


2017 INTERNATIONAL SYMPOSIUM OF BAEKDUDAEGAN NATIONAL ARBORETUM

“
Future of BDNA·Seed Vault
for Global Biodiversity
Conservation ”

27 October 2017

Host by  Korea Forest Service

Organized by  국립백두대간수목원
Baekdudaegan National Arboretum

Sponsored by  Korean Association of
Botanical Gardens and Arboreta  한국식물분류학회
THE KOREAN SOCIETY OF PLANT TAXONOMISTS 아시아식물분포연구회

 국립백두대간수목원
Baekdudaegan National Arboretum

Seed Vault



국립백두대간수목원 현황

국립백두대간수목원은 백두대간 자생식물과 우리나라 희귀·특산 식물, 그리고 고산식물을 수집·증식하여 보존하고 이를 전시, 교육하기 위해 조성되었으며 기후변화와 생물다양성 협약에 적극 대응하여 국가의 생물주권을 강화하는 중추적 역할과 지역사회의 발전에 기여하기 위해 조성된 수목원이다.

국립백두대간수목원은 세계 유일의 야생 식물 종자저장시설인 시드볼트(Seed Vault)를 비롯한 연구시설과 26개의 다양한 주제원 등으로 구성되어 있다

식물 보유 현황 - 국립백두대간수목원 내 1,982종 361만본 식재

국립백두대간수목원 내 식물 식재 현황

구 분	자생식물	희귀식물	특산식물
식재 종 / 전체 종	678 / 4,176	126 / 571	57 / 360
비 율	16.2%	23.3%	15.8%

주요 전시원

고산식물 수집 및 보전



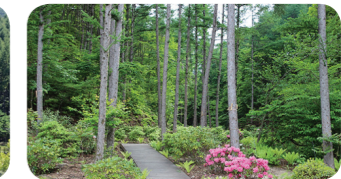
암석원

백두대간 자생식물 수집 및 보전



백두대간 자생식물원

진달래속 식물 수집 및 보전



만병초원

종자연구 저장시설(Seed Vault) 현황

지구온난화 등 기후변화로 생존 위협을 받고 있는 백두대간 지역의 고산식물과 이와 근연관계에 있는 아시아 지역 식물 종을 수집하여 장기·안정적으로 영구 보존하고 관련 연구 수행

시설 현황

- 사업 기간 : '09~'15(7년간)
- 사업 규모
 - 면 적 : 4,327㎡(중·장기 저장시설, 연구실, 실험실 등 포함)
 - 규 모 : 지하 40m, 진입터널(폭 8m× 연장 130m) 및 저장터널(폭 7m× 연장 37m)
 - 저장규모 : 200만점 이상
 - 저장환경 : -20℃±1, 상대습도 40% 유지, 연중 항온·항습 냉방시스템 가동
- 시설 특성 : 지하터널형 산림종자 중복보존시설

종자저장 현황

- 국립수목원, 고려대학교 등 16개 기관 3,243종 45,092점
- ※ ('15년) 20,180점 → ('16년) 20,303점 → ('17년) 4,609점



Seed Vault 전경



지하저장시설

About Baekdudaegan National Arboretum

Baekdudaegan National Arboretum is established to exhibit, educate and preserve native plants of Baekdudaegan, rare plants, endemic plants and alpine plants of Korea by collecting and multiplying them. Also, the arboretum not only contributes to the development of regional communities in Korea but also plays a key role in strengthening biological sovereignty by aggressively engaging in Convention on Biological Diversity and addressing climate change issues.

The Baekdudaegan National Arboretum has Seed Vault, -the only vault in the world housing seeds of wild plants- research facilities and gardens with 26 different themes.

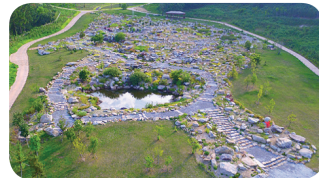
Plants in the Arboretum - 3.61 million plants of 1,982 species are growing in the Baekdudaegan National Arboretum

Status of Plants in the Arboretum

Category	Native Plants	Rare Plants	Endemic Plants
Planted / Total Species	678 / 4,176	126 / 571	57 / 360
Ratio	16.2%	23.3%	15.8%

Key Gardens

Alpine Plants



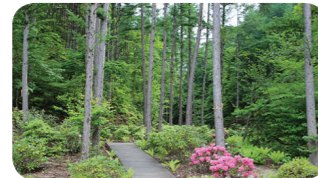
Rocks Garden

Native Plants of Baekdudaegan



Baekdudaegan Native Plants Garden

Rhododendrons



Rhododendron Garden

About Seed Vault

The Seed Vault was built to store seeds of alpine plants native to Baekdudaegan region and their relatives in Asia which are threatened by global warming and climate change. The seeds are permanently preserved in a stable manner and used in related research

Status of Facilities

- Project Period : '09-'15 (for 7 years)
- Facilities Details
 - Gross Area : 4,327m² (incl. mid to long term storage, office, lab)
 - Size : located in 40m below the surface, consisted of an entrance tunnel (w 8m × l 130m) and a storage tunnel (w 7m × l 37m)
 - Storage Volume : More than 2 million plants
 - Storage Environment : -20°C ± 1, relative humidity of 40%, constant HVAC system at all times
- Characteristics : underground tunnel-type multiple seed storage

Status of Seed Storage

- 45,092 seeds of 3,243 species from 16 institutions including Korea National Arboretum and Korea University
- ※ (2015) 20,180 seeds → (2016) 20,303 → (2017) 4,609



