

亞洲實驗林聯合研討會

# 2018 森林生態系統服務

2018 NTU – UTokyo Joint Workshop  
on Long-term Monitoring and Data  
Analysis for Ecosystem Services in  
Asian University Forests



**NTU – UTokyo Joint Workshop on Long-term Monitoring  
and Data Analysis for Ecosystem Services in Asian University  
Forests**

**June 25-26, 2018**

National Taiwan University, Nantou County, Taiwan





*Organized by*

**College of Bioresources and Agriculture, National Taiwan University  
The Experimental Forest, National Taiwan University  
The University of Tokyo Forests, The University of Tokyo**

*Supported by*

**The Experimental Forest, National Taiwan University  
College of Bioresources and Agriculture, National Taiwan University  
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Japan Society for the Promotion of Science**



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NTU – UTokyo Joint Workshop, June 25-26, National Taiwan University, Nantou County, Taiwan

## Opening Address

*Professor Naoto Kamata*, project leader of the JSPS Core-To-Core Program, all distinguished guests, ladies and gentlemen!

I would like to express my warmest welcome to all distinguished participants for attending the Joint Workshop on Long-term Monitoring and Data Analysis for Ecosystem Services in Asian University Forests organized by the University of Tokyo and National Taiwan University. The agriculture sector, whether overseas or in Taiwan, is facing multiple socio-economic, ecological, and political challenges. To better address these issues, the international community has devolved numerous efforts to the development and management of ecosystem services, sustainable use of resources to support the development of green economy and bioeconomy. The focus of this workshop is directed to many advanced topics regarding local and global issues of climate changes, forest hydrology, ecology, and forest management. This workshop will advance us not only essential knowledge but also provide a great opportunity to share experiences in management of university forests.

National Taiwan University Experimental Forest manages about 32,770 hectares of forest located in six tracts and one wood utilization factory. With abundant natural and biological resources, the Experimental Forest provides an ideal field to support field practices and research programs of undergraduate and graduate students and forest-related for diverse topics either for domestic universities or abroad. All the research findings and developed strategies also help to establish advanced forest management techniques and field operation skills for sustainable forest management.

This joint workshop is a very meaningful exchange for sharing experiences in the education and research activities in Asian university forests. By the JSPS Core-To-Core program, Asian university forests will continue to forge very practical cooperative relationships. Furthermore, through this international collaboration, National Taiwan University Experimental Forest will be able to contribute the energy and promote breadth of research in long-term monitoring program.

I would like to thank all participants who join this workshop and share their fruitful results. I would also like to give my sincere appreciation to all the contributors who have organized or contributed to this workshop. I hope this workshop will come up with strong resolution on how we move forward as one to address various challenges at the national and regional levels to long-term, sustainable development of university forests. I hope all of you will have rewarding exchanges during the next few days. I wish you every success with this workshop.

Prof. **Huu-Sheng, Lur**  
Dean of the College of Bio-Resources & Agriculture  
National Taiwan University





## Welcome Address

Professor Naoto Kamata, the project leader of the JSPS Core-To-Core Program,  
Distinguished guests, ladies and gentlemen,

First, I would like to express my warm and sincere welcome to all of you coming to Xitou, the Experimental Forest, National Taiwan University for attending the “3rd Joint Workshop on Long-term Monitoring and Data Analysis of Forest Resources and Environment”. Also, it is our pleasure to host this joint workshop and we appreciate the University of Tokyo Forests, the University of Tokyo to co-organize it.

The terrain of the Experimental Forest rises from 220 meters at the southern bank of Jhuoshuei River to 3,952 meters at the peak of Yushan, covering 32,770 ha and occupying about 1% of Taiwan Island. So far, over 130 experiment fields for long-term experiments at different altitudes in the Experimental Forest were established. Except for forest land management for national land conservation, the Experimental Forest have been supporting student field practices and research projects relating to forestry, plant, Entomology, hydrology, soil science, wood processing, meteorology conducted by the researchers from National Taiwan University, other universities in Taiwan, even from other countries. A major goal of these scientific studies is to implement their results on forest management and resources conservation and to achieve sustainable forest management.

In this joint workshop, many professors, researchers, and students from the universities in Japan, Korea, Malaysia, Thailand, and Taiwan will share their experiences of applying long-term monitoring data for meteorology, hydrology, and long-term ecological research. I believe the joint workshop will strengthen our cooperative relationship, and through the discussions, more transnational cooperations in the future are anticipated.

