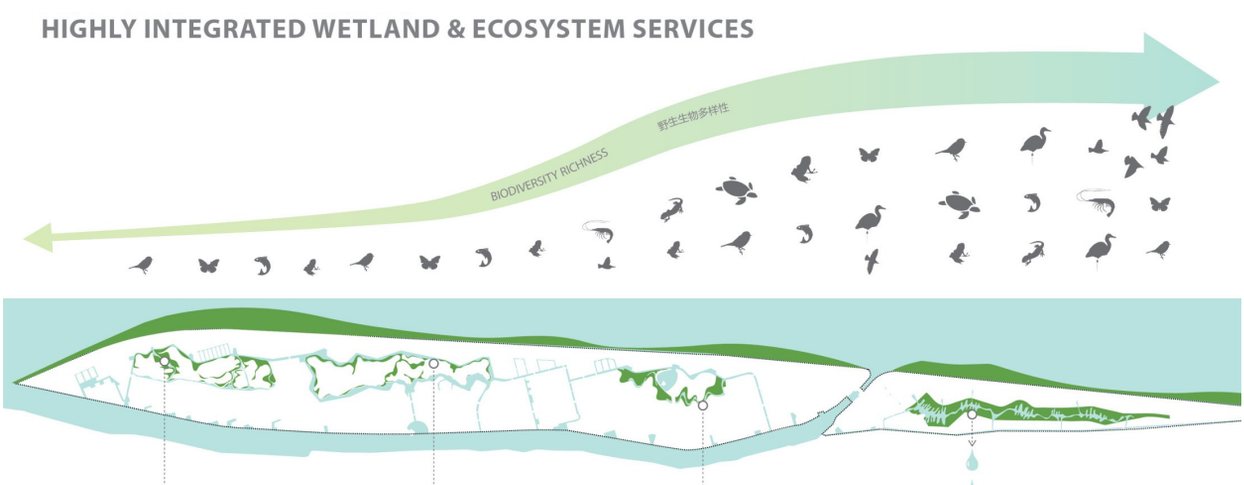
How green is green enough? Shall green always be assumed ecological? In the landscape planning and design fields, the lack of deep ecological understanding is often manifested by the tendency to equal all green open spaces to wildlife habitats, especially in the urban areas. Often solely human activities oriented recreational outdoor space is regarded as the ultimate form of nature in the city. However, if urban biodiversity and sustainable environment is the goal for landscape planning, designers need to undertake the responsibility of applying many shades of greens in these novel ecosystems in dense urban environment. These shades of greens represent the heterogeneous composition and patterns in the landscape, as well as the underlying processes and functions of the complex ecosystems.

This article will illustrate the challenges of the landscape planning and design in creating functional ecosystems in urban areas with a case in Shanghai. In the given government control plan for a new urban district, the major open spaces are designated to golf courses. Sasaki Associates, an interdisciplinary planning firm who was invited to conduct urban design and landscape planning for the city, fought the misconception of golf course is green enough for the city. The proposed large civic parks and a wetland park as alternatives supported by empirical data and case studies convinced the mayor to change the golf course to multi-functional public spaces. These parks not only offer rich recreational programs to more diverse users but also provide substantial wildlife habitats that have degraded in the Lower Yangtz River Delta.



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PLANNING THE FIRST ECOLOGICAL WATERFRONT CITY INNOVATED BY BLUE AND GREEN NETWORK: THE CASE OF BUSAN ECO DELTA CITY IN SOUTH KOREA

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Waterfronts have begun tobe revisited by urban researchers, practitionersand developers during the last two decades because they were considered to be valuable urban assetsfor vitalising urban areas and significant natural assets for ecological benefits. At present, waterfront developments hasbecome a world-wide phenomenon, trying to maximise water's economic, socio-cultural, and environmental potential. First of all, waterfronts have been recognised as not only an important 21st century quality human settlements because of their wide open natural settings, but also as significant ecological benefit to the public. Despite benchmarking on the successful waterfront development experiences in Europe and North America, water-oriented waterfront developments in South Korea is only now beginning to be incorporated intourban planning and management. In particular, integrating water and waterways' ecological potential into a city is facing a great challenge among researchers, practitioners and developers. Busan Eco Delta City, an area of around 12 million square meters, is at the heart of the challenge. It is located atNakdongDelta andis a pioneer model to demonstrate utilisation of water's ecological potential in the waterfront city making process, especially using blue and green network. It is now undergoing its planning process from a clean slate. Busan Eco Delta City is planning a 33 miles blue and green network in land use and spatial planning process. This ecological network is combined with a Low Impact Development (LID) to minimise water-related environmental problems.It is valuable to look at how Korea's the first waterfront city forms eco-friendly human settlements in the early stage in terms of urban planning and design process using water's ecological potential.

11-OR2.3-05

ENHANCEMENT OF URBAN ECOSYSTEM SERVICES USING GREEN ROOF AND RAIN GARDEN

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The number of green roofs has been increasing in Japan, especially extensive green roofs for cooling buildings in mid-summer. However, it is often argued that the plants on extensive roofs hardly play a role to contribute to cooling, because of depending on evaporation directly from the soil surface. Although several experiments for substantiating the phenomenon has been implemented so far, comparative experiment of such strategy for converting the theory into residential environment at human scale has never progressed. This study aims to monitor how indoor thermal environment is affected by irrigated-soil-covered-roof by means of real residential models.

Firstly, as the preparatory experiment, we set up five miniature green roofs, 500*500 mm. Each of them was under experimental conditions as follows; A1 [irrigated-soil & Plantain], A2 [irrigated-soil & Sedum], A3 [irrigated-soil & Lawn], A4 [irrigated-soil], A5 [bare]. Inside temperatures of Styrofoam boxes, 150 *250*150 mm, under each roof were monitored. Secondly, as the main experiment, contributions of irrigated-soil-covered-roof, sunlight-reflection-roof and green wall by Loofah for cooling inside a building were assessed by means of six Green Cubes, 2500*2500*2500 mm. Each of the cubes was under experimental conditions as follows; Cube 1 [irrigated-soil-covered-roof & green-wall], Cube 2 [untreated-roof & green-wall], Cube 3 [sunlight-reflection-roof & untreated-wall], Cube 4 [sunlight-reflection-roof & green-wall], Cube 5 [untreated-roof & untreated-wall], Cube 6 [irrigated-soil-covered-roof & untreated-wall]. Inside temperatures of cubes were monitored.

As a result, to cover roofs with irrigated-soil may be the most beneficial way because of lower cost for installing and maintenance than any green roofs, with only slightly lower performance. Next, it was shown that green wall was in first place, followed by irrigated-soil and sunlight reflection, in order of effective approach for achieving a desirable indoor thermal environment, in terms of metric for inside temperature. Besides, in case of combining treated roof and walls, the effect of cooling potential was naturally higher. Thus, it can be seen that irrigated-soil-covered-roof plays a role to cooling inside temperature.

In addition, regarding the design for surface of irrigated-soil-covered-roof for urban biodiversity, brown/biodiverse roof in the UK would be informative. Firstly, from valuable vegetated areas, the top 150 mm of substrate must be carefully removed and appropriately stored so that some of the existing vegetation, seed bank and soil organisms can be conserved and saved (if suitable) for subsequent use on extensive roofs; for example, white and biting stonecrops have some of the most spectacular flowering displays and are very attractive to bees, butterflies and other insects. Secondly, small logs laid across the substrate will not only provide shelter for insects but also create nesting sites for many small bees and wasps that burrow into dead timber. Thirdly, designing brown/biodiverse roofs so that they have varying substrate depths and drainage regimes creates a mosaic of microhabitats on and below the soil surface and can facilitate colonisation by a more diverse flora and fauna. Furthermore, it should be noted that rain garden is quite important for enhancement of urban ecosystem services in addition to green roof. It can be predicted that it will be important to pay attention to brownfield in the near future, in countries facing severe population decline, especially Japan and Republic of Korea, where there is a possibility that brownfields will increase. Brownfields will be suited for rain garden.

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Integrating Biodiversity Conservation and Sustainable Development：Perspectives and Way Ahead by

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Abstract

Biodiversity has strained an unusually extensive concentration since of the realization that it is fade away. The integer of living species on top of earth is conventional between 5-90 million, of which just 1.5 million have been described, by means of highest attention in tropical regions and 25% of the biodiversity is next to extinction through the next 25-35 years owing to environment loss, fragmentation or alteration, over - exploitation of living resources, etc. According to Environmental Protection Agency (EPA), habitat destruction, biodiversity loss, stratospheric ozone reduction and global climate change comprise the comparatively high- risk trouble. Herbicides, pesticides and pollutants in exterior water, acid authentication and air borne toxics comprise the moderately intermediate risk problem. lubricate spills, groundwater pollution, radionuclides and thermal pollution be in the right place to low down risk problem. Owing to unprecedented population increase man has made uses and misuses of land resources, indefensible consumerism, increasing discharge of fritter away and pollutants, urbanization, international disagreement and inequities in giving out of prosperity and resources are at the moment being viewed in entirety to improve ecological problems as well as to make sure the prospect of existence on earth. Scientist declare 90% of the warmth attentive by greenhouse gasses has almost certainly been wrapped up in the oceans. The oceans have previously engrossed concerning 30% of the man made CO_2 resulting in the sea acidification. More than 85% of the world's ocean fisheries are completely exploited , over-exploited or used up, causing yearly worldwide capability losses of US dollar 50 billion. Mangroves in India explanation for concerning 5% of the world's mangrove plant life and are extend in excess of an area of 4,445 km^2 the length of the coastal States and union Territories of the country. An estimated 35% of comprehensive mangrove vicinity has been gone or converted, just about 20% of the planet's coral reefs have been shattered in the most recent few decades, by means of more than a additional 20% creature tainted, and 30% of sea grass beds encompass been shattered. The global approximation seeing that IUCN Red List , 2008 propose that 10% (5,966 species) of vertebrate and 0.20% (2,496 species) of invertebrate described fauna is threatened. According to IUCN Red List 2008, India has 246 worldwide threatened floral species, which make up just about 2.9% of the world's 8457 total figure of threatened floral species. The grassland ecosystems of India are threatened by habitat alterations due to unplanned agro-industrial developments and overgrazing through over 500 million livestocks of widespread species. In spite of these role, they have been for the most part unobserved in the procedure of growth and over-exploited by agro-pastoral practices. The Himalaya has been exaggerated by anthropogenic Grasslands are recognized to give a enormous collection of ecology services, hold up human livelihoods and harbour a integer activities, as well as developmental activities that are most important to modify in land use models. Poaching is one more threat predominantly intended for large mammals like Tigers Leopard and Rhinoceros, all along with indefensible taking away of valuable medicinal herbs. There are now, over 100,000 protected areas worldwide, covering in excess of 12% of earth's land exterior. These areas stand for one of the nearly all noteworthy human resource make use of allocations on earth. Sustainable use is based on a social, economic or natural standpoint, used by organization and persons concerned by means of the relationships flanked by humans and the worldwide ecological. People have to be vigorous in all aspects of sustainability including the significant vicinity of sustainable edifice. We must therefore develop suitable strategies to save the biological resources not only for the present but also intended for the future generations. We require to confined our prospect by securing food, water and environmental safety.

Keywords：Biodiversity conservation, Threat, Protected Area, Habitat destruction, Sustainable Use

11-OR3.4-01

A RESEARCH AGENDA FOR URBAN BIODIVERSITY

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This session will continue the dialogue on a research agenda on urban biodiversity, and build on the keynote "Towards a global Research Agenda on Urban Biodiversity, Ecosystem Services and Design". In 2013 scientists of the network URBIO, representatives of local authorities, NGOs and the SCBD met in Erfurt (Germany) to discuss how to develop a research agenda for local authorities. In this session we will continue this dialogue and discuss ideas in three areas. (1) What information do local governments really need to manage biodiversity and urban ecosystems? (2) In what specific areas do we lack key knowledge? (3) How can scientists, practitioners and decision makers interact more effectively? Key results are that while there is substantial global knowledge about urban biodiversity, information is lacking is some key areas (especially evidence-based design and the communication of knowledge to the public) and data are wildly variable across cities － some cities are data rich, while many others data poor. Dialog between scientists and city managers has not always been productive and needs more support, and an infusion of new ideas for effective collaboration in conservation, ecosystem services, and ecologically sophisticated design. The session is concluded by a panel discussion.

11-OR3.4-02

PIONEERING NATURE-BASED SOLUTIONS FOR CITIES

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Nature offers great untapped potential for improving the quality of life of urban citizens and finding cost-effective solutions for urban challenges. Protecting nature in and around cities can help secure resources for the future and turn our current economic challenges into opportunities to achieve sustainable development. Biodiversity and ecosystems provide numerous services to urban citizens, such as clean air, water filtration, flood prevention, noise reduction, food, water and energy supply, recreation, as well as climate change mitigation and adaptation and improved health.

There are strong incentives for cities and local governments to develop innovative ways to integrate natural capital in policies and planning and to maintain vital ecosystem services for the enhancement of the well-being of their citizens. Investing in nature can play an important role in making our economies and societies more resilient by enhancing quality of life, saving money, strengthening the local economy and reducing the impacts of climate change.

IUCN is committed to mobilise the expertise of its network and exchange best practices to help cities, local and regional authorities develop natural solutions for the challenges they are facing and to strengthen the integration of nature's values in urban planning, management and decision-making. Better knowledge on the benefits of biodiversity and ecosystem services for urban development, and an improved dialogue between the scientific community and city representatives, can support cities to contribute to the international and European biodiversity targets.

Nature-based solutions (NBS) are solutions using ecosystems (through conservation and restoration) to address global challenges such as climate change, natural disasters, food, energy and water scarcity, or pollution. IUCN has introduced NBS in 2007 during the international climate negotiation process, where forests were proposed as a partial solution to climate change mitigation and since 2012, they are an integral part of IUCNs global programme of work.

To make optimal use of nature-based solutions, it is important to improve our understanding of the links between biodiversity, the condition of the ecosystem and its capacity to deliver ecosystem services. Also essential is a landscape approach to conserve and restore the connectivity between natural areas within cities and those in peri-urban and rural areas, which can contribute to enhance the multiple goods and services that green areas provide to society.

Governments would benefit from the establishment of a mechanism for exchange of knowledge, examples of projects, initiatives and experiences from across the world that support the protection and enhancement of biodiversity and restoration of the functions of ecosystems at local and regional level. This will serve as inspiration and guidance for duplication of successful ideas to protect biodiversity and restore ecosystems.

Identification and designation of those sites within and around urban areas that present the highest potential to deliver enhanced ecosystem services and their multiple benefits will help to optimize the return on investment for the economy and the society. Tools to audit and map the benefits of natural assets can support these efforts for achieving positive impact at the local level.

To achieve the maximum result, it is important that the values of nature based solutions are recognized and integrated spatial planning, policies, strategies and implementation. This requires engagement of all key stakeholders working towards sustainable urban development, such as urban planners, developers, landscape architects, politicians, land owners, business, scientists and civil society organisations and requires as well mobilizing financing.

11-OR3.4-03

WHAT BIODIVERSITY KNOWLEDGE DO CITIES NEED - EXPERIENCES FROM THE LOCAL ACTION FOR BIODIVERSITY (LAB) PROGRAMME

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One of the primary goals of ICLEI – Local Governments for Sustainability's global Cities Biodiversity Center (CBC) is to provide a platform to bridge the science-policy gap. ICLEI CBC aims to do this by improving communications between local government officials and urban biodiversity researchers. This bilateral communication includes understanding what biodiversity practitioners and decision-makers within local governments need to make effective biodiversity management decisions. On the other hand, this also involves making research accessible, through the presentation of applicable and tangible information that can easily be implemented in cities. The publication of ICLEI's *Local Action for Biodiversity Guidebook* built on the experience of local governments from around the world participating in the Local Action for Biodiversity (LAB) Programme, capturing lessons and case studies for innovative approaches to managing local biodiversity. The publication of a variety of other resources for local governments by ICLEI CBC and partners has translated scientific information and research into tangible guidance for local governments to utilize, such as, for examples, *Local Biodiversity Strategy and Action Plan Guidelines*, and *TEEB Manual for Cities*. This presentation will outline the kinds of biodiversity knowledge that cities need to strategically conserve and sustainably use biodiversity, based on experiences from the Local Action for Biodiversity (LAB) Programme.