Seed Vault

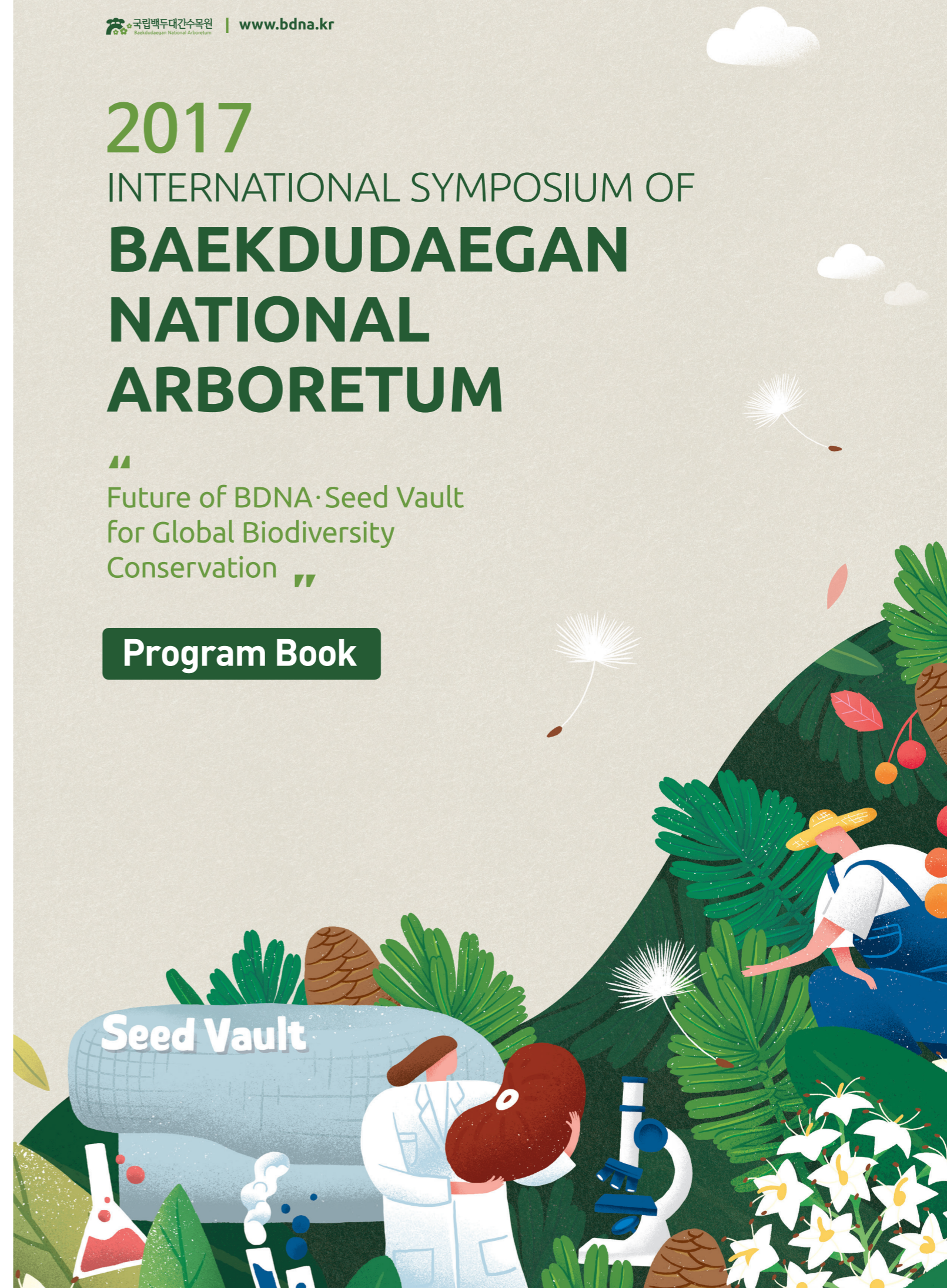


Underground Storage Facility

2017 INTERNATIONAL SYMPOSIUM OF BAEKDUDAEGAN NATIONAL ARBORETUM

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”

Program Book



Overview

Title 2017 International Symposium of Baekdudaegan National Arboretum

Date & Time October 27(Fri) 2017

Venue Baekdudaegan National Arboretum

Theme Future of BDNA·Seed Vault for Global Biodiversity Conservation

Host by  Korea Forest Service

Organized by  국립백두대간수목원
Baekdudaegan National Arboretum

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 한국식물분류학회
THE KOREAN SOCIETY OF PLANT TAXONOMISTS

아시아식물분포연구회

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Mira LEE, President, Korea Institute of Arboretum Management

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No Wook PARK, Mayor, Bonghwa-gun

Kwang-Woo PARK, President, Korean Association of Botanical Gardens and Arboreta

You Mi LEE, General Director, Ph.D., Korea National Arboretum

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Myeong Gi Chung (Prof., Gyeongsang National University, Korea)

Katherine O'Donnell (Seed Conservation Coordinator, BGCI, England)

Jonas Mueller (Head of our Seed Conservation programme, RBG Kew, England)

Samantha Kendall (Eden Project, England)

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Hyeok Jae Choi (Prof., Changwon University, Korea)

Takashi Shiga (Prof., Niigata University, Japan)

JEONG WON JANG (Doctorate, Baekdudaegan National Arboretum, Korea)

Shynar Dagarova (Junior Researcher, Institute of Botany and Phytointroduction, Committee of Science of the Ministry of Education and Science, Kazakhstan)

Bulkair Mambetov (Director, Kazakh Research Institute of Forestry and Agroforestry, Kazakhstan)

Tatiana Novikova (Deputy Head, National Biodiversity and Biosafety Center, Tajikistan)

Kachibekova Elmira (Leading specialist, The state Agency on Environment Protection and Forestry, Kyrgyzstan)

Poster sessions 24

Opening Address

Opening Speech of
2017 International Symposium of
Baekdudaegan National Arboretum

Honorable Director General of Korea National Arboretum You-Mi Lee, Mayor of Bonghwa County, North Gyeongsang Province No Wook Park, President of Korean Association of Botanical Garden and Arboreta Kwang-woo Park and members of arboreta and related academia!

I would like to extend my sincere appreciation to all of you for participating in 2017 International Symposium of Baekdudaegan National Arboretum.

Also I would like to express my gratitude to officers and people of Bonghwa County for their relentless support in establishment of Baekdudaegan National Arboretum.

As you may well aware, Bonghwa County is where Baekdudaegan, the axis of Korean ecosystem goes through, connecting Mt. Baekdu and Mt. Jiri. This is the place where Korea's outstanding forest ecosystem and biological resources are reserved. The Baekdudaegan National Arboretum, located in this wonderful region, was established as a mean to create a national arboretum with various gardens categorized into climate and vegetation belt so that biological resources that are vulnerable to climate change can be stably preserved and utilized.

This Baekdudaegan National Arboretum is the biggest arboretum in Asia with total gross area of 5,179ha. For this project alone, 220 billion won-worth of government budget was injected.