I would like to thank all the participants to join this workshop, and I also would like to offer my sincere appreciation to those people who contributed themselves to organize this workshop.

Thank you and hope you have a fruitful day.

**Prof. Dr. Min-Jer Tsai**

Director of the Experimental Forest  
National Taiwan University



## Outline of Schedule

Time	June 25 (Mon)	June 26 (Tue)	June 27 (Wed)	June 28 (Thu)	June 29 (Fri)
06:30			Breakfast		
07:00	Breakfast	Breakfast		Breakfast	Breakfast
08:00	Registration		Field excursion (long-term experimental plots at Alishan)	Field excursion (Xinyi Dream Works of the mei (plum), Neimaopu Tract)	Depart for airport
09:00	Opening address	Research Group Sessions			
10:00	Plenary speech session				
11:00	session				
12:00	Lunch	Lunch	Lunch	Lunch	
13:00	Poster session	Field excursion (CO2-flux station, hydrological research station, long-term experimental plots)	Field excursion (Tataka Area, insect research plot, Taiwanese aboriginal culture)	Field excursion (Community forestry)	
14:00					
15:00					
16:00		Moving to			
17:00	Refresh break	Heshe NEA	Refresh break	Refresh break	
18:00	Banquet	Dinner	Dinner	Dinner	
21:00	Stay at Xitou Nature Education Area	Stay at Heshe NEA	Stay at Heshe NEA	Stay at Moon Garden Resort Hotel	

## NTU–UTokyo Joint Workshop on Long-term Monitoring and Data Analysis for Ecosystem Services in Asian University Forests

### Workshop Program

June 25, 2018			
Time	Topic	Speaker	Place
<b>08:40-09:00</b>	Registration		Atrium
09:00-09:30	Opening address	Huu-Sheng LUR (Professor, Dean of College of Bioresources & Agriculture, NTU) Ming-Jer TSAI (Professor, Director of The Experimental Forest, NTU) Kenji Fukuda (Professor, Director of University of Tokyo Forests)	<b>International Conference Hall</b>
09:30-09:40	Group photo		
Time	<b>Plenary speech session</b>		Page
09:40-10:10	Strategies for developing Eco-service industry in upland areas of Taiwan	Yue-hsing HUANG [Director General (retired), Taiwan Forestry Research Institute, Council of Agriculture]	20
10:10-10:40	Long term data archives and specimens in The University of Tokyo Forests	Kenji FUKUDA (Professor, Director of University of Tokyo Forests)	21
<b>10:40-11:00</b>	<b>Tea break</b>		
11:00-11:30	Aims of the JSPS Core-to-Core Project: “Developing a network of long-term research field stations to monitor environmental changes and ecosystem responses in Asian forests”	Naoto KAMATA (Professor, University of Tokyo Forests)	22
11:30-12:00	Sugi ( <i>Cryptomeria japonica</i> D.	Biing T. GUAN	23