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ECOLOGICAL KNOWLEDGE THAT CITIES NEED: THE VIEW FROM NEW YORK CITY

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New York City has a significant amount of green open space, extensive waterfronts, and a large parks system (the most urban parkland in the United States), with ample natural areas. New York lies at the confluence of several waterways that form one of the world's largest natural harbors. The city's population grew 2.1% from 2000 to 2010, and the population is expected to increase by another 10% to over 9 million residents. Much of NYC's urban core is already dense, so intensified urbanization (i.e., land conversion) will present a challenge to maintaining regional biodiversity and ecosystem services. New York's position on the border of two major eco-regions results in exceptional biodiversity. The range of habitats, from serpentine grasslands in Staten Island to vernal ponds in Alley Pond Park in Queens is an indication of this variety. There are 26 distinct habitat types in and 1450 species of plants are native to the 5 counties of NYC. Despite, or because of these biological assets, there are three major areas of knowledge that are needed in New York. First, we need better inventories of what biodiversity we have in New York, it's distribution among natural areas, and which elements are threatened. How can we management what we don't know exists?Second, we need better information on how people perceive the city's natural areas: how they value them and how they use them. Third, we need clear information on valuing natural resources so biodiversity and ecosystem services can be placed within political dialog about funding and resources.

11-OR3.4-05

BIOLOGICAL SURVEYS AND CONSERVATION ACTIVITIES IN COOPERATION WITH CITIZENS(ACTIVITIES OF THE NAGOYA BIODIVERSITY CONSERVATION ACTIVITY COUNCIL)

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The Nagoya Biodiversity Conservation Activity Council, which was founded on May 15, 2011, is an organization composed of citizens, experts and the government (City of Nagoya) with the aims of understanding the current status of biodiversity by continuous surveys of the flora and fauna in Nagoya as well as the environment, and conserving the immediate natural environment through control of non-native species. The members of the council include representatives of 35 citizen groups and university laboratories, as well as 22 individuals such as experts. The secretariat is established at the Nagoya Biodiversity Center.

The Nagoya Biodiversity Center was set up by the Environmental Affairs Bureau, City of Nagoya to inherit the achievements of the 10th Meeting of the Conference of the Parties to the Convention on Biological Diversity (COP 10), which was held in Nagoya in October 2010. Before COP 10, Nagoya did not have any nature-related museums or other bases for investigation, collection of samples, awareness-raising and enlightenment activities, and exchanges between citizen groups. Furthermore, it did not sufficiently encourage people to adopt a lifestyle supported by the power of nature or companies to perform activities in consideration of biodiversity. While the center has no permanent exhibition facilities, it serves as a base for municipal employees to conduct biodiversity related conservation activities (storage of samples, publication of bulletins and other research activities, awareness-raising and enlightenment activities, etc.) in Nagoya with advice from academic experts.

In the meantime, the council mainly performs the following initiatives as an active player in the biodiversity conservation activities in cooperation with citizens, experts and the government.

Main programs:

- Measures to control non-native species (raccoons, red-eared sliders, non-native fish, non-native water lilies, etc.)
- Biological surveys (investigation of shrine forests and storage reservoirs, establishment of an online database)
- Awareness-raising and enlightenment (citywide wildlife surveys, lectures and practical training mainly for elementary school students)
- Exchanges between citizen groups (executive committee meetings, regular meetings)
- Support of local activities

These activities are funded by grants from central and municipal governments and donations from companies and citizens, and basically performed by citizen volunteers.

Past achievements: In addition to the council members, 607 “citizen wildlife investigators” are currently registered in the council to engage in the survey activities. Hundreds of citizens also participate every time a citywide wildlife survey or an event to get rid of non-native species is organized.

Challenges to be addressed in the future: There are also a wide range of challenges, including aging of the leaders, systematic upskilling of citizen investigators, participation of the people of the next generation and their continuous involvement, fundraising in various ways and development of human resources to promote collection and arrangement of samples.

The UNESCO World Conference on Education for Sustainable Development (ESD) will be held in Nagoya in November of this year. Using this event as a trigger, the city plans to develop a new action plan for the promotion of environmental conservation activities and environmental education. We aim to develop the people who will play central roles in the conservation activities in the future, and at the same time, to promote biodiversity conservation activities that also involve citizens and companies.

11-OR3.4-06

ANALYZING URBAN RESILIENCE AND SUSTAINABILITY THROUGH A SOCIAL-TECHNOLOGICAL-ECOLOGICAL SYSTEM APPROACH. LESSONS FROM THE CITIES AND BIODIVERSITY OUTLOOK PROJECT.

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The Cities and Biodiversity Outlook project describes and analysesmultiple dimensions of urbanization, focusing on how the processes affect patterns ofbiodiversity and ecosystem services within as well as outside city boundaries. CBOisan assessment of the process of urbanization, rather than an assessment of cities per se. Further, it focuses on the biosphere and analyses how the living environment is impacted in a rapidly urbanizing world, and explores connections to human well-being and how an increasing urban population may succeed or fail to develop mechanisms for reconnecting with the biosphere.

The CBO project explored the social-ecological foundation of cities and their sustainability. A social-technological approach has, up until now, been a traditional way of analyzing urban complexity, and in this context many have struggled to define exactly what is meant by a city.

As high-lighted in the CBO the rapidly emerging framework of viewing cities as complex social-ecological systems puts the human dependence on the biosphere on the urban agenda. Although the social-technological and social-ecological approaches will continue to be important in the urban sustainability discourse, I will explore how an urban ecological-technological approach may be increasingly important in the future. This approach represents how living systems may be integrated in built systems and necessary to succeed in enhancing human well-being in urban areas in the face of new and complex challenges such as climate change, enhancing food and water security in an increasingly shifting and globalized world.

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BRIDGING MEGA CITIES AND SUBURBAN ECOSYSTEMS: SELF-ORGANIZING, HIERARCHIC, OPEN SYSTEMS APPROACH WITH VISIONEERING

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Modern science has been structured primarily around Newtonian and Darwinian approaches. In Ulanowicz's term (2009), the former was the first window on our nature, captured in mechanistic worldview with its time reversible laws. The latter brought history into the second window on the world and a third window now seeks to go beyond both reductionism and even their synthesis (e.g., Harte, 2002). Considering high levels of uncertainty, epistemological conflicts over facts and values, and a sense of urgency, such normal paradigm-driven science would be insufficient to sustain our pursuit of a comprehensive description of complex ecological-societal systems (e.g. Waltner-Toews and Kay, 2008; Mooney *et al*., 2012).

The co-evolving nature of ecological-societal systems has become increasingly obvious as human ecological footprint has increased. Yet, the conceptual framework to bridge the societal system dynamics with that of the larger Mother Nature within which humanity operates remains deficient. The key to understanding their coevolution is to understand 'self-organization' (e.g., Kay and Boyle, 2008), and thus we need a transdisciplinary approach that draws on the theories and principles from physical, ecological, social and information sciences. Integrating these sciences based on thermodynamic perspective provides a first step to bridging complex ecological and societal systems. The human society must be viewed and studied as an integral part of ecological systems. We need to develop a science that allows us to study the coevolution of the natural world and the human-constructed world. The self-organizing, hierarchic, open systems (SOHO) approach, built upon the laws of thermodynamics, is about maintaining integrity of the combined systems. The SOHO-Visioneering framework provides a heuristic basis for complex systems thinking and a better understanding of the interactions between the two systems as coupled self-organizing systems (Kim and Oki, 2011).

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11-OR4.3-02

COMPARISON OF TRANSPIRATION AND CARBON ASSIMILATION BETWEEN A NATURAL MIXED HARDWOOD FOREST AND CONIFER PLANTATION SURROUNDING MEGA CITY SEOUL

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To project the effects of mega city such as Seoul on urban ecosystem, the accurate estimates of water and carbon balance forvarious ecosystemssurrounding mega cities are essential. The estimation of water and carbon balance of ecosystem requires a combination of experiments and modeling. As an efforts to improve the estimation of water and carbon balance from various ecosystems with similar environment, we comparedthe amounts of transpiration and carbon assimilation from a natural mixed hardwood forest and two conifer plantations, *Pinus koraiensis* and *Abies holophylla*, near mega city Seoul. The experiments can provide insights and parameters to improve models and data to tests model performance.

In this study, stand transpiration and canopy conductance were estimated by sap flux measurement using thermal dissipation probe method and canopy conductance was evaluated independently by closing water balance using mass balance equation. After the evaluation, stand net photosynthesis was calculated with 4C-A (Canopy Conductance Constrained Carbon Assimilation) model using canopy conductance. The calculated stand net photosynthesis was validated with the net primary production (NPP) estimated by tree diameter increment and allometric equation.

Our preliminary analysis showed measured sap flux density for a natural mixed hardwood forest,*Pinus koraiensis* and *Abies hollophylla* stand were 0.095 ± 0.059 mmol $m^{-2}_{leaf\ area}\ s^{-1}$, 0.081 ± 0.050 mmol $m^{-2}_{leaf\ area}\ s^{-1}$ and , 0.071 ± 0.045 mmol $m^{-2}_{leaf\ area}\ s^{-1}$ respectively. Daily transpiration of *Abies hollophylla* stand (1.06± 0.55 mm/d) was highest due to higher LAI, and it was followed by the natural forest(1.05 ± 0.54 mm/d) and Pine plantation stand (0.87 ± 0.43 mm/d), however, due to the differences in growing season between conifer and deciduous species, the annual transpiration was 316.5 mm yr^{-1}, 212.5 mm yr^{-1} and 209 mm yr^{-1}, respectively. The estimation of canopy carbon net assimilation was the highest at the *Abies hollophylla* stand with 1920.2 g C m^{-2} yr^{-1}, and it was followed by a natural mixed hardwood forest (1330.3g C m^{-2} yr^{-1}) and Korean pine stand (1183.2g C m^{-2} yr^{-1}). The estimated NPP of natural forest, *Abies* and pine plantation during measurement period were390 gC m^{-2} yr^{-1}, 391.5 gC m^{-2} yr^{-1}, and 267 gC m^{-2} yr^{-1}, respectively.

This study shows the amount of carbon uptake by photosynthesis can be reasonably estimated by sap flux measurement and 4-CA model from various forest types near mega city Seoul.

11-OR4.3-03

ECONOMIC EVALUATION OF PM10 WASHING EFFECT BY RAINFALL: CASE STUDY IN SEOUL METEROPOLITAN AREA

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Rainfall is a double edged sword. Heavy rainfall cause floods but plays an important role in cleaning the air. Recently, particulate matter (PM) is an important social concern in Korea and we need to pay attention to the role of rainfall in removing the particulate matters in the atmosphere. To the general public, it is important to properly evaluate socioeconomic benefits of urban vegetation. Recently, particulate matter. In this presentation, we discuss quantification of the economic benefits of rainfall by reducing the PM using the contingent valuation method.

11-OP4.3-04

Roles of BVOCs in Determining Oxidation Capacity in a Suburb of the Seoul Metropolitan Area (SMA)

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East-Asian megacities have known for serious air pollution from fast economical development and industrialization. This motivated to study impacts of anthropogenic air pollution from the megacities in regional to global scales. Recent observational and modeling studies clearly have shown that photochemistry of biogenic volatile organic compounds from surrounding forests near East Asian megacities accelerates photochemical product formation such as ozone and secondary organic aerosols. To accurately constrain impacts of the photochemical products to regional to global air quality, scientific understanding of oxidation capacity in high BVOC (e.g. isoprene and monoterpenes) environments with a wide spectrum of anthropogenic influences should be warranted. Recent research results, however, indicate significant uncertainty in our understanding of oxidation capacity especially in high isoprene environments. We will discuss the implications of uncertainties in constraining tropospheric oxidation capacity to ozone and secondary aerosol production at the Taehwa Research Forest (TRF). The TRF is located around 30 km from Center of the SMA, population of 25 million. Observations indicate that Isoprene mostly accounts the chemical sink of hydroxyl radical (OH) at the TRF during the summer season with a wide range of anthropogenic influences from the SMA. The observational dataset is used for the discussion using an observationally constrained box-model.

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11-OR4.3-05

EFFECT OF ENVIRONMENTAL CONTROLS ON DYNAMICS OF CO2 BUDGET IN A SUBTROPICAL WETLAND ECOSYSTEM NEAR TAIPEI METROPOLITAN

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On a global and regional scale, low-latitude estuarial wetland ecosystems play important roles in carbon cycling and ecosystem functioning, but few studies have focused on these ecosystems. In this study, to quantify the CO_2 exchange and characterize how environmental factors affect the seasonal dynamics of this exchange in low-latitude estuarial wetland ecosystems, we used continuous eddy-covariance (EC) measurement to conduct the research at a subtropical estuarine wetland ecosystem close to the Taipei Metropolitan area in northern Taiwan. In this study site, two flux towers were built over two different but representative tropical-to-subtropical vegetation types, para grass and reed. We used EC techniques to analyze temporal variation in CO_2 exchange and determined the effect of environmental factors on the dynamics of CO_2 budget in these two different ecosystems. We aimed to (1) quantify the CO_2 budget, including GPP, ecosystem respiration (R_{eco}), and NEE by examining EC data in terms of environmental variables; (2) analyze the effect of environmental factors on the CO_2 budget; and (3) interpret possible shifts and trends in C sequestration in this representative subtropical estuarine wetland ecosystem near a metropolitan area under environmental change.

The results suggest that gross primary production (GPP, in the order of 1700 gC m-2 yr-1) of CO_2 was higher in our low-latitude wetlands than in previous studies of northern peatlands and estuarial wetlands because of the direct effect of environmental factors. As for the role of environmental controls, temperature and radiation had more effect than water status (soil moisture content and vapor pressure deficit) on GPP for the two low-latitude vegetation types, which differs from the results for high-latitude regions. Environmental variables had a strong but different impact on the CO2 budget for para grass and reed areas. This diversity led to different potential shifts and trends of biomass accumulation and distribution of these two typical low-latitude vegetation types under different seniors of environmental changes in the future. The finding from this study can sufficiently provide quantitative understanding on managing wetland ecosystem close to metropolitan areas at different temporal and spatial scales.

11-OR4.3-06

QUANTITY AND QUALITY OF DISSOLVED CARBON OF THE FIVE LARGEST RIVERS IN SOUTH KOREA

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The Han River (HR), the Geum River (GR), the Youngsan River (YR), the Sumjin River (SR), and the Nakdong River (NR) are the five largest rivers in South Korea, draining approximately 70% of land area supporting more than 32 million people. We investigated both the quantity and quality of dissolved carbon exported by those rivers for 2012 – 2013. Annually ~700 Gg of dissolved carbon was transported to the ocean through the five rivers, and DIC accounted for ~85% of riverine dissolved carbon. About 32-60% of annual DOC loads and 32-52% of annual DIC loads were exported in monsoon season (June-August) indicating strong effects of precipitation in the riverine carbon export. Fluorescent spectra of riverine DOC combined with PARAFAC analysis suggested that terrestrial humic materials became dominant components of riverine DOC after strong storm events in all the rivers although tyrosine-like or tryptophan-like components were dominant in NR during periods without storms. Modern to ~1000 years old dissolved carbon was released from the five basins suggesting that the sources of dissolved carbon could be diverse. The results suggested that quality as well as quantity of riverine dissolved carbon released from the five river basins could be strongly influenced by the monsoon climates. More young, terrigenous carbon could be exported through rivers by the increased frequency and intensity of hydrological events under climate change, which could alter the functioning of coastal ecosystems.

October 11

Oral presentation

16:00–17:30

11–OR1.4(Rm.306)

11–OR3.5(Rm.101)

11–OR4.4(Rm.102)

11-OR1.4-01

Residents' Preference and Willingness to Conserve Homestead Woodlands: Coastal Villages in Okinawa Prefecture, Japan

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Fukugi (*Garcinia subelliptica* Merr.) homestead woodlands spread through the Ryukyu Islands, the southernmost part of Japan. Homestead woodlands have played a key role in protecting settlements from strong winds, as well as providing timber, green manure, and other services. However, with rapid urbanization and economic and societal change, homestead woodlands in Japan have largely vanished.

The primary purpose of this study was to assess residents' perceptions of homestead woodlands. The secondary purpose was to evaluate residents' willingness to conserve homestead woodlands using the contingent valuation method (CVM).