Distinguished guests!

World is suffering from global warming which was led to changes in ecosystem and destruction of natural habitat. As such, forest biological reserves are critically threatened.

To that end, countries in the world have been doing their best for preservation of biodiversity and its sustainable use since 1993, when Convention on Biological Diversity was entered into force. All these efforts were made because biodiversity plays a key role in survival of the mankind.

Following this global trend, the Baekdudaegan National Arboretum will carry out various activities including preservation research in forest ecosystem of Baekdudaegan, study on conservation of domestic biological resources outside indigenous environment for climate change preparation and utilization of such resources.

In particular, this arboretum has facilities to exhibit, preserve, and utilize plants of Baekdudaegan and other alpine plants.

Also, Seed Vault is in operation. Seed Vault is the only underground tunnel type permanent storage for seeds of wild plants, in the world.

This Seed Vault is located 40m beneath the surface to protect seeds safely from environmental changes or natural disasters such as hurricane or earthquake to name a few. I am proud to call this vault the safest seed storage in the world.

With this Seed Vault, we will develop various skills and conduct research to enhance efficiency of seed preservation, which is the genetic resource. Furthermore, we will make our utmost effort to conserve global biodiversity.

I hope 2017 International Symposium of Baekdudaegan National Arboretum to be a venue for active discussion and paves a way for Baekdudaegan National Arboretum and Seed Vault to contribute hugely to preservation and utilization of global biological diversity.

Now, I would like to end my opening speech by thanking once again those who spared no effort into establishment and operation of Baekdudaegan National Arboretum.

Thank you.

Mira LEE

President, Korea Institute of Arboretum Management

Congratulatory Message

Greetings! Ladies and Gentlemen.

It is a great honor and privilege to host the International Symposium at Baekdudaegan National Arboretum here in Bonghwa during the season of abundance.

As the Mayor of Bonghwa, I would like to convey my sincere gratitude for your visit from home and abroad, to Bonghwa in order for preservation of diverse biological resources.

Also, I would like to extend my appreciation to all personnel from Korea Forest Service and Baekdudaegqan for working tirelessly to make this wonderful event possible.

Bonghwa, located in between the Taebaek Mountains and Sobaek Mountains of Baekdudaegan at the northernmost end of Youngnam in Korea, is the nation's first-rate city for forest recreation, 83% of which is covered in naturally magnificent forest.

I take great pride in Baekdudaegan National Arboretum as Asia's largest arboretum formed on astonishing forest resources.

Also, the city is endeavoring to form a forest complex for experience and recreation by establishing Bonghwa Forest Recreation, Wood Culture Center and National Youth Forest Center. Furthermore, Korea Forest Science High School, the very first of its kind in Korea, is continuing to nurture local talents in forestry.

It is my sincere hope that the International Symposium of Baekdudegan National Arboretum will act as an window of opportunity to exchange ideas and insights that will help Bonghwa better preserve forest resources and become world-class forest seed vault facility, in order to take the lead in tackling climate challenges.

I kindly encourage all distinguished guests to take this rare opportunity you have had to travel long and far and experience Korea's first ever Valley train, Daksil Village the capital of the Confucian culture and the beautiful provincial park in the Mountain Cheongnyang at its finest Autumn splendor.

Please accept my renewed gratitude for your visit to Bonghwa and I wish you the most wonderful time in Korea.

Thank you.

No Wook PARK

Mayor, Bonghwa-gun

Congratulatory Message

Honorable experts and scholars from home and abroad. It is my great honor to welcome all of you to the 2017 International Symposium. I appreciate your participation to ensure a brighter future for the Baekdudaegan National Arboretum.

We have experienced ecological environment changes that are too rapid to comprehend. In this time of crisis, I found a ray of hope at the Baekdudaegan National Arboretum. I believe the Seed Vault will be the last and best hope to save the world should the world face imminent destruction someday.

Today, we are going to discuss species conservation, transcending national borders and ideologies. This is one of the greatest missions our generation must fulfill for future generations. We will talk about in-situ and ex-situ conservation over endangered, rare plant species and other plant species that fade out of the public attention gradually due to their low economic value.

I will make sure the outcomes of the discussion are supported by our 58 member botanical garden organizations until they are successfully realized.

I hope you enjoy this trip and have a wonderful time here in Korea.

Thank you

Kwang-Woo PARK

President, Korean Association of Botanical Gardens and Arboreta

Congratulatory Message

I would like to express my heartfelt welcome to all the participants in 2017 Baekdudaegan National Arboretum International Symposium organized by Baekdudaegan National Arboretum. This international symposium is a meaningful opportunity where Baekdudaegan National Arboretum can take the first step towards flourishing future.

Eminent scholars from Kew Gardens and Eden Project in Britain, and BGCI, Japan, and five Central Asian countries will share their research results through presentations. They will also share ideas and insights on the operation and roles of BDNA's Seed Vault, seed conservation and relevant education, which will make this symposium fruitful and constructive. Once again, I'd like to extend my gratitude to all the speakers who will enrich this symposium with their informative and inspirational presentations.

As you are well aware, in an effort to ensure conservation and sustainable use of biodiversity and benefit-sharing, various international activities including Convention on Biodiversity have been undertaken. Biodiversity conservation significantly matters both at the national and international levels.

In this regard, in order to strengthen ex-situ conservation and further raise public awareness of biodiversity conservation, Korea Forest Service has committed itself to establishing national arboreta by climatic and vegetational zone. Baekdudaegan National Arboretum, completed in 2015, is a fruit of such commitment. Moreover, projects to launch national arboreta in Sejong City by 2021 and in Saemanguem by 2028, respectively, are ongoing. To ensure seamless operation of these arboreta, Korea Institute of Arboretum Management was established in last May.

Baekdudaegan National Arboretum boasts of favorable natural conditions. It has 26 gardens with different themes including a rock garden and runs the world's largest underground tunnel-shaped Seed Vault. This facility will play a pivotal role in conserving domestic and foreign-grown seeds, contributing to conservation of global genetic resources. With this cutting-edge technology fully employed, Baekdu -daegan National Arboretum will be able to serve as a global herb in seed research.

Distinguished guests and ladies and gentlemen!

Korea National Arboretum and other national arboreta have made every effort to set up strategies for ex-situ conservation against biodiversity loss caused by climate change by cooperating international organizations such as CBD and BGCI.