	Don) Spacing Trial in Xitou, NTU Experimental Forest: Some Lessons Learned	(Professor, School of Forestry and Resource Conservation, NTU)	
<b>12:00-13:30</b>	<b>Lunch break</b>		
	<b>Poster session</b>		<b>Place</b>
13:30-17:00	Poster oral presentation  Please see below [Poster Oral Presentation Program]		<b>Room 201</b>
<b>17:30-</b>	<b>Banquet</b>		XYAC
<b>June 26, 2018</b>			
<b>08:45-09:00</b>	<b>Registration for RG1 : Water &amp; Climate</b>		<b>Room: 203</b>
<b>Time</b>	<b>Topic</b>	<b>Speaker</b>	<b>page</b>
09:00-09:15	Long-term Observation of Groundwater Level in the North Creek, Shirasaka Experimental Watershed, Akazu Research Forest, Ecohydrology Research Institute	Koichiro KURAJI (Professor, University of Tokyo Forests)	26
09:15-09:30	Long-term measurement of sediment yield in reforested catchments recovering from degraded condition	Nobuaki TANAKA (Assistant Professor, University of Tokyo Forests)	27
09:30-09:45	Storm hydrograph analysis of small forest watersheds in Seoul National University Forests	Sangjun IM (Professor, Seoul National University)	28
09:45-10:00	Response of aerosols to the Synoptic Cloud and rainfall characteristics in Northern Thailand	Venus TUANKRUA (Lecturer, Kasetsart University)	29
10:00-10:15	Forest structure and rainfall partitioning in Sabah Tropical Lowland Forest	Maznah MAHALI (Seniour Lecturer, University Malaysia Sabah)	30
<b>10:15-10:30</b>	<b>Tea break</b>		
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	pollutants and cloud top temperature using meteorological satellite in Xitou Watershed	(Associate Research Fellow, Experimental Forest, National Taiwan University)	
10:45-11:00	Climatic classification and mapping: results for Asian Experimental Forests	Yen-Jen LAI (Associate Research Fellow, Experimental Forest, National Taiwan University)	32
<b>08:45-09:00</b>	<b>Registration for RG 2: Ecosystem</b>		<b>Room: 201</b>
<b>Time</b>	<b>Topic</b>	<b>Speaker</b>	<b>page</b>
09:00-09:15	Long-term phenology data of woody plants at The University of Tokyo Hokkaido Forest and their phenotypic plasticity to climate	Naoto KAMATA (Professor, University of Tokyo Forests)	36
09:15-09:30	Temporal variation of tree species composition and forest production in a warm-temperate secondary forest	Takanori SATO (Project Assistant Professor, University of Tokyo Forests)	37
09:30-09:45	Xylariaceae in Japan and recent research effort	Shuhei TAKEMOTO (Assistant Professor, University of Tokyo Forests)	38
09:45-10:00	Effects of forest management system on bat activity in Japanese temperate forest	Dai FUKUI (Assistant Professor, University of Tokyo Forests)	39
10:00-10:15	Evidence for a growth acceleration in secondary forests in the University of Tokyo Chichibu Forest	Satoshi N SUZUKI (Assistant Professor, University of Tokyo Forests)	40
<b>10:15-10:30</b>	<b>Tea break</b>		
10:30-10:45	Collaborative research on the population genetics and genomics of <i>Chamaecyparis obtusa</i> in East Asia	Kyu-Suk KANG (Associate Professor, Seoul National University)	41
10:45-11:00	Structural dynamics of the Tropical Seasonal Forests,	Dokrak MAROD (Associate Professor, Kasetsart	43

	western Thailand	University)	
11:00-11:15	Bark and ambrosia beetle composition in logs of various tree species at Long Mio, Sabah	Maria Lourdes LARDIZABAL (Seniour Lecturer, University Malaysia Sabah)	44
11:15-11:30	The proposed scheme of stand classification in Taiwan	Ching-Feng LI (Assistant Professor, School of Forestry and Resource Conservation, National Taiwan University)	45
<b>08:45-09:00</b>	<b>Registration for RG 3: Management</b>		<b>Room: 202</b>
<b>Time</b>	<b>Topic</b>	<b>Speaker</b>	<b>page</b>
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09:15-09:30	Local growth variations in Sugi plantations	Takuya HIROSHIMA (Lecturer, University of Tokyo Forests)	49
09:30-09:45	Long-term Sugi growth at The Univ. of Tokyo Chiba Forest	Keisuke TOYAMA (Assistant Professor, University of Tokyo Forests)	50
09:45-10:00	Radial growth response of <i>Cryptomeria japonica</i> to air temperature and precipitation in SNU Nambu University Forest, Korea	Jong Bin JUNG (Graduate Student, Seoul National University)	51
10:00-10:15	A study on annual increment of Teaks in plantations for supporting forest management goals	Kritsadapan PALAKIT (Lecturer, Kasetsart University)	52
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	data		
10:45-11:00	Stand development and annual aboveground net primary production with Japanese Cedar and <i>Taiwania</i> Plantations in Xitou	Chih-Hsin CHENG (Associate Professor, School of Forestry and Resource Conservation, National Taiwan University)	54
11:00-11:15	Characterization of growth in a <i>Taiwania cryptomerioides</i> clonal seed orchard in Xitou, Taiwan	Chieh-Ting WANG (Assistant Research Fellow, Experimental Forest, National Taiwan University)	55
11:15-11:30	A close-range photogrammetry system with spherical panorama for sampling and tree measurement	Tzeng Yih LAM (Assistant Professor, School of Forestry and Resource Conservation, National Taiwan University)	56
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June 25, 2018				
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8	14:35-14:40	The value and importance in forest management for utilization of domestic plantation timber in Taiwan	Min-Jay CHUNG (Experimental Forest, National Taiwan University)	66
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**\*Only student posters (#1-14) are qualified for the best poster award.**