A survey was conducted in three hamlets with the best-preserved Fukugi homestead woodlands in Okinawa Prefecture. The overwhelming majority of respondents (91%) favored the conservation of homestead woodlands. Residents highly valued the amelioration of the microclimate by homestead woodlands such as serving as windbreaks (85.6%) and cooling the air in summer (60.9%). In contrast, the contribution to biodiversity was only modestly (16.8%) valued. An OLS model revealed that residents of small islands valued Fukugi trees highly for their function of protection from typhoons. Fukugi homestead woodlands were considered as private goods by the residents as well as by local authorities. Approximately half of the respondents felt that homeowners and/or a local authority such as the hamlet community should be responsible for their conservation. Estimated mean and median WTP values were JPY 1,451 (approximately USD14)/household and JPY 1,000/household, respectively. The low CV value by the residents and perception of woodlands as private property suggests a relatively low concern for conservation. A BLR model suggested that respondents with better education and higher income were more concerned about conservation. It is suggested that fostering environmental education and awareness will contribute to better conservation of their homestead woodlands. This research result provides information to local policy makers for coastal settlement landscape planning and conservation strategies.

Key words: residents' perception, traditional forest conservation, urban forest, windbreak

11-OR1.4-02

PERCEPTUAL EVALUATIONS OF GREEN INFRASTRUCTURES WITH VARING DEGREES OF NATURALNESS: THE ROLE OF INDIVIDUAL CONNECTION TO NATURE

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Green infrastructures of a city, such as parks, woodlands, or wilderness areas, are important places for urban dwellers to understand biodiversity. Although urban dwellers generally know that exposure to green environments can promote health and wellbeing, do they actually prefer to go to green areas for relaxation? The answer seems to be negative. Although contact with nature has been shown to promote health and wellbeing across the life-span, many people do not seem to perceive sufficient restorative and preference-related qualities while in contact with nature. The uninspiring perceptual experiences that they have had in green areas may diminish their preference for, and willingness to, visit natural areas.

In order to identify potential antecedents of positive perceptual experiences in green settings, we investigated the influential role of a personal connection with nature on perceptions of preference-related environmental information in settings with varying degrees of naturalness. The concept of connection to nature describes a deep appreciation of, and affiliation with, natural environments; and individuals with higher levels of connection to nature are suspected to view natural landscapes as more attractive and fascinating. A sense of connection to nature should encourage individuals to resonate with the green environment spontaneously and to find fascinating information in the encountered natural landscapes. We suggest that an individual's connection to nature may help individuals to retain a sense of safety, to take an active role in seeking positive environmental information, and consequently, to perceive more restorative and preference-related qualities of green areas.

In the current study, we investigated the relationship between the participant's personal connection to nature and their perceptual evaluations of landscapes by images with different levels of perceived naturalness. The four sets of images are photos of urban area without greens, urban woods, rural woods and natural woods. Each participant (n = 268) rated one set of images in terms of perceived environmental information, including sense of safety, coherence, complexity, legibility, mystery, attentional restorativeness, familiarity and preference, and provided their connection with nature by NR scale. The results showed that deeper personal connections to nature are associated with greater perceptual evaluation of positive environmental information in urban woods, rural woods and natural woods. In contrast, this relationship does not exist in the urban area without greens. It is concluded that a personal connection to nature is likely to enhance a person's perceptual experiences in green areas, no matter how natural the green area is.

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11-OR1.4-03

NATURAL NEIGHBOURHOODS FOR CITY CHILDREN

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That children need nature for health and well-being is widely accepted, but what type of nature? The assumption that children must interact with wild pristine nature has justified recognition of a "nature deficit disorder" when such contact is lacking. We have evaluated children's reported nature interactions during independent movements, and biodiversity within self-defined neighbourhood nature maps in three cities in New Zealand, to explore nature contact from a child's perspective, in an urban context. In this presentation we address the questions: (1) is biodiversity available and accessible to children living in cities? (2) are children choosing to be in the most bio-diverse areas available to them?; and (3) what social factors support or limit contact with nature? Most children in these cities had access to bio-diverse areas, although availability was limited when independent home range size was small and in higher deprivation areas. When outside the home, children preferred to remain in their own gardens, and often did not use bio-diverse areas available to them. The often restricted independent home ranges emphasizes the importance of gardens as bio-diverse areas.

11-OR1.4-04

choice behavior for Resting Places in Urban Green Spaces

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1. Introduction

Recent landscape studies have confirmed stress reduction effects in urban green spaces. Previous studies have specified that these effects are influenced by environmental conditions (Velarde et al. 2007). However, little research has focused on users' preference such as psychological criteria for selecting a resting place. This study investigated choice behavior for resting place in urban green spaces using a pilot experiment.

2. Method

The experiment was performed in Tokyo with 20 participants over eight weekdays in the afternoons in November in a city park (A) and an open space (B). A is designed to be spacious as well as symmetrical. Resting places in A are regularly spread. B is a courtyard designed to be complex and have varied landscape. Resting places in B are irregularly spread. Participants selected a resting place in which they preferred to sit from the three areas of the case study and answered to a questionnaire.

3. Results

"The area is empty," "The area has a good atmosphere," and "Flowers and trees are present in the area" accounted for over 50%, and "The area is crowded," "The area is located in a prominent place," and "The area is located in a windy place" accounted for 0% of answers on average in the two cases (Figs. 1 and 2). Next, we categorized the preferences of choice behavior and participants. Because of class III mathematical quantification theory and cluster analysis, factors 1 and 2 were interpreted as "preference object" and "location." Participants were divided into three groups, namely "sunny environment type," "access type," and "marginal environment type."

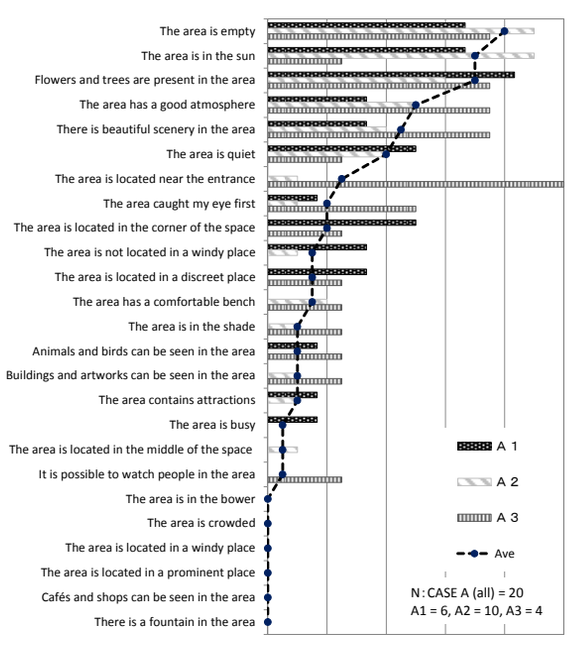

Figure 1 Reasons for selecting three areas (A)

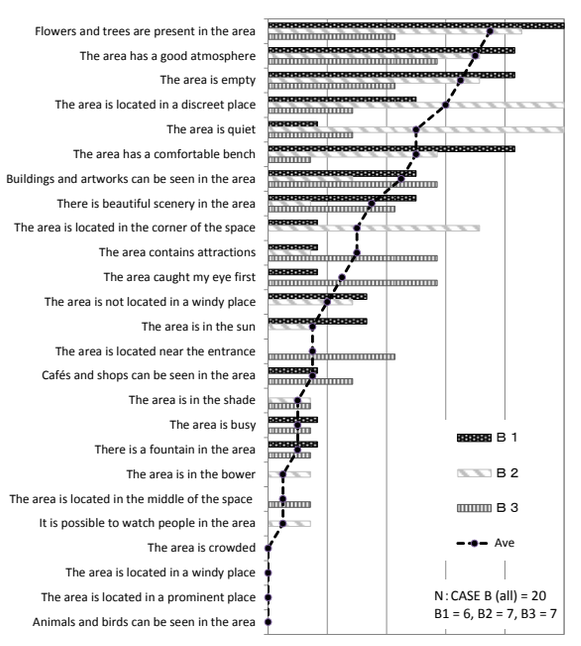

Figure 2 Reasons for selecting three areas (B)

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11-OR1.4-05

COMMUNITY GARDENS AT HEALTH CLINICS IN SOUTH AFRICA AS COMPLEX SOCIAL-ECOLOGICAL SYSTEMS

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Urbanisation is rapidly increasing in Africa and Asia and several sources are predicting that poverty will also increase in these areas. It is estimated that half of the South African population is already living below the poverty line (CIA, 2012). Increasing urbanisation will impact negatively on the diversity and functioning of urban ecosystems and on human health and well-being, which are closely associated with green infrastructure, including gardens. Previous studies focused on domestic gardens (Lubbe et al., 2010) indicated that social and ecological issues should be linked, due to the complexity of the social interactions, and we believe that it is even more relevant for community gardens.

Resilience thinking is increasingly used as a framework to study social-ecological systems. Resilience is the capacity of a social-ecological system to absorb shocks and although it changes, the same structure and function will be retained. A central theme in resilience thinking is the temporal dynamics of social-ecological systems, the so-called complex adaptive system that moves over rapid growth, conservation, release and reorganization phases (Walker & Salt, 2006). Health clinics have gone through all the phases since their inception in 1994 to a stable conservation phase, fulfilling their primary role to render accessible, equitable and integrated quality health services. We do hypothesize, however, that the gardens are still in a reorganization phase and inventions and experimentation may thrive, contributing to building resilience in times of crises. European allotment gardens were sources of local resilience for food security during both World Wars; they are also regarded as pockets of social-ecological memory (Barthel et al., 2010). Community gardens may also increase functional and social diversity (Colding & Barthel, 2013) and form arenas for environmental learning (Krasny & Tidball, 2009). We believe that malnutrition is the main crisis that health clinic gardens will be able to address. In South Africa, 33% of children under five suffered from vitamin A deficiency and according to Vorster et al. (2011) nutrition transition occurs which increases non-communicable health-related diseases (e.g. obesity) in areas where chronic diseases are major epidemics, placing a double burden on the society.

The aim of the larger project on 350 health clinic gardens in the North-West Province was to determine the different resources available in terms of building resilience in these gardens, namely social, cultural, physical, and natural resources. Preliminary results of a subset of gardens will be given comparing different sub districts, types of clinics and urban and rural areas focusing on plant and social diversity. Large social diversity leads to the integration of traditional, local, technical and scientific knowledge, making clinic gardens innovative havens for knowledge creation and transfer in terms of nutritional security.

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11-OR3.4-01

BIODIVERSITY AND CONSERVATION IN CITIES: CRITICAL KNOWLEDGE GAPS

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This work emerges from a recent call by the CBD, emanating from a rapid growth in both cities themselves and the research field of urban ecology, to develop a research agenda on urban biodiversity, ecosystem services and design. An examination of work on biodiversity and conservation in cities shows significant progress, but also a number of critical knowledge gaps that should inform an emerging research agenda. At the global scale there is considerable scope for more detailed, comparable species inventory and community process research. In turn a better understanding of ecological functioning and processes in response to urban drivers will serve to better inform conservation needs and management practices in cities in light of growing understandings around societal needs for urban green space, and the role of green infrastructure in the face of global change and urban resilience. In turn, in relating ecological system and process understandings back to the role of governance practices that inform system and composition shifts would be critical to improve urban biodiversity and conservation.

There tends to be a northern hemisphere bias in terms of urban ecology research outputs and consideration of the question of critical knowledge gaps with respect to urban biodiversity and conservation in the Southern Hemisphere shows some geographically-specific issues of relevance. Reflections from two Southern Hemispherecountries, South Africa and New Zealand, suggest both specific issues pertaining to particular shared colonial histories of land use (for example timelines of urbanization, and invasion biology)and then in turn country-specific agendas for example around development (poverty, development and conservation tensions) in the case of South Africa, and biosecurity, biodiversity crises, and environmental tensions in the case of New Zealand. Reflections demonstrate the value of region-specific considerations where shared histories and geographical factors (eg, climate, coastlines) may inform much needed comparative work and similarly country-specific issues where novel circumstances demand relevant but independent research agendas.

11-OR3.4-02

Comprehensive Urban Biodiversity and Role of Cities in Broader Scale Biodiversity Conservation

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Researchers have studied the biodiversity of cities in an organized way since the 1940's and managers, planners, and designers have worked to maintaing urban biodiversity since the early 1900's. However, efforts of researchers and practitioners often take place in isolation with little sharing of information at local, national, and international levels. Recent international efforts suggest that a new emphasis on information sharing and communication is taking place. The recently completed Cities and Biodiversity Outlook Project provided a global overview of biodiversity and ecosystem services. The Cities Biodiversity Index has resulted in a network of urban areas using a common set of metrics to assess biodiversity. In this presentation I will discuss additional approaches to bringing together urban biodiversity researchers and practitioners. These approaches include research driven approaches such as data and policy synthesis projects at research centers in Germany (sDIV) and the U.S.A. (NCEAS, SESYNC), international networks like URBIO, and networks of planners and managers such as the Urban Sustainability Directors Network that staff of local governments in North America.

11-OR3.4-03

BODIVERSITY AS A TOOL FOR SUSTAINABLE LANDSCAPE DESIGN

Maria Ignatieva

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The challengeof integrating biodiversity in to practical landscape design is quite complicated and directly connected to problems of globalization in design and homogenization of urban environment. The character of market economy itself creates conditions for the use of unified architectural and landscape design styles,where landscape architects are using standard design language and "global" plant material from a select number of nurseries. It is this process that is now leaving no room to promote urban biodiversity. Even Landscape Architecture education globally is moving towards unification. For example in Europe, Bologna educational system hasrequired that all European landscape architecture schools accepta certain educational model. However education in particular can be seen as a very powerful tool where our research results in urban biodiversity can be included in appropriate subjects and curricula. That can be a starting point in changes towards the attitude of using evidence-based knowledge of biodiversity in practical landscape architecture.

Market economy with its freedom of choice in using design, developer's and management firmsmake it very difficult forthe process of implementation of any design and planning regulation standards (including those related to biodiversity). Since the beginning of the 21st century economic profitas opposed to ecological or biodiversity benefit, is the major driven force of any big or small design projects. The only option of integrating biodiversity into urban planning and design standards (on city or local level) is to provide specific economic advantages of using biodiverse sustainable design (compare to a conventional practice) and its direct financial benefit.

In this presentation I critically analyze different examples of successful sustainable landscape design from around the globe based on the idea of promoting biodiversity. These examples were accepted by the citizens and various levels of administrative sources. They can be used as a positive starting point to our process of using biodiversity as a major driving design force.

11-OR3.4-04

SIMULATION MODELS AND PARTICIPATION－IDEAS FOR COLLABORTIONS BETWEEN SCIENTISTS, DESIGNERS AND CITIZENS

David Maddox

The Nature of Cities, New York City, USA

The desire for greater and more effective collaboration between scientists, natural resource managers and citizens has been around for a long time, and more or less everyone believes such dialog is a good idea. But while there are examples of effective collaboration, it isn't the norm. In many ways academic scientists and land managers (both rural and urban) exist in different worlds, and are rewarded for different things. I want to discuss two areas that warrant increased investment and attention. First, we need more fora in which scientists and land mangers meet to discussion their needs and work － not in meetings with formal presentations, but in conversations and dialog that aims to find comment interests and needs. Second, an exciting new area is the development of tools that meld design and science into simulation models that can be used by regular people to explore the ecological consequences of their opinions and desires aboutdesign of their neighborhoods and cities.

11-OR4.4-01

THE EFFECTIVENESS OF PHOTOGRAMMETRY IN MOUNTAIN STREAM SURVEY

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One approach to the energy issue, small hydroelectric generation projects are actively going on in Japan. Small hydroelectric generation plant creates reduction of water flow that makes some impacts to the ecosystem (James et al, 2008). To recognize ecosystem of mountain stream, understanding of morphological data of stream is needed (Rosgen, 1994). However, it spends a large amount of effort to obtain the data by traditional measurement method at mountain stream. Recently, digital photogrammetric technology has been improving. Therefore, we inspected whether we could use photographic surveying to grasp the morphological form of the mountain stream easily.