In this sense, 2017 Baekdudaegan National Arboretum International Symposium under the title of 'Future of BDNA-Seed Vault for Global Biodiversity Conservation' is timely and relevant.

I hope that insightful and profound ideas to be put forward at this symposium can contribute to the enhancement of international cooperation for effective operation of BDNA's Seed Vault and ecological conservation of Baekdudaegan region, fully used for creating various policies for biodiversity conservation.

Once again, I'd like to deliver all the participants of this 2017 Baekdu- daegan National Arboretum International Symposium. My thanks also go to staff members of BDNA who committed themselves to preparing for this symposium.

Thank you.

You Mi LEE

General Director, Ph.D., Korea National Arboretum

2017 International Symposium of Baekdudaegan National Arboretum Schedule

Time(Min)	Program
09:00~09:30(30)	Registration
09:30~09:34(4)	Opening Address Mira Lee (President, Korea Institute of Arboretum Management)
09:34~09:38(4)	Congratulatory message No Wook PARK (Mayor, Bonghwa-gun)
09:38~09:42(4)	Congratulatory message Kwang-Woo PARK (President, Korean Association of Botanical Gardens and Arboreta)
09:42~09:46(4)	Congratulatory message You Mi LEE (General Director, Ph.D., Korea National Arboretum)
09:46~09:50(4)	Photograph for Commemoration
I . Role of the Baekdudaegan National Arboretum Moderator : Yong-Shik KIM (Prof., Yeungnam University)	
09:50~10:20(30)	Role of the Baekdudaegan (Korean Peninsula) as a Major Southern Glacial Refugium for Plant Species : Priorities for Conservation Myong Gi Chung (Prof., Gyeongsang National University, Korea)
10:20~10:50(30)	BGCI Supporting Seed Banking in Botanic Gardens Around the World Katherine O'Donnell (Seed Conservation Coordinator, BGCI, England)
10:50~11:10(20)	Coffee Break I
11:10~11:40(30)	Seed Conservation Standards for MSBP Collections Jonas Mueller (Head of our Seed Conservation programme, RBG Kew, England)
11:40~12:10(30)	Current trends of education & learning in Arboretum Samantha Kendall (Eden Project, England)
12:10~13:30(80)	Lunch
II . Global Plant Conservation Challenge Moderator: Joohwan Kim, Gachon University	
13:30~13:50(20)	Korean Allium (Alliaceae) in Baekdudaegan Hyeok Jae Choi (Prof., Changwon University, Korea)
13:50~14:10(20)	Herbarium specimens' seeds still alive?: availability for regional plant conservation Takashi Shiga (Prof., Niigata University, Japan)
14:10~14:30(20)	Biodiversity Preservation and Role of Seed Vault JEONG WON JANG (Doctorate, Baekdudaegan National Arboretum, Korea)
14:30~15:00(30)	Break
15:00~15:20(20)	Creation of seed bank of wild plants of Kazakhstan Shynar Dagarova (Junior Researcher, Institute of Botany and Phytointroduction, Committee of Science of the Ministry of Education and Science, Kazakhstan)
15:20~15:40(20)	Collection of seeds and herbarium in the territories of the Ile-Alatau State National Nature Park Bulkair Mambetov (Director, Kazakh Research Institute of Forestry and Agroforestry, Kazakhstan)
15:40~16:00(20)	The prospect of cooperation with KNA: overview of the first results of cooperation on Tian Shan flora research Tatiana Novikova (Deputy Head, National Biodiversity and Biosafety Center, Tajikistan)
16:00~16:20(20)	Plant Diversity Conservation in Kyrgyzstan Elmira Kachibekova (Leading specialist, The state Agency on Environment Protection and Forestry, Kyrgyzstan)
16:20~16:50(30)	Coffee Break III
16:50~17:50(60)	Discussion
17:50~18:00(10)	Closing Remark
18:00~20:00(120)	Farewell Banquet



Role of the Baekdudaegan National Arboretum

Moderator :
Yong-Shik KIM, Prof., Yeungnam University



Role of the Baekdudaegan (Korean Peninsula) as a Major Southern Glacial Refugium for Plant Species : Priorities for Conservation

Myong Gi Chung (Prof., Gyeongsang National University, Korea)

Curriculum Vitae

Education

B. S., Biology, Busan National University, Busan, South Korea

M. S., Botany, University of Georgia, Athens, GA, USA

Ph.D., Botany, University of Georgia, Athens, GA, USA

Professional Experience

Teaching Assistant, Botany Department, University of Georgia, Athens, GA, USA

Post-doc. Associate, Rutgers University, Piscataway, NJ, USA

Professor, Gyeongsang National University, Jinju, South Korea

Research Interests

Conservation biology of plants, Population genetics, Phylogeography, Conservation genetics, Orchid breeding systems.

Honours & Awards (Maximum 3)

Academic award for Gyeongsang national University

Award for the Korean Federation of Science and Technology Societies

Publications (Maximum 3)

Chung, M. Y., J. D. Nason, M. G. Chung. 2007. Effects of population succession on demographic and genetic processes: predictions and tests in the daylily *Hemerocallis thunbergii* (Liliaceae). *Molecular Ecology* 16: 2816-2829.

Chung, M. Y., M. G. Chung. 2013. Significant spatial aggregation and fine-scale genetic structure in the homosporous fern *Cyrtomium falcatum* (Dryopteridaceae). *New Phytologist* 199: 663-672.

Chung, M. Y., J. López-Pujol, M. G. Chung. 2017. The role of the Baekdudaegan (Korean Peninsula) as a major glacial refugium for plant species: A priority for conservation. *Biological Conservation* 206: 236-248.

Brief Summary of Presentation

The Baekdudaegan (BDDG), the main Korean mountain range, is thought to have served as a glacial refugium during the Last Glacial Maximum (LGM), mainly for the boreal and temperate flora of northeastern Asia. Consistent with this hypothesis, Korean populations showed higher intrapopulation genetic diversity, harbored ancestral haplotypes, and/or exhibited significant amounts of unique haplotypes/alleles. Palaeoecological data support the genetic studies, indicating that the BDDG sustained an assemblage of boreal and temperate forests at the LGM. Given its floristic, biogeographic, and cultural value, the BDDG merits high priority for conservation. In order to guarantee the preservation of the BDDG, we suggest enlarging the current BDDG Mountains Reserve in South Korea, whereas in North Korea the accelerated deforestation should be stopped and new protected areas should be set up. Cooperation between the two Koreas is also needed, and may constitute an important step towards more ambitious initiatives such as the creation of the "Ecological Corridor of Northeast Asia".