**\*All posters should be set up before 13:30 in ROOM202.**

**\*All poster oral presentations will be held in ROOM201.**

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# Plenary Presentation

## **STRATEGIES FOR DEVELOPING ECO-SERVICE INDUSTRY IN UPLAND AREAS OF TAIWAN**

**Yue-hsing HUANG**

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### **Abstract**

Ecosystem services are the benefits people freely obtain from the natural environment and ecosystems. Taiwan is an island with area similar to the Netherland. The population of Taiwan is 23 million which ranked the 2nd densest in the world. With more than 260 mountain peaks over 3,000 meters in elevation, this island is rugged, young and unstable. Basically, the upland area is very vulnerable. However, people settled in upland areas for generations and still rely on agriculture for livelihood. Serious soil erosion or even mass landslides may occur after torrential rain or typhoon in those cultivated uplands. Therefore, we need to find a solution to strike a balance between agricultural activities for livelihood and sustainability of upland ecosystems. The eco-industry combined the concepts of ecosystem services and sharing economy together, tried to set up a framework including agroforestry, ecotourism, ecotherapy, and social forestry. This framework can be augmented and refined gradually to meet the demands of local communities and the resources consumers.

## **Long term data archives and specimens in The University of Tokyo Forests**

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### **Abstract**

The University of Tokyo Forests (UTF) was founded in 1894 at Chiba. At present, the UTF includes seven university forests: Chiba, Hokkaido, Chichibu, Tanashi, Ecohydrology Research Institute, Fuji Iyashinomori Woodland Study Centre, and Arboricultural Research Institute. The UTF have been taking various scientific data such as meteorology, biology and hydrology, and holding them. Fundamental Data Development Committee of UTF is responsible for collecting, archiving and publishing these data. The Committee comprises five sectors; meteorology, biology, hydrology water quality science, GIS (geographical information system), and forests for long-term observation. A variety of funding sources have been used for the activities of the Committee: funding from national and local governments, donation or joint research with private companies, donation from individual persons as well as normal budget of UTokyo. The Committee has also involved in managing inventory data and maintained herbarium specimens and insect specimens. Recently, database of old herbarium specimens preserved in Chiba has been released on the web.

**Aims of the JSPS Core-to-Core Project: “Developing a network of long-term research field stations to monitor environmental changes and ecosystem responses in Asian forests”**

Naoto KAMATA

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**Abstract**

Under changing environments, long-term monitoring and inventory data are important to detect temporal changes in environments and ecosystems. The University of Tokyo Forests (UTF) has adopted the research exchange project entitled “Developing a network of long-term research field stations to monitor environmental changes and ecosystem responses in Asian forests” for the JSPS Core-to-Core Program. This project is implemented in collaboration with core institutions in five countries (Japan, Korea, Taiwan, Thailand, and Malaysia). It aims to promote the development of long-term research field stations for stable and continuous monitoring, and to establish a multilateral research cooperation network between core institutions through close collaboration. The UTF has accumulated long-term ecological and meteorological data that are available for our forest management and researches: LTER plots, other stand plots, meteorological and hydrological data, bird community, plant and vertebrate inventory, and others. I will present two fruitful outcomes that were obtained from our long-term data.

## **Sugi (*Cryptomeria japonica* D. Don) Spacing Trial in Xitou, NTU Experimental Forest: Some Lessons Learned**

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### **Abstract**

Established in 1950, the sugi (*Cryptomeria japonica* D. Don) spacing in Xitou Forest Management District of NTU Experimental Forest is the only spacing trial for not only sugi, but also any plantation species in Taiwan. Set up in an area about 3 ha with cuttings from a relatively few trees, the experiment had 5 initial planting densities in a square spacing design with 3 replicates (0.05 ha per replicate) for each spacing. No artificial thinning takes place, except for the 1 m spacing. Although initially established to find the optimal sugi spacing in Xitou area and study the self-thinning processes, because of the trial's relatively homogeneous environment and limited genetic variation, many other research topics were examined over the years, including the effects of spacing on wood quality, initial size effects, growth and yield, and competition. Results and some lessons learned from the spacing trial will be addressed in this presentation.