The study site is the Osaka River (Kumamoto), the Midori River (Kumamoto) and the Kaji River (Tottori). A pole was hung on a tree as vertical and the length standard. Photographs were taken at least twice in each investigation spot. One of the three-dimensional photographic surveying software, Kuraves, was used for analysis of the photograph data. The software can calculate three-dimensional coordinates from photographs which were taken from different angles. After that, we measured the distance between optional two points plotted on the picture. Applying this principle, a distance measurement and the three-dimensional model can be made. Major physical environment data of river morphology (step interval, the length of pool, water width, drop, Bankfull width, particle size, water incline, water's edge, plan and the area of the sandbar) could be measured by this method. In contrast, particle size of riverbed and water depth could not be measured by the photographic survey that field survey should be conducted together. It is expected that photographic surveying can contribute to a future study of mountain stream morphology.

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11-OR4.4-02

THE INFLUENCE OF URBAN LANDSCAPE STRUCTURE ON MICROCLIMATE AND USERS' HEALTH RESPONSES

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Human beings are subjected to various kinds of stressin the urban environment. Living in a large city has been shown by many studies may increase stress levels and produce a higher risk of mental illness (mood and anxiety disorders). In 2010, about 300,000 (12%) Taipei City residents suffer in mental disorders. People have recognized the negative impacts of urban development on climate conditions and human health. Urban artificial infrastructures trigger particular urban climate phenomena, such as heat-island effect or building wind, as well as lead to anxiety and negative emotions. On the contrary, green spaces in urban area help moderate ambient temperature and reduce cardiovascular disease mortality. Therefore, the urban landscape structures may determine the comfort experiences and health of urban dwellers. This study aimed to examine the influences of landscape structures on urban microclimate conditions and user's health benefits. Of particular interest is the effect of artificial area and vegetation style on microclimate conditions and users' landscape preference, emotional states and restorativeness.

In complex urban environments, the diverse spatial structures may create different microclimate states and comfort experiences within a short distance. This study relates landscape structures to the environmental quality from an ecological perspective. The indexes of the landscape structures such as patch area, patch number, size of patch, and patch density are utilized to determine landscape characteristics of urban environments. Three landscape structure factors were selected: artificial pavement, vegetation density, and vegetation configuration. For artificial pavement, we used the area percentage of artificial paving (C_Artificial) to divide 12 sites into 3 groups, high artificial (>50%), moderate artificial (30~50%), and low artificial <30%). Woods mean patch size (MPS) and woods patch density (PD)as the basis for determining vegetation density were used to assort sample sites in 3 groups: high vegetation density, moderate vegetation density, low vegetation density. Vegetation configuration which was identified by aero photography distinguished sample sites into 2 groups: clump configuration and symmetrical configuration.

The results revealed that microclimate conditions vary with different landscape structures (artificial pavement, vegetation density, vegetation configuration). Low-moderate artificial paving area (< 50%), high dense vegetation, and clump vegetation lead to more comfortable microclimate. In addition, people show greater preference and positive psychological and physiological responses in the environments with low-moderate artificial paving (< 50%), moderate dense vegetation, and clump vegetation. This study may help urban landscape design and planning to improve microclimate and increase users' health benefits.

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11-OR4.4-03

ANALYSIS OF SNOW COVER VARIATIONS AT MT. KILIMANKARO FROM MULTI-TEMPORAL LANDSAT IMAGES

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Mt. Kilimanjaro, which is the tallest mountain in Africa, stands on the Kenya-Tanzania border approximately 370 km south of the equator. The snow cover of Mt. Kilimanjaro has frequently been used as an indicator of the global and regional climate because it presents the interaction between snow cover and the climate of the tropics. The objective of this study is to observe the snow cover variations at Mt. Kilimanjaro using Landsat TM and ETM+ images. For this, we estimated: 1) the snow covered area variations, 2) the snowline variations of the snow covered area, and 3) the variations of the land surface temperature (LST) lapse rate from Landsat-7 images and the Shuttle Radar Topography Mission (SRTM) digital elevation model (DEM). Total numbers of 23 Landsat-5 TM and Landsat-7 ETM+ images are used for observing snow cover variation, spanning the 27 years from June 1984 to July 2011. To estimate the variations of the area, the snowline and the LST lapse rate, the following steps were required: 1) atmospheric correction was performed on each image using the cosine approximation (COST) atmospheric correction model, 2) the extraction of the snow covered area was conducted by the normalized difference snow index (NDSI) algorithm, 3) the determination of the snowline was achieved using the SRTM DEM and the extracted snow covered area, and the estimation of the LST lapse rate was performed using Landsat TIR images. The following findings were obtained at Mt. Kilimanjaro: 1) the snow covered area decreased from 11.2 km^2 to 2.3 km^2 over approximately 27 years, which is a 79.5% reduction, 2) the snowline also changed from 4,740 m to 5,020 m, and 3) the LST lapse rate changed from -5.2 '>/km to -2.7 '>/km. The results indicate that snow covered area of Mt. Kilimanjaro has decreased according to climate change. These results enable us to: 1) prove the relation between the variations of the snow cover and the LST lapse rate and the global or local climate change and 2) predict the snow cover variations in the near future.

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October 11

Poster presentation

11-PO1.1-01

Rice terraces in the Nachikatsuura area and its effects on the prevention reduction of flooding and landslides.

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Rice terraces around the world have been noted for their beauty. In the Philippines, therice terraces of the Philippine Cordilleras have been enlisted into UNESCO's world heritage list since 1995 for its cultural importance to its residents. In Japan, rice terraces are being preserved mainly for its aesthetical and cultural value. Sadly, rice terraces preserved lonely for its aesthetics is not feasible in the current economic climate in Japan. However rice fields and terraces are believed to serve a multitude of other purposes as well despite the amount of manual labor and resources required to maintain them. Rice fields have been used in other prefectures to mitigate the flow of water during heavy downpours. The rice fields serve as a natural holding tank to slow the flow of water downstream, thus preventing flood damage to downstream areas This study discusses the use of rice terraces in the prevention and reduction of landslides (mainly debris flow) damage in the Nachikatsuura area of Wakayama prefecture in Japan. The said area was heavily affected by Typhoon Talas which occurred from August 30th to September 6th of year 2011. Due to heavy rainfall, rampant flooding and many landslides caused heavy damages to the surrounding areas. In the Nachikatsuura area, the amount of landslides which occurred was counted manually through the use of Google Earth satellite images after the passing of Typhoon Talas. Out of the observed 82 landslides that occurred in 11 valleys (main valleys that flow into Nachi River), 58 landslides, more than 70 percent stopped before being able to combine with water flow in the sub and main valleys to become bigger landslides. Out of these 11 valleys, 3 valleys (Nagatani, Hirano, Higuchi) were selected for further investigation due to accessibility and the availability of non-terraced slopes for comparison. The combined amount of landslides in these 3 valleys stand at 32 and of these, 17 stopped before being able to join the 3 named main valleys. Of the 17 which stopped, 14 stopped in rice terraces (mostly abandoned and/or reforested with Japanese cedar or Japanese cypress). Of the leftover 15 landslides which passed into the 3 valleys and formed significant debris flows, parts of the debris flow stopped in rice terraces and only one debris flow flowed into the Nachi River causing damage to residential buildings. Further research is required to understand the full ability of the rice terraces, especially the gradient of the region where rice terraces were made. However the loss of rice terraces are not only a loss of aesthetical value, but that of significant use in the reduction of landslides and debris flow was proven in this study.

Key words：rice terraces, aesthetical and cultural value, landslide prevention, landslide damage reduction

11-PO1.1-02

MULTIFUNCTIONAL ROLES OF STREET TREES: PLANT BIODIVERSITY IN URBAN AREAS

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Urban vegetation is an important component of urban ecosystems [Sarel & Stefan 2011]. Consequently, numerous studies have been conducted on the plant biodiversity in the urban landscape, particularly in remnant environments such as forests, parks, lawns, wetlands, and riparian areas [Sarel & Stefan 2011]. Vegetation found in urban matrixes, such as mortared walls, curbside cracks along roads, residential gardens, and derelict areas, has been also investigated in recent years [Payne 1989; Muratet *et al.* 2007; Sarel & Stefan 2011; Uchida *et al.* 2014].

Other components of urban flora, such as street trees, perform critical ecological and social services in urban areas, including moderating the heat island effect, and increasing the sense of community well-being and aesthetics of an area [Mohd & Noriah 2012;Vailshery *et al.* 2013]. Street trees also contribute considerably towards the plant biodiversity of an urban landscape [Subburayalu & Sydnor 2012]. However, despite their importance in these environments, the value of the narrow soil beds at the bases of street trees is not well understood (*Photo 1*), particularly within the context of the importance of this space as an environment for other plant species.

The aim of this study was to obtain baseline information on the plant biodiversity in the narrow soil beds at the bases of street trees. The species composition of plants that had colonized these beds was surveyedat 33 intersections (164 plots) in FukuokaCity in southern Japan from early September to mid-October 2013. A total of 55 families containing 166 species were observed in the beds, and of these 111 were native plants (66.9%), 66 were perennial herbs (39.8%), and 37 were woody plants (22.3%). We propose that the narrow soil beds at the bases of street trees fulfill an important ecological role by providing habitat for plants and in so doing, contribute towards the conservation of plant biodiversity in urban areas.

Photo 1: Narrowsoil beds at the base of a street tree

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11-PO1.1-03

EFFECTS OF GEOHUMUS ON SOIL WATER CONTENT AND PLANT SURVIVAL ON A GREEN WALL SYSTEM

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On green wall and rooftop, precipitation is the only source of water if it is not irrigated. The light-weight soil used for wall greening can hold large amount of water compared to normal soil (Kim et al., 2003). There are, however, many cases that green walls are failed due to drought condition and lack of irrigation including the changes in soil bulk density (An and Kim, 2001). One of the measures to help plants to survive on green wall is increasing soil moisture content by adding soil enhancer in the soil. Geohumus is a new type of soil enhancer that exhibits excellent water retention qualities. It is made up of two components: an organic water-retaining materialand mineral soil enhancers" in the form of volcanic rock dust, clay and silicates.The objective of this study was to investigate the effect of Geohumus on improving the water holding capacity of light-weight soil. It was also intended to examine the reduction of plant drought stress on the soil mixed with Geohumus.

Plant growing media have been prepared with three different types of light-weight soils: soil A (perlite 70, peat moss 10, cocopeat 10, organic compost 10), soil B (perlite 70, peat moss 10, cocopeat 10, coffee ground compost 10), and soil C (Ecosoil, manufactured for rooftop greening). Geohumus was mixed the soils, 0 g (control), 45 g, 90 g and 180 g per container (0.042 m^3). Four plant species were planted on the prepared growing media: *Pachysandra terminalis*, *Sedum takesimense*, *Allium senescens*, and *Hedera rhobea.* The growing media were irrigated after planting, and maintained without further irrigation till the end of experiment. Soil moisture was measured once a week with a soil moisture meter (Mirae senser, WT1000N). Plant drought stress was measured with a chlorophyll fluorometer (Opti-sciences, OS-30p) (Maxwell and Johnson, 2000). Data process and significance test were carried out by PC SAS 9.0.

Geohumus increased soil water retention up to 4 times of control soil. There were positive relationship between the amount of Geohumus in the soil and soil water retention. The effect of Geohumus on soil water retention was greater in soil A and soil B which have lower water holding capacity. The effect was lower in soil C which has higher in water holding capacity. The effect of geohumus on soil water retention lasted longer in soil A and soil B compared to soil C where the effect disappeared after 3 months. The drought stress of the plants was greatest on *Pachysandra terminalis*. And *Hedera rhobea* was a little less stressful. *Sedum takesimense* and *Allium senescens*, which are drought resistant species, did not show drought stress until the end of experiment. *Pachysandra terminalis* showed wilt after 5 weeks and started to wither. Increasing the amount of Geohumus in the soil related in the reduction of wilting rate.

There were significant increases in soil water content by adding Geohumus in the soil. And the effects of Geohumus on plant drought stress and wilting were positive. In case of extended drought period, however, it was not clear that the increased amount of soil water by adding Geohumus was available for plants. There were a few cases that soil water content and plant drought stress did not show consistent result. This seemed to be various depending on plant species and soil properties, which need to be investigated further in future researches.

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11-PO1.1-04

A Study on the Vegetation Restoration Model of Street Environment for Improvement of Urban Environment

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Roadside trees in urban areas and urban forests have scenic functions that improve the city landscape and urban image, while also serving ecological functions such as absorbing carbon dioxide, lessening heat islands, and acting as habitats for small animals.

There are many cases in which decision-making is necessary on whether to plant roadside trees that can satisfy both of the above functions, to emphasize the scenic effects, or whether to emphasize the ecological functions.

Due to the various functions and necessities of urban environments, expanding green areas in urban areas will be an effective response to climate change. Studies on street environments of Seoul Metropolitan City and other districts can improve the effects of street environments by taking the role of forming and bridging green networks.

Accordingly, this study conducted investigations and analyses on the ecology and landscape of sixty-three green strips along the street in Seoul. The status, function and effects of green strips along the street were defined and the relationship and influence factors of ecology and landscape were deduced. Based on this, the vegetation model by type of green strips along the street was proposed.

For the ecology analysis of green strips along the street in Seoul, plant species, soil environment, climate, vegetation structure, and carbon dioxide absorption rates were examined. For the landscape analysis, self-entry questionnaires were handed out for majors and non-majors according to their major.

Results of the ecology investigation showed that multi-layer planting had the highest average plane and facade ratio of green coverage, and carbon dioxide storage and absorption volumes. It also showed good saline decomposition in the winter, making it the best green strip types. Shrub mass planting was found to be the second best. Planter type had the lowest average plane and facade ratio of green coverage, while ground cover planting was found to have the lowest carbon dioxide storage and absorption rates. Hence, it is evident that the ecology of ground cover planting and planter types were the lowest.

Upon analyzing the landscape, it was possible to deduce that when the ecology was high, visual preference was also high. There was high preference for multi-layer planting and shrub mass planting, followed by ground cover planting and planter type. However, even in the multi-layer plantings that had high average preference, some of those in the case of complex commercial streets showed low value of the landscape scenery. Thus, it was analyzed that use of surrounding land, seasons, and the ratio of green coverage had an impact.

Based on such results, this study took into consideration the surrounding land usage and seasonal ages and proposed a vegetation model by 'multi-layer planting', 'shrub mass planting', 'ground cover planting' and 'planter type' per green strip along the street.

11-PO1.2-05

CONCEPTUAL FRAMEWORK FOR ASSESSING VULNERABILITY AND RESILIENCE OF REGIONAL VEGETATION CONDITION USING LONG-TERM TIME-SERIES SATELLITE IMAGES

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Landscape vulnerability and resilience to an extreme weather condition could be estimated from monitoring the changes in regional vegetation condition during the period. In terms of a severe drought, the degradation patterns and recovering phases of local vegetation condition could be regarded as the vulnerability and resilience of the region, respectively. For the drought monitoring at a large scale, previous studies attempted to detect the drought-induced geospatial anomalies in vegetation condition, from the analysis of long-term time-series satellite remote sensing data. Song et al. (2013) improved the drought assessment methodology in terms of considering (1) the seasonality of each vegetation-cover type, (2) cumulative damage during the drought event, and (3) the application to various types of land cover. For the further step, this study aimed to discuss the conceptual framework to assess the 'time-series patterns' of drought-induced abnormal vegetation responses, from the viewpoint of landscape vulnerability and resilience, at the diverse landscape mosaics.

Time-series profiles of vegetation condition in the extreme drought and normal precipitation years were acquired by using the values of Enhanced Vegetation Index (EVI; Huete et al. 2002), which was provided in the Terra MODIS remote sensing dataset (MOD13Q1) taken every 16 days at the scale of 250-m spatial resolution. These per pixel phonological features could be used to estimate (1) drought impact, which was determined by integrating the annual differences in EVI profiles between drought and normal conditions, (2) vulnerability, the gradient declining from the EVI-series in normal years to those in drought states, and (3) resilience, the gradient retrieving from the degraded EVI-series in drought to those in normal condition.