BGCI Supporting Seed Banking in Botanic Gardens Around the World

Katherine O'Donnell (Seed Conservation Coordinator, BGCI, England)

Curriculum Vitae

Education

MSc in Ecology, Evolution and Conservation Imperial College London, UK

BSc in Plant Science, University of Edinburgh, UK

Professional Experience

Global Seed Conservation Challenge Coordinator, BGCI, UK

Digital Collections Unit Team leader, Royal Botanic Garden, Kew, UK

Project Coordinator, Royal Botanic Gardens, Edinburgh, UK

Research Assistant, Millennium Seed Bank, Kew, UK

Publications (Maximum 3)

Seed Banking in Botanic Gardens

Brief Summary of Presentation

BGCI Supporting Seed Banking in Botanic Gardens Around the World

Target 8 of the Global Strategy for Plant Conservation calls for 75% of threatened plant species in ex situ collections, preferably in the country of origin and at least 20% available for recovery and restoration programmes by 2020. Botanic Gardens Conservation International's Global Seed Conservation Challenge (GSCC) was launched to support botanic gardens that conserve plant species through seed banking. The network currently includes around 200 seed banking botanic gardens worldwide, working cooperatively. Skills, knowledge and data built up through the GSCC can also be used to support wider plant conservation activities.



Seed Conservation Standards for MSBP Collections

Jonas Mueller (Head of our Seed Conservation programme, RBG Kew, England)

Curriculum Vitae

Dr Jonas Mueller is a senior manager at the Royal Botanic Gardens, Kew, one of the world's most famous botanic gardens. As Senior Research Leader in Seed Conservation and chairman of Kew's Banking the World's Seeds strategic output group, Dr Mueller is heading the seed biology and conservation research agenda across Kew Science and building the bridge between scientific research, conservation and horticulture. He is the lead for the Royal Botanic Gardens Kew's Millennium Seed Bank (MSB) Partnership, a global network for plant conservation. At the same time, Dr Mueller leads global thematic projects within Kew, such as the Adapting Agriculture to Climate Change project and the Global Tree Seed Bank Project. A plant ecologist by training, Dr Mueller is particularly interested in the ecology of germination and of the establishment of plants, and in understanding the plants' responses to stress, such as heat or drought stress. His interests focus on plants from seasonal climates and mountain ecosystems.

Education

PhD in biological sciences, University of Frankfurt

MSc, University of Freiburg

Professional Experience

Senior Research Leader in Seed Conservation, Royal Botanic Gardens Kew

Chairman, Banking the World's Seeds strategic output group

Lead, Millennium Seed Bank Partnership

Brief Summary of Presentation

There are some 391,000 plant species on Earth. The Millennium Ecosystem Assessment highlights the fundamental importance of plants for human well-being, providing us with food, medicine, clothes or timber. However 21% of all plant diversity are threatened with extinction as a result of human activities. Seed banking is one of the best tools available to preserve plant diversity in the long-term. The Royal Botanic Gardens Kew's Millennium Seed Bank (MSB) is the largest seed bank for wild plant species in the world. The MSB Partnership is a unique species conservation programme and a global network for science-based plant conservation. Managed by Kew, it consists of a multitude of individual projects linking together 150+ partner institutions worldwide. The main aims of those projects are to collect high quality seeds of 25% of the world's bankable flora and to make them available. Currently, seeds from over 40,000 plant species are stored at the MSB in 82,500 accessions. MSB Seed Conservation Standards in seven main work areas ensure high quality storage of seed collections at the MSB and at partner banks across the world. The standards provide a basis for technology transfer amongst MSBP partners and for capacity development in the network. The MSB Data Warehouse is the data sharing platform of the MSBP. It allows the network to track e.g. progress towards Global Strategy for Plant Conservation targets and it drives improved conservation standards. Showing seed accessions from Korea, GIS based mapping tools are presented.



Current Trends of Education & Learning in Arboretum

Samantha Kendall (Eden Project, UK)

Curriculum Vitae

Education

BA Hons, Natural Science – Cambridge University

Postgraduate Certificate of Education – University of West of England

Key Professional Experience

Education Manager, Eden Project

Education Officer, Eden Project

Teacher, Tynning Hengrove Junior School, Bristol

Brief Summary of Presentation

Current trends of education & learning in Arboretum

Creating memorable and meaningful programmes for schools

What can we uniquely offer as Arboreta and Botanic Gardens to engage and challenge our young learners and meet the needs of their teachers? How can we use story, narrative and challenge to make our learning programmes meaningful and memorable? What role should we play in shaping the citizens of a sustainable future?

The Eden Project is an educational charity whose aim is to connect people with each other and the living world, exploring how we can work towards a better future for everyone. Eden's programme for schools engages over 50,000 learners each year and includes day visits, residential programmes and teacher training. In 2015 we launched University-level courses based at Eden and we are working towards opening an Eden-inspired school in 2020.

This presentation explores Eden's approach to these key questions for Arboreta and Botanic Garden educators, sharing practical examples and exploring how these are applicable in different contexts.

2017
INTERNATIONAL SYMPOSIUM OF
BAEKDUDAEGAN
NATIONAL ARBORETUM



Global Plant Conservation Challenge

Moderator :
Joo-Hwan Kim, Prof., Gachon University



Korean Allium (Alliaceae) in Baekdudaegan

Hyeok Jae Choi (Prof., Changwon University, Korea)

Curriculum Vitae

Education

B.Sc., Biology, Chungbuk National University, Cheongju, Korea

M.Sc., Botany, Chungbuk National University, Cheongju, Korea

Ph.D., Botany, Chungbuk National University, Cheongju, Korea

Professional Experience

Associate Professor, Department of Biology & Chemistry, Changwon National University, Korea

Research Assistant Professor, Graduate School of Agriculture, Kyoto University, Japan

Junior Researcher, Korea National Arboretum, Korea Forest Service, Korea

Postdoctoral Fellow, Department of Biology, University of Saskatchewan, Canada

Research Interests

Plant systematic, evolution and biogeography of the genus *Allium*, biodiversity and conservation, conservation genetics

Honours & Awards

2013 Best Teaching Award, Changwon National University

2014 Best Teaching Award, Changwon National University

Publications

Choi, H. J., A. R. Davis and J. H. Cota-Sánchez. 2011. Comparative floral structure of four New World *Allium* (Amaryllidaceae) species. *Systematic Botany* 36: 870–882.