# **Research Group 1**





**Long-term observation of groundwater level in the North Creek,  
Shirasaka Experimental Watershed, Akazu Research Forest,  
Ecohydrology Research Institute**

Koichiro KURAJI<sup>1</sup> & Rika KUROKI<sup>2</sup>

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**Abstract**

There has been a recent decline in harvesting of natural and planted forests due to the lack of sufficient economic incentive to produce conventional forest products. Consequently, their woody biomass is increasing and their litter layers are thickening. These forests can exacerbate evaporation and contribute to a decrease in runoff from forested watersheds. If this decrease occurs mainly during flood runoff events, flood mitigation could be positively affected; however, if the loss of runoff occurs mainly via the baseflow, this could have negative impacts on the management of water resources. The Ecohydrology Research Institute (ERI), one of the seven University Forests in The University of Tokyo Forests, was established in 1922. The long-term hydrological measurement has been continuing nearly 100 years in ERI. The paired watershed method is applied in order to evaluate directly the effect of anthropogenic manipulation on runoff and evaporation. We analyse 57 years continuous groundwater level data observed in a groundwater well in the North Creek of Shirasaka Experimental Watershed (SEW) in the Akazu Research Forest (ARF) in ERI and found that the summer / winter water level tend to increase, and the timing of winter minimum water level becomes earlier. These long-term trend may be correspond with both forest ecosystem change and climate change.

## **Long-term measurement of sediment yield in reforested catchments recovering from degraded condition**

Nobuaki TANAKA<sup>1</sup>, Atsumi KATO<sup>1</sup> & Makoto INOUE<sup>1</sup>

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### **Abstract**

It is fundamental in flood and river managements to understand sediment yield upstream. Ecohydrology Research Institute of the University of Tokyo has been measuring removed sediment volume from a stilling pool of a gauging station which monitors discharge from a headwater 88.5-ha granite catchment in central Japan. The station has been operated since 1929 to date and thus the removed sediment data currently covers an almost 90-year period. At the beginning of the long-term measurement, the catchment was highly degraded due to past overuse of forest and forest production by humans. However, after the establishment, the degraded catchment has gradually been restored by both reforestation and sediment control efforts. The 90-year deposited sediment volume, which can roughly be considered as sediment production of the catchment, showed a clear decreasing trend with reforestation progression, though there were considerable year-by-year fluctuations.

## **Storm Hydrograph Analysis of Small Forest Watersheds in Seoul National University Forests**

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### **Abstract**

Forests play a significant role in regulating hydrological processes for both wet and dry periods. Great achievements have been made in the field of forest hydrology research since Kittredge's illustration (1890). Storm flow problem is recognized as the most important issue of requiring further research in forested watersheds. University Forests(UFs) are well managed to provide in-situ information for accurate understanding rainfall-runoff relationship. Storm hydrograph is the necessary parameter for designing small hydraulic structures, such as check dam, drainage culvert, and drainage channel. Soil Conservation Service (SCS) curve number method has been used to estimate the total volume of direct runoff. In order to examine temporal distribution of direct runoff, SCS developed the dimensionless unit hydrograph method to derive synthetic unit hydrograph on a small watershed from assigned SCS curve number. This procedure has been originally proposed based on the observed data from large numbers of small watersheds over the United States, which varies in characteristics such as size, landuse, and geographic location. Although references for this method can be found in most hydrology textbooks or handbooks, little guidance is given on how to apply this procedure on steep terrain and forested watersheds. In this study, SCS procedure has been employed to simulate storm hydrographs and provided the technical explanation for practical use in small forest watersheds.

## **Response of Aerosols to The Synoptic Cloud and rainfall characteristics in Northern Thailand**

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### **Abstract**

Nowadays, in northern Thailand is experiencing the haze crisis due to burning of forests and agricultural areas. The burning aerosols are not only cause health problems, but also to influence precipitation. So, aerosols are vital for cloud and rainfall formation because they may serve as cloud condensation nuclei (CCN). An increased amount of aerosols may increase the CCN number concentration and lead to more or less precipitation (Twomey, 1977). This research was focus on response of aerosols to the synoptic cloud and rainfall characteristics in northern Thailand. It was found that the highest aerosols were released during Summer Intermonsoon Season; SIM from agricultural residues burning. Aerosols in Northeast Monsoon (NM), Summer Intermonsoon Season (SIM) and Winter Intermonsoon Season (WIS) are mostly small aerosols dominance (90%). Fine aerosols have high significant responded with decreasing rainfall amount in Winter Intermonsoon Season (WIS). In contrast, coarse aerosols high influence on decrease rainfall amount.