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11-PO1.2-06

DEVELOPMENT OF NEW CONTROL METHOD FOR PLATYPUS KORYOENSIS, AN ISNECT VECTOR OF OAK WILT DISEASE THREATENING URBAN MOUNTAIN FOREST IN KOREA

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Oak wilt disease caused by ambrosia beetles is serious problem in oak forest in Asian countries, and could become a great threat to oak forest of urban mountainin Korea. Several control methodshave been developed to prevent the spread of oak wilt disease. Although effective, current control methods have many side effects. In this study, we developed a new control method named mass capturing device of ambrosia beetles, and evaluated the effectiveness of this device for practical use in field. In a field test of mass capturing device, total 87,081 ambrosia beetles were caught from 23 damaged oak trees. More beetles were caught in collection bottles installed at low part of oak stem compared to collection bottle located at middle and upper parts of oak stem. The effect of alcohol and water on beetle capture was analyzed, and bottle position was more important than materials filled in collection bottle. At the same position of collection bottles, more beetle were caught in collection bottles filled with alcohol than water although there is no statistical difference. Relationship between DBH (diameter of breast height) of oak tree and the number of caught beetles was also analyzed, and there is a positive relationship between DBH and number of beetles caught. Mass capturing device was very effective for catching emerged ambrosia beetles from damaged oak trees in field test.Our new development could be useful for managing the population of ambrosia beetles, and reduce the spread of oak wilt disease in oak forest.

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11-OR1.3-06

Urban and plant community Form: study of contemporary ecology in the City of Cape Town

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Urban green space is variably configured in response to social and economic drivers. This paper explores the ecology of the City of Cape Town, through a plant functional type lens where the urban form serves to act as a driver of local ecologies. Despite 20 years of democracy Cape Town's urban form still bares the hallmarks of an apartheid city with racial and economic segregation and associated inequality between neighbourhoods. The accompanying plant communities and ensuing ecologies have yet to be explored. In light of the current acknowledgement of the multiple benefits offered by green space to urban dwellers, a full understanding of the ecology of these diverse neighbourhoods is critical in terms of redress and reimagining the City in an equitable form. Plant functional types have proved a useful means of interpreting landscape form and function, where structural diversity can be correlated with ecological rigour. The plant cover, composition, and associated functional types, of green space were investigated along a social and economic gradient, within a single original vegetation type. Preliminary findings are presented from a subset of the sites sampled, presenting only those findings relating to private gardens.Data are explored in light of current theory linking the adaptive capacity of neighbourhoods and ecological status, where undermined ecologies potentially present greater exposure to risk and shock.

Key words: community diversity, plant functional types, socio-economic gradients, urban drivers

11-PO1.3-08

LONG-TERM TRENDS OF DISTRIBUTION OF INVASIVE PLANTS ALONG THE ROAD NETWORK IN H. J. ANDREWS FOREST, WESTERN OREGON, USA

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Roads provide corridors for plant dispersal and establishment, thus aiding exotic plants in overcoming barriers to expansion. Roads can act as the initial point of entry into a landscape for exotic plants. Studying patterns of distribution over many years can give a broader perspective of change at the landscape level. This study aims to examine how the distribution of invasive plants has changed along roads over time (from 1994 through 2005 to 2013), and to explain the environmental factors that might have influenced increases or decreases in abundance of these species. The study site, the Andrews Forest is situated in the western Cascade Range of Oregon, and covers the entire drainage basin of Lookout Creek. Road survey of the presence/absence of 11 target species and relative abundance of 4 target species were conducted on 104 km of roads in the Andrews Forest and an additional 50 km of roads in the surrounding area. The presence/absence of 11 exotic plants was noted along each 0.16 km segment of the road survey in 2013. Data from the 1994, 2005, and 2013 road inventories were used to evaluate the change in exotic plant distributions over time. Spatial analysis of the distribution patterns of exotic plants was conducted of the HJ Andrews and Deer Creek areas using ArcGIS. This study showed that exotic species distributions have changed over time through the process of dispersal along road corridors associated with traffic and other factors promoting spread (wind, water movement and change in light associated with canopy closure).

Table 1. The percentage at road network of the 8 species from the 11 target species and the differences of its percentage between 1994 and 2013

Species name	Investigation year	% at road network	Differences of % at road network between 1994 and 2013
Digitalis purpurea	1994	0.71	4.078
	2002	4.08	
	2005	7.98	
	2013	4.79	
Hypericum perforatum	1994	94.15	3.546
	2002	93.26	
	2005	99.47	
	2013	97.70	
Chrysanthemum leucanthemum	1994	79.61	14.362
	2002	90.60	
	2005	95.04	
	2013	93.97	
Cirsium vulgare	1994	72.87	-60.461
	2002	46.45	
	2005	54.79	
	2013	12.41	
Cirsium arvense	1994	15.78	-0.709
	2002	19.86	
	2005	15.43	
	2013	15.07	

11-PO1.3-09

HABITAT ENVIRONMENTAL CHARACTERISTICS OF VULNERABLE PLANT SPECIES *IRIS LAEVIGATA* AND *I. SETOSA* IN KOREAN EAST COASTAL LAGOONS

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Iris laevigata Fisch. is protected as 2nd grade of endangered species by the Korea Ministry of Environment and *I. setosa* Pall. is regarded as "Critically Endangered" species by the Korea Forest Service. Although those species are only found in some lagoons on the eastern coast of Korea, no study on ecological and habitat characteristics of those species has not been performed yet. In this study, we analyzed the growth of two endangered *Iris* species and environmental characteristics of habitat such as water, soil, and vegetation.

I. laevigata have shown a restricted distributional pattern in the Sunyoodam and Bongpoho lagoon as a form of floating mat. *I. laevigata* showed an early life-cycle process particularly in shoot growth, growing higher (about 75 cm) than other accompanying species such as *Phragmites australis* and *Persicaria thunbergii* at flowering season. *I. setosa* was mainly found on sediment and soil layer in lagoons such as Songjiho and Hwajinpo. Vertical growth of *I. setosa* seemed to be reduced under waterlogged condition (Songjiho, about 36 cm in shoot height) than non-waterlogged condition (Hwajinpo, about 72 cm in shoot height). For water environment, there was a significant difference between conductivity values in habitats of *I. laevigata* (63 μS/cm to 340 μS/cm) and *I. setosa* (13.8 μS/cm to 24.1 mS/cm).

We found that *I. setosa* has more various habitat types than *I. laevigata* only inhabiting floating mat. Continuously monitoring is necessary for conservation of two *Iris* species by reason of the habitats which limited in a few lagoons. Although those *Iris* species inhabit same habitat type (east coastal lagoons), there are two distinctive ecological niche of *Iris* species. It is necessary to investigate the differences in life history including germination and establishment processes. This study was supported by the Korea Ministry of Environment as "The Eco-Innovation project, 416-111-010".

11-PO1.3-10

HERON'S COLONY DISTRIBUTION IN SHIGA PREFECTURE

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When summer comes, the nestsare built by kinds of Herons near the fields of private houses. Citizens often suffer from the gregarious Herons with their disgusting smell and noisy crying sound all day. Because of such issues, citizens have to take actions to cut down trees or to sprinkle water on the nests. The actions directly have impact on the young Herons that they lose their mothers and the nests, so they are forced to live alone even die. Rapid environmental changescaused by human activities for the Heron's coloniesnearby fields of human activities have impact on the number of the Heron's population.

At early stage, in order to know the Heron's colonies distribution and the status of inhabitation, Shiga branch of Wild Bird Society of Japan conducted a large-scale survey on the distribution of Heron' colonies, in 2008 and 2012 .According to the result of this survey, the amount of colonies had decreased from 24 in 2008 to 21 in 2012. Nine old coloniesfound in 2008had disappeared, while 6 new colonies had found. In order to understand the reasons – why these old colonies had disappeared, they conducted following-up interviews among local citizens. These interviews showed that birds dispelling caused 6 old colonies to disappear,but the serve did not show the reasons for the other 3 old disappeared colonies.

The scale of colonies could be classified into five categories, according to the population of birds. The comparative research showed that, during 2008 to 2012, the amount of coloniescontaining 101-500 birds had reduced by 3, and the amount of colonies containing more than 500 birds had reduced by 2. On the contrary, the amount of small-scaled coloniescontaining 11-50 birds, had increased and distributed more widely.

In order to coexist with Herons, we must take steps on the issues. We can learn from the survey done with the citizens in Shiga town in Feb. 2014. The survey focused on checking 1) whether the citizens witness the colony of Herons or not; 2) the population of the Herons; 3) whether the citizens suffer from the Herons or not; 4) the status of the sufferance; 5) the period of the sufferance; 6) the solution that the citizens want, etc. 1010 questionnaires were distributed and 316 were collected, with a response rate of 31.3%.In short, we must try our best to created good environment for both Herons and human to live in harmony with each other.

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11-PO1.3-11

GENETIC DIVERSITY ON SEEDS OF *PERSICARIA THUNBERGII*, AN AMPHICARPIC PLANT

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Persicaria thunbergii (Polygonaceae) as one of the amphicarphic species is a common annual wetland plant and has a strong reproductivity in East Asian regions. Previous studies presented that subterranean and aerial seeds from a single *P. thunbergii* individual showed a difference on the characteristics of seed and seedling. The aim of this study is to investigate the genetic characteristics of aerial and subterranean seeds of *P. thunbergii* by RAPD method. Aerial and subterranean seeds from a single *P. thunbergii* individual were collected, and eight seeds were randomly selected from each seed type. Total genomic DNA of each decoated seed were extracted, and PCR with random primer followed. The genetic diversity difference was shown in the two types of seeds from single *P. thunbergii* individual (aerial seeds h=0.2881; subterranean seeds h=0.1849). Aerial seeds were distributed more widely than subterranean seeds on 2-D plot of principal component analysis. Also, subterranean seeds were located in a same subgroup in UPGMA dendrogram. These results are due to a reproductive difference of amphicarpic seeds, respectively formed from cleistogamous and chasmogamous flowers. This study showed that aerial and subterranean seeds from a single individual have genetic differences from a genetic diversity perspective. Investigations for the genetic diversity of *P. thunbergii* in field are ongoing. This work was supported by Korea Research Foundation (KRF-2012R1A1A2001007).

11-PO1.3-12

Relationship between the number of plant and insect in rooftop gardens and green walls

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This study was performed to confirm the relationship between the number of plant species and insect species. Eleven sites of green rooftop and eight sites of green wall were investigated in Seoul, Gyeonggi, Daejeon, and Pusan. The number of plant species increased with size of area especially in green rooftop. The number of insect species was proportional to the number of plant species especially in herbaceous plant than woody plant, and introduced plant species than planted plant species. Because the number of introduced plant increased with size of area, the artificial greening area was important for the number of plant and insect species. Therefore, it is an opportunity to be positive in species diversity if artificial greening sites are comprised of large area, herbaceous plant than woody plant, introduced plant than planted plant.

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11-PO1.3-13

COMPARISON OF STAND CHARACTERISTICS BETWEEN 1990S AND 2010S IN MT. GARIWAN AREA, KOREA

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Stand structure continuously changes, which is the major characteristic of forest ecosystems. Species composition, growth rate of each species, soil condition and disturbance history determine the stand structure of the area at the time. Understanding changing patterns of the stand structure of the area is the basis for forest management and the information is applied for forest restoration and ecological integrity improvement.

Mt. Gariwang area has been a platform for ecological and economic studies to develop forest management techniques since 1990. The area has high biodiversity and environmental heterogeneity, especially high diversity in tree species composition. This study compared species composition and stand structure in natural deciduous forests in Mt. Gariwang area between 1990s and 2010s to understand natural deciduous stand dynamics. Data in 1990s were from the Reports of Korea Forest Service.

Species distribution in this area showed characteristic patterns by altitudes and topography. *Quercusmongolica* dominated ridges. *Fraxinusrhynchophylla* and *Acer pictum* subsp. *mono* dominated slopes and valleys above 1000 m asl, while *A. pictum* subsp. *mono*, *F. rhynchophylla, Maackiaamurensis* and *Tiliaamurensis* largely distributed on slopes under 1000 asl.

In 1995, about 26 woody species were found in the study area. Major tree species were *Q. mongolica, A. pictum*subsp. *mono*, *T. amurensis,Ulmuslaciniata, M. amurensis, and Abiesholophylla. Mean stand density was ca. 1000 ha^{-1}, mean stand DBH 17 cm, and mean stand volume about 436 m^{3} ha^{-1} (Korea Forest Service 1995). In 2010, about 40 woody species were reported.* The species of greatest importance value in the study area were *Q. mongolica, A. pictum*subsp. *mono, Acer pseudosieboldianum, Carpinuscordata,* and *Cornuscontroversa,* respectively, in the order from greatest importance to least importance values. The mean stand density was 916 *ha^{-1}, and mean stand DBH was 17 cm in2010, showing similar values between 1990s and 2010. The comparison indicated little temporal differences in species composition and stand structure for about 20 years in mature forests.*

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11-PO1.3-14

VEGETATION AND STAND STRUCTURE DYNAMICS OF MT. JIRI AND BAEKWOON DURING LAST 13 YEARS (1999-2012)

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The dynamics of forest structure and tree species diversity in Jiri/Baekoon mountains was investigated using the species composition and DBH size collected over the past thirteen years in 152 quadrats across Jiri and Baekoon Mountains, South Korea. *Quercus mongolica, Carpinus laxiflora, Styrax japonicus, Quercus variabilis,* and *Quercus serrata*,were common dominant species ooccupying about 50% of stem density over the thirteen years. Overall tree species composition increased both diversity and biomass growth over thirteen years according to the indices of Shannon-Weiner diversity, Bray-Curtis dissimilarity, species evenness. In addition, the pattern of variation of tree species composition was categorized into four major species community based on the hierarchical cluster analysis.

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11-PO1.4-15

LANDSCAPE URBANISM AS A THEORETICAL FRAMEWORK FOR LANDSCAPE JUSTICE

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Nearly two decades ago, landscape urbanism (LU) emerged as practical theory which asserted that the landscape would be used as the medium of urban design. Over time and with practice, this concept has been revised and has matured, now becoming one of the dominant theories in the landscape architecture discipline. On the other hand, landscape urbanism has been accused of advocating neo-liberalism in terms of political economy by new urbanists (NU). Specifically, it is suspected of not only appealing to visual biophilia via its use of a digital technique in the design process but also of encouraging the spectacularization and commercialization of privileged designed landscapes in actual spaces.

To a certain extent, such criticism can be persuasive. Condemnation, however, still remains as a permanent dichotomous way of thinking, as exemplified by urban design/landscape architecture or NU/LU, simply excluding LU as the other pole and regarding it as an enemy in combat, and in some sense, inversely exalting it to dominant discourse of urbanism.

This study examines social justice or equity pertaining to LU discourse in an effort to propose an alternative way of thinking in the urbanism discourse scene. First, the study scrutinizes, from the perspective of social equity, the deployment process of adjectivally modified discourses of urbanism under the LU sphere of influence over the last two decades, as typified by landscape/ecological/everyday or other forms of urbanism. This is followed by the offering of an alternative proposition which holds that landscapes in a city are distributed equally as a right to the landscape, in accordance with Jacques Rancière's politics of aesthetics. The concept of the 'distribution of sensible' is one of his insightfully particular ways of thinking, which has been widely applied in urban theories on social justice or political aesthetics recently. Accepting such recent perspectives critically, the study rethinks possibility of LU as a newer theoretical basis of social value, that is, as common ground between the political and the aesthetical.

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11-PO1.4-16

A COMPARATIVE STUDY OF PLUM BLOSSOM CULTURE AND THEIR APPLICATIONS IN CHINA, JAPAN AND KOREA

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About the culture of plant, some Chinese researchers called it 'plant culture', and it is a pity that people haven't reached a unified definition on the 'culture of plants' till now in China. The west researchers called it 'the symbolism meaning of plants', or 'the symbolism of flowers'(Michel Conan. 1999; Lehner, Ernst and Johanna. 1960), and some researchers called it 'plant culture'(Richard Napier. 2003), they considered that what is connected with plant such as art, literature, myths and legends, religion, philosophy, plant science, etc. should belong to the scope of plant culture(Harold and Alma. 1952; Janick and Jules. 1979).

At present, researchers about the plant culture is no unified definition of the view, but there are some similarities of them, they considered that: 1) Plant culture is not innate, is that people in the long history of plant domestication, cultivation and utilization through long practice gained(Frances. 1988). 2) Plant culture has the social attribute, created by the people who are the members of society, people share it, spread it, and inherit it, plant culture was recognized in certain social groups. 3) The function of plant culture is the needs of the people, or material needs, or spiritual needs, or some combination of the two. 4) Plant culture is not a simple phenomenon, but with other cultures, such as gardening, agriculture, art, religion, philosophy, mutual influence, mutual fusion result, has a certain structure.