Choi, H. J. and B. U. Oh. 2011. A partial revision of *Allium* (Amaryllidaceae) in Korea and north-eastern China. *Botanical Journal of the Linnean Society* 167: 153–211.

Choi, H. J., L. M. Giussani, C. G. Jang, B. U. Oh and J. H. Cota-Sánchez. 2012. Systematics of disjunct northeastern Asian and northern North American *Allium* (Amaryllidaceae). *Botany* 90: 491–508.

Brief Summary of Presentation

A taxonomic revision of *Allium* in the Baekdudaegan Phytogeographical Region (BPR) is presented based on critical observations of wild populations as well as extensive herbarium material. Species delimitations are re-evaluated by macro- and micro morphological and cytological characters, resulting in the recognition of 23 species comprised of 24 taxa, among which, 18 species of 19 taxa are distributed in the Korean peninsula. From the result, (1) Morphological barcoding characters for *Allium* species are suggested, (2) *A. ochotense* in Ulleung Island is needed further studies especially on its origin, (3) *A. minus* is considered as extinct in the wild, (4) *A. sacculifeum* is treated as an additional synonym of *A. thunbergii*, and *A. thunbergii* var. *deltoides* also unified into the basic species of *A. thunbergii*. This study will provide sound foundation for a future global monograph and the systematic understanding of the genus *Allium*. seed banking. The network currently includes around 200 seed banking botanic gardens worldwide, working cooperatively. Skills, knowledge and data built up through the GSCC can also be used to support wider plant conservation activities.



Herbarium specimens' seeds still alive?: availability for regional plant conservation

Takashi Shiga (Prof., Niigata University, Japan)

Curriculum Vitae

Education

Ph. D, 2007, Graduate School of Science and Technology, Kobe University, Kobe, JAPAN

M.S., 2003, Graduate School of Science and Technology, Kobe University, Kobe, JAPAN

B.S., 2001, Faculty of Science, Niigata University, Niigata, JAPAN

Professional Experience

Associate Professor, Mathematical and Natural Sciences, Faculty of Education, Niigata University (2012-)

Curator of Botanical Division, Osaka Museum of Natural History (2007-2012)

Assistant curator of Botanical Division, Osaka Museum of Natural History (2006-2007)

Research Interests

Plant taxonomy, Plant systematics, Conservation biology

Honours & Awards (Maximum 3)

The Japanese Society for Plant Systematics Young Researcher Award (2017)

Publications (Maximum 3)

Shiga T., K. Tsubota, and H. J. Choi, 2017. Actual distribution and present status of threatened aquatic plant, *Sagittaria aginashi* (Alismataceae), in Korea. *Korean Journal of Plant Taxonomy* 47(3): 180-188.

Shiga T., M. Yokogawa, S. Kaneko, and Y. Isagi, 2017. Genetic diversity and population structure of *Nuphar submersa* (Nymphaeaceae), a critically endangered aquatic plant endemic to Japan, and implications for its conservation. *Journal of Plant Research* 130: 83-93.

Nakahama N., Y. Hirasawa, T. Minato, M. Hasegawa, Y. Isagi, and T. Shiga, 2015. Recovery of genetic diversity in threatened plants through use of germinated seeds from herbarium specimens. *Plant Ecology* 216: 1635-1647.

Brief Summary of Presentation

In herbaria, many plant specimens from local populations including already extinct populations are stored. The use of herbarium specimens' seeds would remarkably contribute to restore the genetic diversity of not only the plant species but also each locally threatened population if the viable specimens' seeds collected at the target species or populations are preserved in herbaria. In this study, we examined the germinability of 722 herbarium specimens' seeds about 131 species. Seeds of 59 herbarium specimens (8.2%) of 24 species (8.3%) were germinated. Viable seeds which combined germinated and stained seeds were confirmed in 336 specimens (46.5%) of 84 species (64.1%). In this presentation, we also discuss the effect of the genetic diversity recovery of wild populations using the germinated seeds of herbarium specimens. Although herbarium specimen has not been collected in order to store living seeds, those seeds will be an important seed source for biodiversity conservation.

var. *thunbergii*. This study will provide sound foundation for a future global monograph and the systematic understanding of the genus *Allium*. seed banking. The network currently includes around 200 seed banking botanic gardens worldwide, working cooperatively. Skills, knowledge and data built up through the GSCC can also be used to support wider plant conservation activities.



Biodiversity Preservation and Role of Seed Vault

JEONG WON JANG (Doctorate, Baekdudaegan National Arboretum, Korea)

Curriculum Vitae

Education

Doctor of Agriculture, Daegu University, Gyeongsangbuk-do, Korea

Professional Experience

KOREA NATIONAL ARBORETUM, Gyeonggi-do, Korea

Forest Biodiversity division. post doctor 05/09 - 04/14

KOREA FOREST SERVICE Daejeon, Korea

Department of Arboretum Development Project, post doctor 05/17 - 05/14

Baekdudaegan NATIONAL ARBORETUM, Gyeongsangbuk-do, Korea

Seed Vault Management Division, Research Manager Now - 06/17

Research Interests

Seed Research, phenology, honey plants

Brief Summary of Presentation

Numerous species on Earth are disappearing each year due to global warming and environmental destruction. As part of an international effort to conserve plants, the Global Strategy for Plants Conservation (GSPC) was formally adopted at the 6th Conference of the Parties to the Convention on Biological Diversity (CBD) in 2002. The Forest Service established the National Baekdu-daegan Arboretum at Bonghwa-gun area which passes through Baekdudaegan, the ecological axis of the Republic of Korea.

The National Baekdudaegan Arboretum will carry out various researches and projects for global biodiversity conservation through various core activities such as restoration of rare plants, ex-situ conservation of plants (seeds) and conservation of alpine plants based on the world's first underground tunnel-type forest seed permanent storage facility.