**Keywords:** Aerosols, Synoptic scale, Cloud and rainfall characteristics, Northern Thailand

## **Forest Structure and Rainfall Partitioning in Sabah Tropical Lowland Forest**

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### **Abstract**

This study was conducted in the alluvial forest and heath forest in the lowland tropical forest of Sepilok Forest Reserve, Sabah. The main objective was to assess the relationship between forest structure and rainfall partitioning which is also known as the sub-canopy rainfall in both forest. Our work involved a series of forest inventory work to determine the forest stand characteristics. Meanwhile rainfall partitioning was quantified by measuring the throughfall for a period of 12 months in ten (15 x 15 m) throughfall plots. Gross rainfall was collected at the open area adjacent to each forest type. In terms of stand structure characteristics, data in the alluvial forest indicates wide variations. Percentage of throughfall as of gross rainfall is higher in the heath forest than in alluvial forest and we found that basal area and biomass had some influence on the partitioning of the sub-canopy rainfall in the study area.

## **Assessing the Relationship of Air Pollutants and Cloud Top Temperature Using Meteorological Satellite in Xitou Watershed**

**Chiang Wei<sup>1\*</sup>, Tsung-Ming Tsao<sup>2</sup> & Ching-Peng Cheng<sup>3</sup>**

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### **Abstract**

This study analyzed the correlation of air pollutants of SO<sub>2</sub> and O<sub>3</sub> collected from ground stations for 48-hours and corresponding cloud top temperature of Himawari-8 meteorological satellite imagery in winter and summer of 2016 at Xitou Watershed. The result indicates difference exists between winter and summer seasons. It also shows the best correlation coefficient of SO<sub>2</sub> and cloud top temperature of satellite imagery for SO<sub>2</sub> at Xitou Nursery is 0.679 for 2016 winter; correlation coefficient of O<sub>3</sub> is -0.521 at Xitou Observatory for 2016 summer. The correlation coefficient of 10-minute interval is slight lower than hour interval. For the spatial scale, the trend of correlation of individual station and the average of the watershed is not significant. Long-term continuous observation is yet to be analyzed to assess the possibility to estimate air pollutants in ungauged sites by combing the ground measurements and meteorological satellite imagery.

## **Climatic Classification and Mapping: Results for Asian Experimental Forests**

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### **Abstract**

Climate is one of the most important factors for formatting the ecosystem types. Climate zoning would help us to understand the basic characteristics of habitat. Similar research has already been done on a global scale, but it is hard to classify zones under the small spatial scale due to the limitations of the ground-truth microclimate stations. For understanding the climate zones of the JSPS Core-to-Core joint forests, this study used the free-download Worldclim database (monthly temperature and monthly precipitation) to classify the Trewartha climatic maps of join Asian experimental forests and parks.

There are 5 universities taking part in this research and they included 8 forests of University of Tokyo (ARI\_Aono, ARI\_Kano, CBF, CF, ERI, FIWSC, HF and TF), 2 forests of Seoul National University (Taehwasan and Nambu), 2 parks of Sabah (Crocker Range and Kinabalu), 1 forest of Kasetsart University (Kog\_Ma) and 1 forest of National Taiwan University (NTUEF). In order to validate the data taken from the Worldclim database, we compared them to the ground-based climatic data near the forests. The results showed strong linear correlation in both air temperature ( $r^2=0.98$ ) and precipitation ( $r^2=0.64$ ). According to the Trewartha classification rules, the results indicated there are 9 of the total 20 climatic types in all research sites. The 9 types are Ar (tropical humid, tropical rainforest climate), Cfa (subtropical, hot humid summer climate), Cfb (subtropical, cool humid summer climate), Dca (temperate continental, warm summer climate), Dcb (temperate continental, cool summer climate), Doa

(temperate oceanic, warm summer climate), Dsb (temperate oceanic, cool summer climate), E (boreal climate) and Ft (tundra climate).