With the continuous progress of human society and the improvement of civilization level, the status of culture becomes more and more important. Whether the classical Chinese garden or the Japanese or the Korea classical garden, plants are the indispensable main elements. In different landscape architecture, the appropriate use of plants can highlight the cultural atmosphere of the overall environment. Thus people could taste the culture in the natural environment, improve their aesthetic interests, world outlooks as well as life values, and know more about human culture and history. This study proposes to: 1) compare the differences about the culture of plum blossom in China, Japan and Korea from the view of religion, literature and drawing. 2) And analyze the differences about the garden applications of plum blossom in the three.

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11-PO1.4-41

EVALUATING THE WELL-BEEING OF URBAN INHABITANTS IN DIFFERENT SURROUNDINGS

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In this work the multidimensional sensitivities questionnaire on the good-bad mood scale by Steyer et al. was used to measure the changes in current feelings of wellbeing (**psychological health**) generated in **urban inhabitants** by **different surroundings** (landscape (G1), urban location without green space (G2), urban location with green space (G3)). An **online survey** was conducted with 700 respondents, the criterion of inclusion being their residence in a small, medium or large European city. The test persons were led to the three different slideshow environments (treatments) in a **randomised** procedure and pre and post values of current wellbeing were recorded: adj. average values of the post wellbeing on a scale of 1-6: G1: 4.653, G2: 4.287, G3: 4.45. In addition, the perceived assessment of the appreciation of the various environments was recorded. These values are embedded in a cultural context. The comparison of the results in the measured (psychological) and in the perceived (cultural) areas, following a breakdown of the estimated attractiveness categories and the changes in wellbeing, show a shift between the values of the individual perception and the measured change. There is a cultural tendency to value the countryside landscape as more attractive than the city. In the process, the actual positive **effects of urban green spaces on the psyche were undervalued** The valences of the psychological and cultural aspects are determined by intrinsic factors. There is a further need for research in order to determine and apply the various aspects, and the connections within these aspects, in the planning of recreational spaces in a health-promoting layout.

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11-PO2.1-17

ECOLOGICAL EFFECTS OF CONSTRUCTED SMALL POND ON BIODIVERSITY CONSERVATION

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Small ponds are commonly utilized in paddy fields in East Asia. The small ponds are a type of palustrine for the accumulation of irrigation water. These ponds provide multi-functional support to paddy field systems, which include flood control, groundwater recharge, and water pollution reduction. The small ponds in paddy fields serve as a refuge for aquatic organisms during the midsummer and winter seasons. This study investigated the benthic macroinvertebrate communities in a paddy field ecosystem and the positive effect of constructed small pond within biodiversity. A field survey was conducted from August to September for three years (2010-2012). The ecological effects of the small pond were investigated by comparing a paddy field with and without ponds. The comparison used measurements of diversity and biodiversity enhancement effect degree (BEED) of benthic macroinvertebrates. The distribution characteristics of benthic macroinvertebrates in the paddy field ecosystem were similar to that of a general wetland ecosystem. In the comparison of benthic macroinvertebrate diversity among paddy field type, it was higher in paddy fields with small pond than in paddy fields without. BEED showed positive value in every taxonomic groups (excluding Crustacea) and significantly differed among taxonomic groups. The results indicate that BEED was related to the dispersal abilities of each taxonomic group, and biodiversity enhanced the effects of small pond irrespective of the region.

<Table 1> Cumulative species numbers and individual numbers according to taxonomic groups of benthic macroinvertebrates that emerged in paddy fields with and without ponds

Taxonomic group	No. of species		Cumulative individuals	
	With pond	Without pond	With pond	Without pond
Non-Insecta				
Mollusca	9	9	10,768	4,571
Annelida	7	5	6,809	1,326
Crustacea	0	1	0	9
Insecta				
Ephemeroptera	1	1	889	402
Odonata	9	5	236	102
Hemiptera	8	8	621	116
Coleoptera	16	13	253	108
Diptera	9	8	30,698	12,028
Total	59	50	50,274	18,662

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11-PO2.1-18

Evaluation of Pond Wetlands by Giving RAM Importance

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Efficient utilization method of wetlands for the conservation and improvement of biodiversity is getting attention. However, the wetland ecosystem is changing because of various contaminants. Therefore, suggestion of conservation value of a wetland is very important to overcome this crisis. In the past, Korea had serious difficulty in irrigation water control because rainfalls concentrate in summer. Accordingly, many pond wetlands are formed around farming land and the water stored in the wetlands was used for farming. However, pond wetlands became unnecessary now because water in dams and underground water are used in farming. Meanwhile, the pond wetlands are being contaminated and reclaimed because they are not need for irrigation water. Still, the pond wetlands have high biodiversity value. Therefore, evaluation and value suggestion on pond wetlands are required to conserve the pond wetlands.

In general, the RAM of Tilton et al. (2001) and Koo (2009) is used for the evaluation of wetlands. However, the RAM is not differentiated for different wetland types. This study calculated the importance of the 10 functions of a wetland. As the study objects, 8 pond wetlands, which were evaluated by Son et al. (2010), were taken. The calculated importances were applied on the evaluation results of 8 pond wetlands.

The 10 functions of a pond wetland are; 1. water storage & irrigation (importance 0.185), 2. vegetation diversity (0.144), 3. amphibian & reptile habitat (0.134), 4. water purification (0.118), 5. aquatic insect habitat (0.109), 6. nutriments control was derived (0.081), 7. groundwater recharge (0.073), 8. fishery habitat (0.064), 9. eco-experience & education (0.056), and 10. aesthetic landscape (0.036). The RAM evaluates ponds by 8 functions. The RAM-based evaluation results of 8 pond wetlands were; A:2.29, B:2.29, C:1.17, D:1.80, E:2.29, F:2.45, G:1.88 and H:1.94. The result of conservation value was; Conservation (F)> Improvement (A, B, C, D, E, G, H)>Restoration (None).

The evaluation results are same and most ponds are improvement class because they do not have the importance by RAM function. Among the RAM functions, the item of 'Shoreline/Stream Bank Protection' was excluded because it does not fit with the 10 pond wetland functions. The ponds were evaluated on; 1. floral diversity and wildlife habitat (importance 0.253), 2. fishery and herpetile habitat (0.198), 3. flood/storm water storage (0.185), 4. runoff attenuation (0.081), 5. water quality protection (0.118), 6. aesthetics and recreation (0.092) and 7. groundwater recharge (0.073); while the importances of them were also considered. The RAM evaluation results considered of importance were; A:2.43, B:2.36, C:1.78, D:1.81, E:2.50, F2.60, G:1.92 and H:1.96. The conservation value changed to; Conservation (F, E, A)> Improvement (B, C, D, G, H)>Restoration (None).

Evaluation of wetlands can be an important role in the conservation of wetlands. It was lacked that applied to the importance based on the RAM. Therefore, the development of the evaluation system of the pond type wetland center is required. There is a need to develop the evaluation item of the 10 function of one of the pond wetlands. This is intend to contribute to the Biodiversity of Agricultural Landscape and conservation of wetlands.

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11-PO2.1-19

ANALYSIS OF WATER BALANCE AND COOLING EFFECT OF LOW IMPACT DEVELOPMENT

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Due to the climate change, there is an emerging problems like increasing frequency of heavy rainfall and urban heat island effect. Moreover, there was a rapid urbanization in South Korea and it caused various environmental problems like destruction of natural water and energy cycle.To solve these problems, LID (low impact development) deserves attention. The LID aims to sustainable rainwater management along with recovery of natural water cycle. The LID approaches designed to minimize impervious cover and maximize infiltration of rainwater. In previous studies, it is proved that LID is effective to reduce stormwater runoff. And evapotranspiration of urban green areas can help reduce temperature of the surfaces and surrounding air.The objective of this research is to evaluate the effect of LID using the quantitative simulation of stormwater runoff as well as an amount of infiltration and evapotranspiration and to evaluate the cooling effect due to latent heat of evapotranspiration.

In this study, it will be investigated that improvement effect of hydrological circulation and cooling effect of LID. Hydrological model named STORM is used for the simulation of water balance associated with LID. STORM model was developed to analyze the improvement effect in water balance due to distributed rainwater management plan. STORM model can simulate infiltration and retention components such as green roofs, wetlands and storage tanks. Cooling effect of LID is evaluated as well as water balance analysis. Through the process of evapotranspiration, temperature is reduced due to the latent heat. Amount of reduced temperature due to evapotranspiration is calculated using heat balance equations. For the evaluation of the effect of LID on urban area by the process of hydrological circulation, construction area of the HanamMisa 21th block is decided as a study site. Hydrological simulation and heat balance calculation of LID is conducted at the study site. Water balance of the study site will be compared before and after the installation of LID facilities. And the water balance of each facility is analyzed and mapped.

Results of this research suggest that LID is effective on hydrological circulation improvement and also presents the quantitative analysis of temperature reduction effect of evapotranspiration by latent heat. This research investigates water balance of urban green infrastructure and its spatial placement. It will be useful to help effective water-related spatial planning and it is expected to suggest the quantitative effect of future green infrastructure.

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11-PO2.1-20

CEPA Application IN Urban Wetlands- Case Study of Bamseom Island of Han River

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The Ramsar Convention is the first international convention on sustainable use and preservation of natural resources to ensure the conservation and wise use of wetlands. The Convention proposes the CEPA program as a method for wisely using wetlands, which is an effective tool for preserving the natural ecosystem through an array of activities including cooperation with civic groups, awareness-raising, and environmental education. The CEPA program is based on four aspects – C(communication), E(education), P(participation), A(awareness) – with each having its own objective and plan.

South Korea is also a contracting party to the Ramsar Convention, and recently, Bamseom has been designated and managed as an ecological and landscape preservation area by Seoul city since 1999, and chosen as Ramsar wetlands in 2012. Since then, many studies have been conducted on Bamseom's natural environment, but few on its humanistic, social aspects and CEPA programs.

This study uses three methods -SWOT analysis, GAP analysis, and Scenario analysis -for applying the CEPA program to Bamseom

Bamseom island of Han River has a weak eco-system in aspect of natural environment. So it is desirable to make citizen avoid a direct approach in Bamseom. For wisely use of Bamseom, a different kinds of indirect ways such as humanistic or sociologic approches are suitable to access Bamseom rather than a direct approach. This study reveals that Bamseom, as important urban wetlands, holds great symbolic meaning for Seoul citizens as they can appreciate the beautiful nature. As a result, the Ramsar site designation will help raise public awareness on the importance of it.

11-PO2.1-21

Flora and Life Form of urban wetlands in Seoul

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Much of wetlands are lost for urbanization and industrialization. In recent years, the importance of wetlands has been reevaluated. At this, Seoul City has been designated 10 urban wetlands as an Ecological Landscape Protected Area. We investigated the flora and analyzed life form of Bamseom and Jingwan-dong wetland. Flora is useful measures to understand ecological characteristic. Life form means adaptation to specific environmental condition, interaction of environmental factor and competition in coexisting plants.

According to the survey results, the number of vascular plants in Bamseom were summarized as 138 taxa, including 42 families, 97 genera, 112 species, 22 varieties, 4 forms. It observed from the life-form spectra that Therophyte(Th), Hydrophyte(HH), Hemicryptophyte(H) was the most common dormancy form.

The number of vascular plants in Jingwan-dong wetland were summarized as 188 taxa, including 63 families, 140 genera, 152 species, 27 varieties, 9 forms. It observed from the life-form spectra that Therophyte(Th), Hemicryptophyte(H) was the most common dormancy form.

11-PO2.2-22

AN EVALUATION METHOD OF RIVERINE ENVIRONMENTS BASED ON LIFE HISTORY CHARACTERISTICS OF FRESH WATER FISH SPECIES

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Many stream restoration projects have been conducted in the world. Although various techniques have been designed, an effective to evaluate stream environment in habitat scale is not established. We report a new method that called FBHI (Fish Biological Health Index) as the method. FBHI is a method for the evaluation of the habitat scale riverine environment on the basis of simple fish ecological data. The index has evaluation 14 axis. The axes are (1) native species, (2) migratory fish species, (3) swimming species, (4) swimming in muddy bottom species, (5) swimming in sandy bottom species, (6) swimming in gravely bottom species, (7) swimming in cobbled bottom species, (8) flowing water species, (9) still water species, (10) temporary water (flood plain) species, (11) spawning in vegetation area species, (12) spawning in muddy bottom species, (13) spawning in gravel bottom species, (14) spawning under rocks species. These indexes have following basic concepts. (A) If the ecosystem of the site is healthy, all species which can inhabit at the place appear. (B) Some species do not appear if a certain environmental factor lacks or the quality of ecosystem is not good.

In this presentation, we show the result of evaluation of the stream restoration projects in the Kamisaigo river by using this index. As the results, it is found that the river environment has been improved by the project. Also weakness points of the Kamisaigo river environment were revealed. In particular, floodplain habitat was not sufficiently restored in the Kamisigo River.

11-PO2.2-23

STUDY ON THE OUTFLOW RESTRAINT OF COMBINED SEWER OVERFLOW WHEN RAINY WEATHER BY THE RIVER BASIN MANAGEMENT -AS A CASE OF ZENPUKUJI RIVER OF URBAN RIVER IN TOKYO-

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We begin to act for river reproduction in the Zenpukuji River of Tokyo. Combined sewer system was constructed in the Zenpukuji River basin. Because sewage is discharged into river in rain, it has a bad influence on the usual quality of water and substratum. This study grasped the runoff characteristic of Combined Sewer Overflow(CSO) in the Zenpukuji River. When We set up storage-infiltration equipment in the basin, I state the reduction effect of frequency in runoff from Combined sewer system.

I installed two water gages before and behind sewer dewatering outlets. By rainfall and their data, I examined how much rainfall caused CSO. Then I created the outflow model based on their data and simulated the frequency in runoff when we set up storage-infiltration equipment.

During September 6, 2013 and November 6, it rained 43 times. In those, CSO was caused 9 times.

CSO was caused when the total rainfall exceeds 4-5mm and it was not caused if lower than it. I examined a correction of maximal overflow and maximal rainfall in each interval(5min, 10min, 30min, 1hour). Maximal overflow has a very high correlational relationship with 30min maximal rainfall .

According to the data, I saw even maximal rainfall that is 2.8mm/30min caused CSO.

Based on data so far, I use outflow analysis model of distribution type (Infoworks ICM) and I simulated. As a result, I saw if I install infiltrations in half of houses that are in the Zenpukuji River basin, 40% of maximal overflow is cut and install infiltrations in half of houses and road that are in the Zenpukuji River basin, 96% of maximal overflow

Even little rain caused CSO in the Zenpukuji River basin. At least, we need to impound rainfall to reduce the number of CSO.

11-PO2.2-24

"INAPPROPRIATE" VERSUS "INCONSISTENT" LAND USE: THEIR EFFECT ON WATER QUALITY

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Inconsistencies between official land use and actual land use in suburban areas usually cause environmental problems, such as water and soil pollution by the farms. Inconsistence between pre-existing-land-uses against legal-zoning-uses are a popular phenomenon of developing countries because of the legitimate development are not fast enough to catch the changes of the land use needs. The inconsistence and the inappropriate land use cause the pollution problem in the developed suburban areas. Previous studies have effectively utilized land cover types (LCTs, often referred to as land use) or their change to evaluate development intensity in natural environments, including the watersheds of rivers, streams and lakes (Kim & Pauleit, 2009; Brown & Vivas, 2005). Along with inappropriate land use, which is usually relative to urban sprawl or population growth, this study focuses on small but inconsistent land use. We attempt to provide stronger evidence to help the decision-makers to establish accurate and detailed land use policy, even to legislated regulations. Therefore, we examine how LCTs and LUDs (land use disparities) impact water quality, which is one of the most important environmental factors.

To achieve this purpose, we selected typical suburban areas in Taiwan. Each area contains 3 land use types (forest, agriculture, and urban) and a reservoir with a perennial river. These areas were identified on an official land use zoning plan and an aerial photo. We adopted the identified aerial photo as a LCT map and overlapped the zoning plan on the LCT map to get a LUD map. On the other hand, this study employs the CTSI, which integrates total phosphorus (TP), Secchi depth (SD), and chlorophyll a (Chl-a) values (Carlson 1977) as water quality parameters. We examined the correlation between LCTs/LUDs and CTSI at 3 scales: watershed, reservoir buffer zone, and riparian corridor.