Creation of seed bank of wild plants of Kazakhstan

Shynar Dagarova

(Junior Researcher, Institute of Botany and Phytointroduction,
Committee of Science of the Ministry of Education and Science, Kazakhstan)

Curriculum Vitae

My full name is Dagarova Shynar. I was graduated the bachelor's degree of Kazakh National University, faculty of Biology and Biotechnology, on by specialty "Biotechnology" and after graduated my bachelor's degree in 2010-2012 years I was worked as a researcher Nutritiologist in the Institute of Kazakh Academy of Nutrition in the laboratory Rationalization of Nutrition.

Then in 2014 year I was graduated master's degree of Kazakh National University, faculty of Biology and Biotechnology, on by specialty "Biology".

Present time Ph. D student Al-Farabi Kazakh National University and junior researcher RSE "Institute of Botany and Phytointroduction" CS MES Republic of Kazakhstan

Education

graduated Kazakh National University. Faculty of Biology and Biotechnology (Bachelor degree)

graduated Kazakh National University, faculty of Biology and Biotechnology (Master degree)

Present time Ph. D student Al-Farabi Kazakh National University Republic of Kazakhstan

Professional Experience

I was worked as a researcher person in the Kazakh Academy of Nutrition

Present time Ph. D student Al-Farabi Kazakh National University and junior researcher RSE "Institute of Botany and Phytointroduction" CS MES Republic of Kazakhstan

Research Interests

Biology, Biotechnology, Botany science

Honours & Awards (Maximum 3)

[2014] Diploma of III degree for the best scientific work in the republican competition of natural, technical, social and humanitarian and economic sciences

[2016 December] Reward on behalf of the Ministry of Education Science of the Republic of Kazakhstan due to the participation of the International specialized exhibition «World Botanic EXPO-2016» in Antalya, Turkey

Publications (Maximum 3)

List of scientific articles

1. Kenzhebayeva S. S., Doktyrbay G., Dagarova Sh. S. and other. Search of new genetic resource for spring wheat, development of productive lines through mutation and identification of iron enriched lines. European Biotechnology Congress Journal of Biotechnology//2014.P.185. Publisher Elsevier Science.
2. Dagarova Sh.S Comparison of the leaf anatomy indicators structure of the endemic plants of *Rheum wittrockii* Lundstr. // International science conference. Antalya, Turkey 2016. P. 21-23.
3. Dagarova Sh.S., Sitpayeva G.T Conservation of Biodiversity of wild Plant of *Rheum wittrockii* Lundstr of Kazakhstan. Biosci Biotech Res Asia 2017;14(1).P. 93-98.

Brief Summary of Presentation

CREATION OF SEED BANK OF WILD PLANTS IN KAZAKHSTAN

Sitpayeva G.T.¹, Murzatayeva T.Sh.¹, Dagarova Sh.S.^{1,2}, A.S., Mugan A.¹

¹RSE "Institute of Botany and Phytointroduction" CS MES Republic of Kazakhstan

²Al-Farabi Kazakh National University Republic of Kazakhstan

Abstract. First time in 2013 specialized Seed Bank of wild relatives of cultivated plants (WRCP) and wild flora of Kazakhstan was created at the Institute of Botany and Phytointroduction. Important aim of Seed Bank – are preservation of genetic diversity of the wild flora of Kazakhstan. Main directions of scientific research: Creation and development of Seed bank of the natural flora of Kazakhstan. Therefore prospects for development of the laboratory of Seed-research and Plant protection replenishment of Seed Bank collections, especially the seeds of useful plant, Red list plant and collections valuable plant species. In general including 11 steps work cycle of the seed bank (Expeditionary collections→ Registration of samples→Preliminary drying→Preliminary cleaning→Preliminary freezing→Secondary cleaning→Final drying→ Description of seeds, photographing, weighing→Viability test→Packing in container→Storage (active and basic collection). Also were created two collections into the seed bank;

1. Basic collection (medium term and a long term) Temperature -18 °C, Seed moisture – 7% (depending on species);

2. Active collection (short term) Temperature 0+6 °C, Seed moisture – to 10% (depending on species).

Present time in Seed bank for storage more than 2,500 specimens, general 70 families, 605 species: 296 (50%) medical of plants, including those listed in the Red Book of Kazakhstan 38 species (6 per cent), 139 species of fodder (23%), 124 (21%) species food (Nutrition) plants.

Keywords: seed, wild, short-term storage, long-term storage, conservation



Collection of Seeds and Herbarium in the Territories of the Ile-Alatau State National Nature Park

Bulkair Mambetov (Director, Kazakh Research Institute of Forestry and Agroforestry, Kazakhstan)

Curriculum Vitae

Education

Ex) Forestry, Agricultural Institute, Almaty, Kazakhstan

Professional Experience

Ex) Deputy Dean of the Institute, Director of the Forestry Branch

Research Interests

forestry, forest melioration, forest cultures

Publications (Maximum 3)

- Carbon budget from forest land use and management in Central Asia during 1961–2010.

Agricultural and Forest Meteorology 221 (2016) 131–141

- A 189-year tree-ring record of drought for the Dzungarian Alatau, arid Central Asia .

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- Dynamics of landscape patterns in an inland river delta of Central Asia based on a cellular automata-Markov model.

@ Springer-Verlag Berlin Heidelberg 2014.

Brief Summary of Presentation

Since 2003, he is the director of the Almaty branch of the Kazakh Scientific Research Institute of Forestry and Agroforestry. He is Doctor of Agricultural Sciences and Corresponding member of the Academy of Agricultural Sciences of the Republic Kazakhstan. The scientific and pedagogical experience of work is 26 years. During the period of scientific and pedagogical activity more than 125 scientific and scientific-methodical works were published.

He is the head of several scientific programs on agroforestry:

- 2009-2011. "Improvement of the technology of forest reproduction and protective afforestation in the arid zone of southern Kazakhstan";

- 2015-2017. "The study of forest reclamation protective plantations on the dried bottom of the Aral Sea, their influence on soil-forming processes and the development of scientific foundations for the creation of forest pasture lands";

- 2015-2017. "Social and economic assessment of the effectiveness of greening large cities of Kazakhstan, the development of a methodology for assessing the effectiveness of greening programs and recommendations for their development";

- 2015-2017. "Monitoring changes in the ecology of coniferous forests in time and space in the southeast of Kazakhstan using methods of dendrochronological analysis."