This study also assessed the future scenarios based on the Coupled Model Intercomparison Project, Phase 5 (CMIP5). 19 GCMs were used for the future scenarios of rcp45 and 17 GCMs for rcp85. The spatial variable ranges of the mean results of the models indicated temperature and precipitation might increase 1.5 °C (1.2 °C (rcp45) and 1.8 °C (rcp85) for 2041-2060; 1.8 °C (1.7 °C (rcp45) and 2.7 °C (rcp85) for 2061-2080. Based on the simulated results of the CMIP5, the Trewatha classification results showed there are 10 of the total 20 climatic types in the research sites. An extra type, Aw (tropical wet and dry, savanna climate), might appear in Kog\_Ma and NTUEF forest in future scenarios. Based on the RG1 members' efforts, the results of this study contribute the essential understandings regarding the present and future climatic zones for joint forests, and might be one of the key factors for collaborating with the rest of the groups.



# **Research Group 2**



## **Long-term phenology data of woody plants at The University of Tokyo Hokkaido Forest and their phenotypic plasticity to climate**

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### **Abstract**

Under changing environments, long-term monitoring data are important to detect temporal changes in environments and ecosystems. The University of Tokyo Hokkaido Forests (UTHF) started phenology observation from the fall 1930, which is one of the longest dataset of plant phenology in the world. Unfortunately, 86-year data exists only for nine species, which include *Quercus crispula*. In this paper, phenotypic plasticity was determined for *Q. crispula* using heat unit model. Analytical approach using observatory data from 2000 to 2011 at The University of Tokyo Chichibu Forest, a base temperature (BT) and growing degree day (GDD) were estimated 0.8 °C and 411.6, respectively. On the other hand, BT and GDD were estimated 0.050 and 500 by a growth chamber experiment, respectively, which supported the results by the analytical approach. We analysed 86-yr data of the heat unit for bud flushing of *Q. crispula* at the UTHF and will discuss its phenotypic plasticity.

## **Temporal variation of tree species composition and forest production in a warm-temperate secondary forest**

Takanori SATO<sup>1</sup>, Nobuaki TANAKA<sup>2</sup>

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### **Abstract**

From 2004 to 2017 in the Akazu Research Forest of the Ecohydrology Research Institute, trunk girth at breast height (GBH) in a 1 ha plot were measured for all trees whose GBH is over 15 cm and their species identified. In 2004, the number of deciduous broad-leaved, evergreen broad-leaved and conifer trees were 810, 744 and 687 respectively. The number of deciduous broad-leaved trees has declined to less than that of evergreen broad-leaved trees as a result of an accelerated mortality rate of *Quercus serrata* by the Japanese Oak Wilt (JOW) disease since 2010. On the other hand, the number of red pine (*Pinus densiflora*) was reduced from 68 to 21 over the period 2004 to 2017 by the Japanese Pine Wilt disease. Thirteen years of observation revealed that tree species composition have been significantly altered.

## **Xylariaceae in Japan and recent research attempts**

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### **Abstract**

Fungi belonging to the family Xylariaceae play various ecological roles in forests: *e.g.*, root rot pathogens, endophytes of woody plants and wood decomposers. In Japan, 49 species in 12 genera of Xylariaceae *s. s.* (*sensu* M. Stadler & L. Wendt 2017) have been reported. Recently, I studied the phenology of sporocarp formation and maturation of a *Xylaria liquidambaris* on the fruits of the *Liquidambar* tree (*L. styraciflua*), considered to be highly host specific. As soon as 2 month after the installation of mature *Liquidambar* fruits on the ground, young sporocarps emerged on the fruits in June. They often beared conidia until early summer, before maturing to be ascostromata in August. Spore formation did not synchronyze with *Liquidambar*'s flowering, early April, nor the fungus was isolated from the fruits that untatched the ground. Therefore, the fungus seemed to rarely infect the fruits from the flowering part.