In accordance with our purpose, the results of this study demonstrate the positive effects of forest LCT and the negative impact of agricultural LCT on water quality, as well as increasing nutrient pollution for the "forest as urban" LUD. Moreover, the effects of LCT are significant at both reservoir buffer zone and riparian corridor scales, whereas the effects of LUD are significant at the reservoir buffer scale. The main findings indicate that the land use associated with the buffer zones, regardless of LCTs or LUDs, are more critical than they are throughout the entire watershed, and this was also noted in related studies (Guo et al., 2010; Sliva and Williams, 2001). This study successfully proves that the inconsistencies between official land use plans and actual land use cause small but non-negligible legal loopholes. The problem of LUDs must be addressed and solved through more completed land use regulations, which aim to remove conflicting pre-existing uses and reviews of re-zoning applications, along with the environmental management regulations.

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11-PO2.3-25

JAPANESE OAK WILT AND GRAZING DAMAGE BY SHIKA DEER ARE THREATENING THE HEALTH OF SECONDARY FORESTS, "SATOYAMA"

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A drastic change is occurring in the vegetation of secondary forests called "Satoyama" that are surrounding rural communities in Japan. The spread of Japanese oak wilt and increasing population of shika deer (*Cervus nippon*) are the main causes. The pathogenic fungus of the Japanese oak wilt, *Raffaelea quercivora* is vectored by an ambrosia beetle, *Platypus quercivorus*. This disease is occurring in the mature aged stands that had been used for fuel wood and charcoal production and then left unmanaged because wood fuels were replaced with gas and kerosene since 1950s in Japan. The vector beetle propagates effectively in thicker trunks. The infestation is increasing annually in aged "Satoyama" forests. Korean oak wilt is a similar disease caused by a congeneric fungus. Protection of oak trees with pesticides is very difficult in the forested area although it is sometimes successful in the urban parks. In the "Satoyama" of western Japan, several evergreen small trees and shrubs such as *Ilex pedunculosa* and *Eurya japonica*, and short-lived species such as *Lyonia neziki* will become dominant after the death of aged oak trees.Itô et al. (2008) reported the condition of the stands damaged by the Japanese oak wilt.To reduce oak mortality, rejuvenation of trees by small-scale clear-cutting (ca. 0.1ha) is effective because the vector beetle cannot propagate in the thin trunks (Kuroda et al. 2008).Experiments of forest rejuvenation combined with the utilization of biomass as fuel wood were successful by a coordinated effort among citizens, local governments and researchers (Kuroda et al. 2012).

In the "Satoyama", grazing damage by shika deer is increasing in severity due to the failure of wildlife management. Although the crops in the agricultural fields are well protected by the fences to block the deer invasion, unmanaged and abandoned "Satoyama" forests are unprotected and the deer are free to graze on a variety of plant material from tree bark, twigs, leaves, to seedlings and grasses. As a result, vegetation on the forest floor is sparse or nonexistent where the deer population is high. Only the Japanese andromeda (Pieris japonica subsp. japonica) with toxic leaves and holly (Osmanthus heterophyllus) with thorny leaves are left after active grazing by deer. This is a serious problem because tree seedlings important for the sustainability of the forests are disappearing. In addition, sprouts from the stump of oak trees cannot grow without protection from the deer. For the recovery of vegetation in such forests, population management of shika deer is imperative.

These two phenomena will exacerbate deterioration of biodiversity and erosion of the soil in the "Satoyama" forests. Controlling the population of shika deer is an especially urgent for reestablishing healthy forests by the rejuvenation of oak trees. Recently, local governments are promoting hunting of the deer with traps.

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11-PO2.3-26

LANDSCAPE STUDIO PROJECT: TRANSFORMATION OF A POLLUTED STREAM TO AN URBAN PARK

Author(s)[1][Asst. Professor Sonal Tiwari[1], Prof. Savita Raje]

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This paper discusses on the process of landscape design project on stream revitalization based on urban planning and landscape conservation of Master of landscape Architecture program at School of Planning and Architetcure Bhopal.

The study area is a polluted stream which runs across the center of the city of Bhopal and connects the new and the old developments. Around two decades back the river was a fresh water stream which would flow through the city to a historical lake, 'Lower lake'. The recent urban densification lead to loss of this natural open space by means of unauthorized settlements, improper waste disposal etc. The stream and the Lower Lake where it ends are in eutrophic status The process envisioned on reclaiming the ecology of the stream and transforming to a valuable open space in the city social structure.

The design process continued with design rationales, solutions and recommendation to interpret an urban regeneration strategy to the place. As a result, the design process enabled students to understand landscape conservation theories, landscape remediation technologies, urban design technique and application on how to regenerate a poor urban place while maintaining its identity of place .

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11-PO2.3-27

‘Ecological playground’ Creation plan and case study for ecological restoration in city

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“Ecological playground” refers to the natural ecological space created to provide various natural factors and materials such as soil, water, grass, tree, plant and animal for both children and parents residing in urban to access the natural ecology at the shortest distance from their home.

A playground is a place where children can play and at the same time, this place is to create community for residents, playing a crucial role in developing children’s emotion. Accordingly, the playground must be built in the residential complex within the city; however, the currently existing playground is to provide a space on a certain area as stipulated in the related laws but doesn’t really reflect the regional characteristics; therefore, the playground with the simple, repeated play facilities, failed to provide children with plays in varied form.

This ecological playground was proposed as an action taken on children lack of opportunity to access the surrounding natural environment due to economical access to city under a rapidly development in the modern society. At a time, this playground is aimed at creating itself as a habitat for species by using the existing geographical features and surrounding ecosystem. By doing this, the ecological playground will pose its function of natural circulation and secure green zone and water space on the natural ground to provide an environment for recovering the biodiversity in the city. Therefore, this playground will recover the ecological function of abandoned or damaged land in the city and provide an excellent environment with the beautiful landscape; ultimately, providing a long-term value and information of surrounding ecology to children and residential community. In addition to this, providing natural material-based playground will lead children to create their own style or form of playing, which is highly differentiated from the existing playground providing a repeated play source.

The cases in this academic publication are the subject areas selected through the demand survey conducted by each local government to create an ecological playground to be built as the policy project of the Ministry of Environment. This playground is either classified into: forest type located in a joint of urban and forest area, waterside located near the river, stream and wetland, and urban living type located in the city surrounding with buildings. This classification was proposed by a guideline on the creation of ecological playground and through this, the expected ecological restoration and enhancement of biodiversity are to be discussed.

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11-PO2.3-28

AN ECOLOGICAL AND ENVIRONMENTAL RESTORATION OF DISPOSAL DETENTION SYSTEM

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This study examines an ecological and environmental restoration of the first ever made dispersal detention system in the Housing District of Shinjeong 3-jigu, in Seoul as follows. First, the dispersal detention system was designed on the basis of renovating the existing single structure detention of 28,337m^3/d into a dispersal type detention, where the total capacity was increased by 5,269m^3 to 33,606m^3/d. With such a restorative design, the system is equipped with the capacity of flood prevention which happens every hundred years. Second, the SSB(Sustainable Structured wetland Biotop) system as the New Excellent Technology of Korean government with proven ecological and environmental restoration method was applied to the disposal detention system. Then it was possible to reach the ecological water purification efficiency of BOD 63.6%, SS 89.4%, T-N 30.1%, and T-P 69.1%. Ecological treatment of non-point pollutant sources in the dispersal detention system has been maintained for the effluent clean water quality. Third, the result of ecological restoration in the first year after construction showed that 1 adult and 10 tadpoles of the endangered species of narrow mouth frog were successfully restored in the detention system. A number of different amphibian species such as 28 adults and 1,000 tadpoles of black spotted pond frogs, 31 adults and 1,500 tadpoles of tree frogs and 30 younglings of Korean Brown Frogs indicating for biological diversity were found in the system. Fourth, the disposal detention system provides people with various educational and recreational activities themed on ecological and environmental restoration.

Key word : Dispersal Detention, Ecological and Environmental Restoration, SSB system, Ecological Water Purification.

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11-PO2.3-29

Urban Agriculture Master Plan of Seoul

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Urban agriculture is emphasized for securing safe food, solution of urban heat island, conservation of urban biodiversity, and the other environmental problems in Seoul. And various public services are delivered for expanding multiple functions of urban agriculture. And so local governments prepare to establish a master plan of urban agriculture in Korea.

The city of Seoul declares the first year of urban agriculture in 2012, and then seoul agriculture master plan was established in 2013. The vision of master plan is 'Seoul urban agriculture for our family, neighbors and earth'. The Action Plans are to supply of family kitchen garden at every house, community garden at every neighborhood, and school farm at every school.

Seoul city government will push promote a support center of urban agriculture, Seoul urban agriculture forum, creating new jobs of urban agriculture. Also the environmental aspect of urban agriculture is important. So Seoul city government have to promote and invigorate urban agriculture for the sustainable city.

11-PO3.1-30

Conservation of Greater Adjutant Stork by Communities in kamrup, Assam: A case study of an endangered urban bird

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Greater Adjutant *Leptoptilos dubious* is an endangered bird with an estimated global population of less than 1000 birds. Habitat loss and poaching were identified as major threat to this bird and population was in decreasing trend. Assam is considered its last stronghold. In Assam this colonial nesting bird makes nesting colonies in the Brahmaputra valley and mainly in privately owned trees within thickly populated human settlements. But, in non breeding seasons they congregates in garbage dumps, butcher houses in cities. Borgaon garbage dump in Guwahati city is found to support worlds largest population. In recent years, many nesting colonies in Assam are missing and population was going down. Nest tree owners used to cut nesting trees to avoid rotten and smelly nest fall materials and excreta of this carnivore bird in their backyards. Many nest tree owners cut the nesting trees to earn their livelihood too. Willingness of nest tree owner is the key for conservation of this bird. Interestingly, worlds largest poupulation of this bird breeds in Dadara Pasariya and Singimari nesting colony, very near to Guwahati city of kamrup District. Garbage dump of Guwhati city attracts the birds in the non breeding season and in breeding seasons, wetlands in Guwahati and Dadara ,Pasariya,Singimari villages provides foods specially fishes, snakes, snails ets. In breeding seasons, birds extensively feed on live vertevrates to fulfill its high calcium requirement and thus conservation of wetlands is crucial. We initiated a community conservation programme for this bird in its biggest nesting colony in Kamrp

Study Area

district of Assam. Using various community conservation tool, we could develop "ownership feeling" for this bird by the villagers. Fisherman were educated to reduce the threats during fishing on wetlands. We consciously avoided any cash incentive for protection of this bird by the villagers. Inkind support was provided once they felt ownership feelings for the bird. In return population of this bird had increased in this nesting colony which is about 50% of its global population.

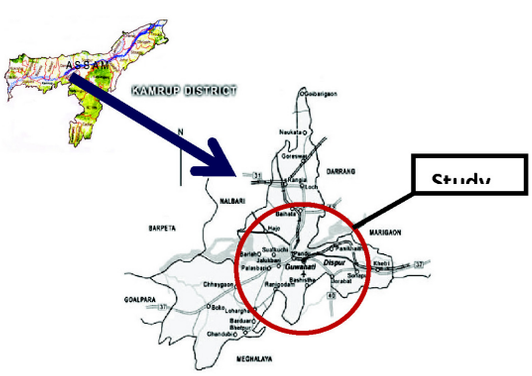

Fig: Study Area

Fig: Greater Adjutant Stork and its chicks

11-PO3.1-40

WE – "THE FARMERS"

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Indian urban physical space boundaries are melting and expanding multi-directionally, encapsulating the suburbs and the rural lands around them. This amplification brings home new opportunities and challenges, both. The urban metropolitan canvas demands sustainability – economic, environmental and social; while the former two have been emphasized adequately, social aspect by and large remains untouched on the practical field. In the hustle and bustle of large migration of skilled labor especially in information technology, heavy investments in the industries, huge acquisition of agriculture lands, ballooning of urban economic activities; cities have become hubs and magnets of growth, whereas social inclusion has been left to be rendered through the externalities and spillovers alone. In the midst of this, one community that looks lost and neglected the most is, the 'farmer community'. Sudden escalation in their land value, prima facie has given them enormous hope and confidence, but their space is yet to be created officially and formally. In the given scenario few cases that stand out as prospective role models, leading by example are select integrated townships, which have used an innovative and sustainable social inclusion model to reverse the trend. Agriculture lands are no more surrendered but pooled in and farmers are made partners in the business. This is a new co-operative model in real estate business and urban development, where farmers become partners and share profitability. The townships are 100 acres and above in size and are designed to accommodate - SEZ, IT park, retail, recreation, residence, green lands and also the farmers, all in harmony; where farmers are now owners, entrepreneurs and skilled workers. Most importantly, they are now enjoying the status of being a part of main stream economy with a role as never before. This piece of research is an attempt to study the model of such integrated townships and analyze its sustainability and replicability. The paper will use case study method and would draw upon the same.

Key words: Externality, Integrated township, Social inclusion, Sustainability.

11-PO3.2-31

ECOLOGY, ECOSYSTEM SERVICES AND ECONOMICS IN MULTIFUNCTIONAL LANDSCAPES

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Multi-functionality of landscapes is assured by incorporating woodlots, rain gardens, use of native vegetation and ponds or constructed wetlands. Landscapes based on ecological principles are capable of sustainingkey ecosystem services －breakdown of pollutants, water purification, habitats that support beneficial species, trophic structures that sustain species interaction and increased throughput from the system. Designing for multi-functionality enables the conservation of soil, water and biodiversity. Agricultural farmers have used this to derive economic benefits.Four landscape designs from small-holder farm plots in south India will be presented to demonstrate that sound ecology makes economic sense.

This articleaims to connect the dots between ecology, ecosystem services and economics in multifunctional landscapes. This article discusseshow private urban landscapes － apartment complexes, townships, private parks － may be guided to create multi-functional landscapes.India is a country where a rapid expansion of private urban landscapes has led to the degradation of ecosystems. Regulatory measures to reverse the process are as yet weak or not fully implemented. This is a bottom-up approach which shifts the onus of conservation to the private sector and citizens.

* I do not wish to disclose my company affiliation. The views expressed here are personal.

FOREST VEGETATION CONDITION AND MEASURES OF TEMPLES UNDER THE INFLUENCE OF DEER BROWSING ALONG THE BASE OF HILLS AROUND KYOTO BASIN

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Introduction

There are many temples and shrines in Kyoto, some of them are located at the foot of hills and traditionally have gardens which is regarded as touristic resources now. Landscape of Kyoto is rich in green historically and has been keeping the high value as one of the mecca of tourism of Japan. In addition the plantations and surrounding forests are regarded as important elements for their landscape, suggests the necessity to take some measures against the damages caused by wild animals such as sika deer (*Cervus Nippon* Temminck) whose number has rapidly increased in these decades and made forest vegetation declined by browsing. In this study we conducted the survey about the damage on vegetation by wild animals and about the measures against the damage in 36 famous temples and shrines located at the foot of hills around Kyoto Basin aiming at the grasp of current condition of landscape surrounding Kyoto City.

Methods

We distributed questionnaires to the 36 sites and obtained the 33 answers. We also conducted vegetation survey and research on the traces of sika deer at 38 sites in the surrounding forests of the 36 temples and shrines, and estimated the damage by sika deer.

Results and Discussions

The results of questionnaires revealed that sika deer appeared in precincts of 17 temples and shrines. On the other hand, at some sites where the road with large deal of traffic intercepts the cross of animals any damage was not found. The damage by sika deer was not verified before 1990s then it began to be verified in 2000s. At present 13 sites are damaged for their planting, and fences are set up on 15 sites. The main plant species damaged in study areas, such as cherry blossoms (*Cerasus jamasakura* H.Ohba, etc.), ume blossoms (*Prunus mume* Sieb. et Zucc.), hydrangeas (*Hydrangea macrophylla* Seringe), Japanese maples (*Acer palmatum* Thunberg), and so on were considered as important resources not only for temples and shrines but for tourists. The results of research on the surrounding forests also revealed that the damage by sika deer was found in 27 of the 38 sites. It suggests the possibility that the temples and shrines without any animal damages at present can be damaged in the future. While, some temples and shrines install fences by themselves uniquely as measures against wild animals, shows the necessity to share the information each other.