Poster sessions

No.	Title
1	Phenological Monitoring of Plant at an ex-situ site in Korea National Arboretum Climate Change - Jeong Won Jang (Beakdu-deagan National Arboretum), Jun Gi Byeon, Seung Hwan Oh, You Mi Lee (Korea National Arboretum), Seung Sun Jung (Korea Forest Service)
2	The Flora of the National Baekdudaegan Arboretum Protected Area for Forest Genetic Resource, in Bonghwa-gun, Gyeongsangbuk-do, Korea - Jeong Won Jang, Hye Jung Yi (Beakdu-deagan National Arboretum), Seung Hwan Oh, Yong Chan Cho, Jun Gi Byeon, Cheul Ho Lee, You Mi Lee (Korea National Arboretum), Kwan Ho Bae (Kyungpook National University)
3	Researches on differences in phenological phases of plants to climate changes in a metropolitan city, Seoul, South Korea - Jeong Won Jang (Beakdu-deagan National Arboretum), Jun Gi Byun, Seung Hwan Oh (Korea National Arboretum)
4	The Classification and Species Diversity of Forest Cover Types in the Natural Forest of the Middle Part of Baekdudaegan. - Kwang-Mo Hwang, Jae-Heon Jeong (Beakdu-deagan National Arboretum)
5	A Study on the Improvement Plan through the Monitoring of Soil Seed Bank(Mt. Gariwang) in the Baekdudaegan National Arboretum - Gi Song Kim, Ki Ho Kang, Hyoug Duk Yi, Chun Hee Nam, Jin Sun Park, Hong Gyun Yoon (Beakdu-deagan National Arboretum)
6	A Phenology of plants distributed near the wind-holes in Jeongseon, South Korea - Jung Won Sung (Beakdu-deagan National Arboretum)
7	Community Structure and Understory Vegetation Distribution Pattern of Pinus densiflora f. erecta Stands in Mt. Cheonchuksan, Uljin-gun - Tae-Im Heo, Jun Gi Byeon, Jun Woo Lee, Ji-Ae Park, Yeong-Su Kim (Beakdu-deagan National Arboretum)
8	Occurrence Patterns and Available offer of Weeds in the Garden - Chun Hee, Nam (Beakdu-deagan National Arboretum), Yun-Chang Jeo, Eun Ju Ahn, Young Jae Kim, Hye Young Jin, Chunghee Lee (Korea National Arboretum)
9	Root Development Characteristics of Viburnum dilatatum Thunb. Cuttings as affected by IBA treatment - Kyu Seong Choi (Beakdu-deagan National Arboretum), Do Hyun Kim, Chung Ho Ko, Han Choi, Sun Hee Ryu, Seung Youn Lee, Ki Cheol Lee and Jeong Ho Lee (Korea National Arboretum)
10	Selection of drought tolerant plants selection indications from Korean native plants - Hyeon Jeong Im(Beakdu-deagan National Arboretum), Hyun Jin Song(Forest Seed Production National Forest Seed and Variety Center), Mi Jin Jeong(Korea National Arboretum), Hak Gon Kim(Gyeongsangnam-do Forest Environment Research institute), Woo Hyeong Yang, Sung Hyun Yong and Myung Suk Choi(Gyeongsang National University)
11	Physiological changes against water stress and selection of drought tolerance plants - Hyeon Jeong Im(Beakdu-deagan National Arboretum), Hyun Jin Song(Forest Seed Production National Forest Seed and Variety Center), Hak Gon Kim(Gyeongsangnam-do Forest Environment Research institute), Yeong Rong Seo, Woo Hyeong Yang, Dong Jin Park, Ma Ho Seop and Myung Suk Choi(Gyeongsang National University)
12	Long-term storage and viability of seeds of Korean native plant species in seed bank - Mi jin Jeong, Balkrishna Ghimire, Gang uk suh (Korea National Arboretum), Go Eun Choi, Hayan Lee (Beakdu-deagan National Arboretum)
13	Effects of seed harvest time and temperature on germination of Deutzia paniculata Nakai, a rare and endemic species - Mi jin Jeong, Balkrishna Ghimire, Gang uk suh (Korea National Arboretum), Go Eun Choi, Hayan Lee (Beakdu-deagan National Arboretum)
14	Systematic significance of Seed morphology in Scrophulariaceae s. l. - Balkrishna Ghimire, Sungwon Son, Gang Uk Suf, Cheul Ho Lee, Mi Jin Jeong(Korea National Arboretum)
15	Seed atlas of Korean plant species : morphological characters - Balkrishna Ghimire, Sungwon Son, Gang UK Suf, Cheul Ho Lee, Mi Jin Jeong(Korea National Arboretum), Go Eun Choi, Hayan Lee (Beakdu-deagan National Arboretum)
16	Investigation on the Fruiting Characteristics and in-vitro Seed Cultivation in Abelia tyaihyoni Nakai - Go Eun Choi, Hayan Lee (Beakdu-deagan National Arboretum), Balkrishna Ghimire, Mi jin Jeong, (Korea National Arboretum)
17	In vitro Seed Germination and Seedling Development of Bulbophyllum inconspicuum Maxim, a rare species in Korea - Go Eun Choi, Hayan Lee (Beakdu-deagan National Arboretum), Balkrishna Ghimire, Mi jin Jeong, (Korea National Arboretum)
18	Effect of temperature and plant growth regulators (PGRs) on the germination of Metanartheicum luteoviride Maxim - Go Eun Choi, Hayan Lee (Beakdu-deagan National Arboretum), Balkrishna Ghimire, Mi jin Jeong, (Korea National Arboretum)
19	Scarification for Breaking Physical Dormancy of Rubus Species - Go Eun Choi, Hayan Lee (Beakdu-deagan National Arboretum), Balkrishna Ghimire, Mi jin Jeong, (Korea National Arboretum)
20	Stratification Protocols for Breaking Combinational Dormancy of Scarified Rubus (Rosaceae) Seeds - Go Eun Choi, Hayan Lee (Beakdu-deagan National Arboretum), Balkrishna Ghimire, Mi jin Jeong, (Korea National Arboretum)

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