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11-PO4.1-33

EVALUATION ON VEGETATION GROWTH CONDITION AND SPECIES COMPOSITION OF A REFORESTED SLOPE IN 18 YEARS AFTER CONSTRUCTION AT SOUTHERN KYOTO, JAPAN

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Re-vegetation on man-made slope has been aimed at reduction risks of slope erosion[2)]. After 1990s, social requirement to these slopes added to create the similar vegetation with surrounding forest vegetation. This wave claimed not only the protection slope surface but also the conservation of environment and landscape[2)]. As a result, plantation of tree seedling similar to the common natural species consisting of surrounding tree species has been continued.

Nowadays, there are many sites long term after plantation, and the necessity to monitor these sites are increasing. In spite of a lot of growth monitoring reports concerning to a few years after plantation[1)], studies of the plantation sites long time after plantation and the evaluation of species diversity or composition are rare. We evaluated vegetation condition, species diversity and species composition of a reforested slope long after construction.

Study site is a reforested slope at southern Kyoto, Japan, constructed and planted in 1994, and the secondary forest around the study slope to compare with the study slope. Six 10m×10m plots were set up on the study slope (two plots on each column), and three 15m×15m plots at the secondary forest. In each plot tree species, diameter at breast height (DBH) and tree height were recorded. To understand the vegetation condition, herbaceous, vine and tree species on each four height class (Layer1: higher than 10m, Layer2: 5-10m, Layer3: 1.3-5m, Layer4: lower than 1.3m) were recorded. Fisheye photograph was taken at each plot for calculation of canopy-gap rate. Sorensen Indexes, indicating dissimilarity of species composition, were calculated between the study slope and the secondary forest, each Layer.

As results, 81.3% of planting trees were alive, average height was 8.04m. The tallest one was 15.10m (*Quercus acutissima*). Gap areas at all slope-plots were less than 10%, suggested canopy of the plantation slope was closed. Total basal area (BA) of tree was 38.53m^2, larger than BA of the secondary forest, 25.26m^2.

On the other hand, at slope plots, the number of seedlings and saplings were small, and occurring of new individuals was found only in Layer4. These individuals were regarded as current year seedlings. Sorensen Indexes were relatively high, over 0.5 on each Layer, especially Layer2 and 3 (over 0.9), showed the clear difference of vegetation condition between slope and the surrounding forest.

According to these results, we concluded that the plantation site is keeping enough volume of green than the surrounding forest, but the ecological quality of plantation site is inferior to the surrounding forests from the points of stand structure and species composition.

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11-PO4.1-34

IMPACTS OF LAND-USE CHANGE ON BIODIVERSITY: AN ASSESSMENT OF URBAN BIODIVERSITY IN BHOPAL

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As more and more people live in cities, restoration, preservation and enhancement of biodiversity in urban areas become important (Cariñanos & Casares-Porcel). Various kinds of urban development have significant and variable impact on biodiversity which are needed to be identified for conservation based planning.

The study is based on findings of LBSAP (local biodiversity strategy and action plan) studio. The studio adopted a suite of methodologies, which included literature review, field surveys, discussions with informants, focus group discussion, and interviews with individuals and organisations working on urban and biodiversity issues. The site selected for the study was Bhopal urban area. Biodiversity mapping on the various city zones was done; which led to analysis of various urban development's and their impacts on biodiversity. Biodiversity indicators where provided to each of the study zones.

The study concludes with the assessment and analysis of different urban land uses in terms of biodiversity.

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11-PO4.3-35

A 3-D RADIATIVE SIMULATION OF CARBON, WATER AND ENERGY FLUXES IN AN URBAN ECOSYSTEM

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Urban vegetation, especially vegetation in urban parks, is unlikely to be homogeneous. It is common that vegetation in urban parks has a complex profile such as vertical vegetation structure, planar distribution, and species composition. Although many advanced studies introduced up scaling of biophysical processes on a leaf surface to canopy level or ecosystem level, applying the upscaling methods to urban parks has remained challenging due to the heterogeneity in vegetation.

We propose to use an ensemble of a 3-D radiative transfer model, Forest Light Environment Simulator, and a 1-D biogeochemical model, CANOAK, to estimate carbon, water and energy flux in an urban park, Seoul Forest Park (Seoul, the Republic of Korea). Through a series of intensive field works, we prepared model input data such as tree positions, crown shapes, leaf area density, photosynthetic parameters such as Vcmax and Jmax. Meteorological data were derived from flux tower observations. We evaluate the model performance against flux tower observations and discuss how the canopy flux modeling in the urban park could be improved.

11-PO4.3-36

RESPONSES OF NATIVE TREE SPECIES IN KOREA UNDER ELEVATED CARBON DIOXIDE (CO2) CONDITION – OPEN TOP CHAMBER (OTC) EXPERIMENT

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The physiological responses of three common temperate and native species in Republic of Korea, *Pinus densiflora, Fraxinus rhynchophylla, Sorbus alnifolia* to elevated CO_2 was investigated using open top chambers with different CO_2 concentrations. Morphological (stomatal size, density and area) and physiological characteristics (maximum rates of photosynthesis, carboxylation and electron transport) were compared among trees grown under ambient, ambient × 1.4 (~550 ppm) and ambient × 1.8 (~700 ppm) CO_2 concentrations for last four years. Morphological responses were different among species. *F. rhynchophyllar* increased their stomatal size and *S.alnifolia* had higher stomatal density under elevated CO_2 than ambient.Stomatal area decreased in *P. densiflora*, whereas it increased in *S. alnifolia*. However, the maximum photosynthesis rate increased in all species up to 43.5% by *S. alnifolia* under elevated CO_2 and the enhancement increased with time. Even with four years of exposure to elevated CO_2, there was no sign of acclimation in the maximum carboxylation rate and the maximum electron transport rates in all species. Especially, *S. alnifolia* even showed the temporary increase of photosynthetic capacities in spring, when leaf nitrogen concentration was high with new leaf development. There was no significant differences in diameter growth rate in any species due to high variation in their tree sizes, however accumulated diameter and biomass for four years showed significantly increment in all species under elevated CO2. For example, *S. alnifolia* showed 59% increase in diameter at the ambient × 1.8 (~700 ppm) compared to ambient.

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11-PO4.4-37

APPLICATION OF AIRBORNE LIDAR DATA FOR MAPPING TREE COMMUNITY COMPOSITION OF URBAN FOREST IN KYOTO

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There is a long-standing practice of managing urban secondary forests in Japan. These forests are renowned for their cultural and aesthetic significance, as well as their rich fauna and flora. Especially in Kyoto, the former capital of Japan, the forests are important visual elements of many Japanese gardens and other cultural heritage sites. However, recent problems, including pine wilt disease, the mass mortality of oak species, and animal grazing, have caused extensive damage to these forests. In addition, there is the retreat of scenery caused by gradual change to the simple forests consisting of evergreen broad-leaved species. Mapping the distribution of tree species composition provides the fundamental information required for the successful management planning of these forests.

Within the established sample plots over the mountains that surround the Shugakuin Imperial Villa, Kyoto, Japan (35○03′N, 135○48′E), species of all living woody plants ≥1 cm in DBH were recorded. To analyze the composition of tree species, we applied nonmetric multidimensional scaling (nMDS) using the number of trees of each species in the sample plots. LiDAR data were acquired by helicopter using a Riegl LMS-Q560 for the whole study area and the relation between LiDAR variables and community composition was evaluated. Our results suggest that there is a potential for utilizing LiDAR data for monitoring tree diversity in urban forests.

11-PO4.4-38

DEVELOPMENT OF A NEW INSTRUMENT THAT ASSESSES TREE VIGOR BASED ON DELAYED FLUORESCENCE

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Tree vigor assessment is essential for growing healthy urban trees, which is important to fully exhibit trees' environmental functions such as alleviating urban climate, fixing carbon, and improving aesthetic beauty and amenity. In practice, tree vigor is usually visually assessed using 4- or 5-point scale check list on several items such as tree shape, branch growth, leaf density, leaf size, leaf color, trunk decay and so on. This visual assessment is useful, however, it is pointed out that it highly depends on ability of surveyors. Therefore, quantitative assessment of tree vigor is needed.Although there are several types of indicators that quantitatively measure vigor of trees, we focused on photosynthetic status of leaves because photosynthesis is the key process that converts light energy to a form that can be utilized in a tree.

Delayed fluorescence (DF) is light that is emitted from green plants, algae and photosynthesizing bacteria in the red-infra-red region of the spectrum after they have been exposed to light, but after the prompt fluorescence (chlorophyll fluorescence) has decayed (Goltsev et al. 2009). The origin of light emission is different from chlorophyll fluorescence. The DF occurs as a result of back electron transfer and charge recombination in the reaction center of Photosystem II (PS II), followed by repopulation of the excited chlorophyll state of the PS II antenna system by fast energy transfer. The high sensitivity of photosynthesis to environmental factors, and the sensitivity of DF to changes in the different photosynthetic processes have made DF a potentially useful indicator for assessing tree vigor.

Firstly, we conducted the experiment that adds acute drought stress on leaves. We added drought stress on a leaf using a pressure chamber, and recorded DF data under the three conditions: non-stressed, -2.0MPa and -3.0 MPa of water potential, with 30 replicates for each of five different landscaping trees (*Benthamidia japonica*, *Cerasus jamasakura* var. *jamasakura*, *Cinnamomum camphora*, *Cerasus* × *yedoensis* 'Somei-yoshino', and *Camellia japonica*). As a result, we found that the intensity of DF from 0.2 to 1.4 seconds had the strongest correlation to water potential. The performance of DF was superior to the well-known indicators of plant stress: Fv/Fm of chlorophyll fluorescence that represents the maximum potential quantum efficiency of PS II, or SPAD value, a chlorophyll content index of a leaf measured by the SPAD-502 chlorophyll meter.

Secondly, we investigated relationship between DF and branch growth in field. We collected data from 102 adult trees of *Cerasus jamasakura* var. *jamasakura* in August 2011. As a result, we found that the intensity of DF around 30 seconds had the strongest correlation to length of branch growth. The performance of DF was superior to Fv/Fm or SPAD value.

Although the effective time in DF were different between the two studies, it was revealed that DF was better indicator of tree vigor than Fv/Fm or SPAD value.

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11-PO4.4-42

THE SELECTION OF REMOTE SENSING TECHNOLOGIES FOR THE IDENTIFICATION AND OPTIMISATION OF URBAN ECOLOGICAL INFRASTRUCTURE IN ASIA

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Cites within Asia are experiencing rapid urbanization as a result of rural-to-urban migration and land-use-change. In some instances urban expansion is resulting in urban regions and territories. Megacities embedded within such urban regions concentrate global investment, make efficient use of resources and promote economies of scale. However such urban density also results in debilitating urban externalities, such as poor environmental quality, urban health problems and urban poverty, limiting the potentially positive impacts of urbanization.

Ecological infrastructure provides ecosystem services that can reduce and even negate the impact of such externalities. Despite Asia's rich biodiversity and highly productive ecosystems, in per capita terms, such natural resources are more limited than any other region. In their prioritization of urban growth, Asian cities have not paid sufficient attention to environmental issues. The strengthening of ecological infrastructure within such urbanizing regions is imperative in this context.

Due to its ability to capture the detailed characteristics of landscapes over large areas, remote sensing is increasingly used as an essential technology to monitor urban expansion and its effects on ecosystems. However such capabilities have not been systematically assessed in relation to ecological infrastructure. This paper considers the proliferation of remote sensing technologies in relation to the complex patterning and material characteristics of urban ecological infrastructure. The ability of different sensors to capture different types of ecological infrastructure is reviewed through a survey of current literature and presented in a comparative matrix. Such analysis reveals the potential for different types of sensors to be used in combination to build up a more comprehensive understanding of ecological infrastructure in the face of Asia's urban challenge.

11-PO4.4-43

MONITORING PERI-URBAN WATER AND LAND-USE STRUCTURES USING WORLDVIEW-2 SATELLITE IMAGE DATA OF THE FAST GROWING URBAN CENTRE HYDERABAD/INDIA

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In this paper the research questions are focused at first on whether the new spectral capabilities of WV-2 instrument are sufficient to analyze and monitor by object-based classification the exact geography (form, extension, surrounding micro-scale land use) of surface water bodies and streams in the peri-urban areas of Hyderabad/India. Secondly, the potential of the new data has been evaluated to detect the lakes' occupation with water plants and ecological quality parameters as well as their conflicting interrelationship (consequences like increasing impermeable surfaces, loss of natural and unsealed soils, misuse of open water bodies as sewage drains, etc.) with neighboring urban land uses.

Since the modest beginning of surface water inventory the remote sensing application scenario has witnessed a phase of transition from resource mapping to decision-making. Remote sensing has thus become one of the most important tools for evaluation of the physical attributes of water and land resources. Satellite remote sensing along with appropriate collateral data enable the inventory of quantity, quality as well as the values of the resources. The repetitive nature of space-based earth observation provides the unique opportunity to do the accounting on a periodic basis. We believe that WV-2 data can help making significant progress in analyzing and monitoring a detailed inventory of natural resources in the vicinity of large urban agglomerations.

Cities are mostly located near adequate - or once adequate - water supplies, usually near-groundwater. Similar to Hyderabad there are many examples in southern Asia, or other developing countries in semi-arid or arid climate environments where the concentrated water demand of growing urban populations has induced groundwater overexploitation. Resulting water shortness has often been responded by tapping water from farther catchments which disagrees with the principles of sustainability. Thus the need for adequate methods for monitoring urban water resources can be highlighted. There are wide ranges for remote sensing based applications which bring the advantages of being a repetitively available and cost-effective data source. Optical satellite data, such as provided from World-View 2, combines high spatial and spectral resolution, which is required to study the urban water resources, their conditions and the interdependency with the neighbouring urban land uses.

With the availability of Very High Resolution (VHR) satellite imagery - here latest WorldView-2 data - new potentials but also new challenges for analysis strategies and methods are emerging. In our contribution we want to tackle the above described process of increasing urbanization and fast development of suburban landscapes with a special focus on its LC/LU changes consequences on peri-urban lakes and water bodies.

11-PO1.1-44

GROWTH AND TEMPERATURE CHANGES OF GREEN ROOF PLANTING TYPE ACCORDING TO THE DEGREE OF IRRIGATION MANAGEMENT

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Recently, greenery system is frequently applied on buildings and artificial grounds to improve urban ecological functionality. Green roofs can reduce surface water runoff, provide a habitat for wildlife moderate the urban heat island effect, improve building insulation and energy efficiency, improve the air quality, create aesthetic and amenity value, and preserve the roof's waterproofing. Specifically, architectural greenery is also known as an architectural language that can meet the sustainable design concept of architects. Therefore, this study is expected to establish the comtemporary architecture as building, landscape architecture and the greenery technology. and This result will be used as a basic study to promote developing the advanced system based on the concept of consilience.

The type of green roof system is generally divided into light-weight green roof and heavy-weight green roof and medium weight depending on building structure and permissible load of building in Korea. It is very important decision of green roof type for each building characteristics and properly management of green roof after construction. This study was conducted investigation of index of greeness and examining the time series for the final aim, landscape architecture conjunction simulation with building. It was carried out on five existing rooftop site from march in 2012 to October in 2014. Using CANON 450D with 18 ~ 55mm and Auto CAD ver.2010 program, time series was analyzed. In this study, green roof planting type was divided into herbaceous plants group, shrub with herbaceous group and shrub and tree with herbaceous group. There was difference in each planting type depending on management degrees. In case of herbaceous plants group, is generally applicated low live-load building, had changes depending on irrigation management. In case of shrub with herbaceous plant group and tree with herbaceous plants group, had differences by extensive or intensive management. Index of Greeness of two groups was recorded higher in intensive management than in extensive management, especially summer and fall season.

The sustainability of greenery is ultimately determined by management specifications and intensity. The intensity of irrigation management may be directly linked with landscaping design and the growth condition for plants. Consequently, the degree of management burdens can be addressed effectively and economically based on a reasonable landscaping design and the condition of planted greenery(Derek and Jeremy, 2008). Furthermore, such results suggest that plant community research and landscape aesthetic research with respect to rooftop greenery should be conducted in tandem.

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