## **Effects of forest management system on bat activity in Japanese temperate forest**

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### **Abstract**

Bats are sensitive to human-induced environmental changes, and their responses vary among species. Thus, it is considered that bats can be excellent indicator taxa and they have previously been used as ecological indicators of environmental change in forest habitats. In this study, bat activity was monitored and compared between four forest types (primary forest, selectively logged natural forest, secondary forest and conifer plantation) that have resulted from different management systems in the University of Tokyo Hokkaido Forest. Overall bat activity was highest in the primary forest, and lowest in conifer plantation. However, results varied among species. For example, *Myotis*, *Vespertilio* and *Nyctalus* spp. had highest activity in primary forest, whereas activity of *Barbastella darjelingensis* was highest in selectively logged forest. These results indicate guild-specific responses of bats to forest management, and that bat assemblages can be used as ecological indicators of the quality of forest environment.

## **Evidence for a growth acceleration in secondary forests in the University of Tokyo Chichibu Forest**

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### **Abstract**

Understanding how current climate change impacts on the rate of biomass accumulation in secondary forests is critical to predicting changes in the global forest carbon sink. I analysed data of repeated measurements of above ground biomass over 30 years in 15 plots along a secondary successional chronosequence in temperate deciduous forests in The University of Tokyo Chichibu Forest, to assessing whether the rate of biomass accumulation was accelerated in central Japan. The rates of biomass changes observed in the secondary forest were clearly higher than that expected from the age-biomass relationship based on the chronosequence. This indicates that the rate of biomass accumulation has been accelerated in these forests. The long-term observation study such as this can provide strong evidences for impacts of climate change on the forest functioning of carbon sink, and should be developed through the collaboration among participants in the JSPS-C2C network.

## **Collaborative Research on the Population Genetics and Genomics of *Chamaecyparis obtusa* in East Asia**

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### **Abstract**

Japan, Korea and Taiwan are close neighbors and related countries in either geographically and culturally, which are located at East Asia. Even though climate and weather vary a lot from countries to countries, some of the most significant plants are common and distributed at all countries. The University of Tokyo proposed an international co-operative project in 2016. In conjunction to the project, the Seoul National University suggested an international cooperative project on ‘Cooperative Research on Population Genetics and Genomics of Forest Trees. International co-operative research team from Japan (Dr. Susumu Goto), Taiwan (Prof. Fang-Hua Chu) and Korea (Prof. Kyu-Suk Kang) was established during the 7<sup>th</sup> Symposium of AUFC in 2016. *Chamaecyparis obtusa* is an evergreen coniferous species that occurs in Japan (Honshu, Kyushu, Shikoku) and Taiwan. Two varieties are recognized: *C. obtusa* var. *formosana* (known as *C. taiwanensis*) is endemic to Taiwan while the typical variety *C. obtusa* var. *obtusata* (*C. obtusa*) is endemic to Japan. It was intensively planted in southern parts of Korea. The demand of the species is greatly increasing in these days due to the forest of *C. obtusa* has spotlighted as a healing forest. In Korea, it is considered as exotic species that was introduced from Japan in 1904. This is one of the main afforestation species and the breeding program in South Korea. But, it seems that the genetic variation is very narrow, especially for cold tolerance. In Vietnam, it is an introduced species and there are two species of *Chamaecyparis* naturally distributed: 1) *C. hodginsii* (Previous name: *Fokienia hodginsii*) that is quite popular and 2) *Cupressus funebris* (previous name: *Chamaecyparis funebris*) that is almost extinct and only several individuals existing in Chi Lang, Lang Son, Northeast of Vietnam. The World-wise distribution of *Chamaecyparis* suggests that vicariance events had taken place in different periods of geological time separating more widespread ancestral taxa. Some fossil records are in Canada and USA. *Chamaecyparis* is derived from Greek *khamai*, meaning ‘ground’; and *kuparissos* for cypress. Main purposes of international co-operative project are 1) analysis of genetic diversity - genetic distance, structure and differentiation among stands and countries from Japan, Korea and Taiwan (marker study), and 2) implementation of provenance adaptation tests (LTGR; Long Term Genetic



Research plots for adaptation) - genetic mechanism of local adaption, genomics and metabolomics. The co-operative study would accelerate the breeding and gene conservation programs and the utilization of genetic resources of *C. obtusa* could be enhanced for each country. During the joint workshop, more details about how and what should be exchanged will be discussed and all of you are very welcome to join the session of research group II (Ecosystem).

\* This study was carried out with the support of ‘R&D Program for Forest Science Technology (Project No. 2014109B10-1820-AA01)’ provided by Korea Forest Service (Korea Forestry Promotion Institute).

## Structural Dynamics of the Tropical Seasonal Forests, western Thailand

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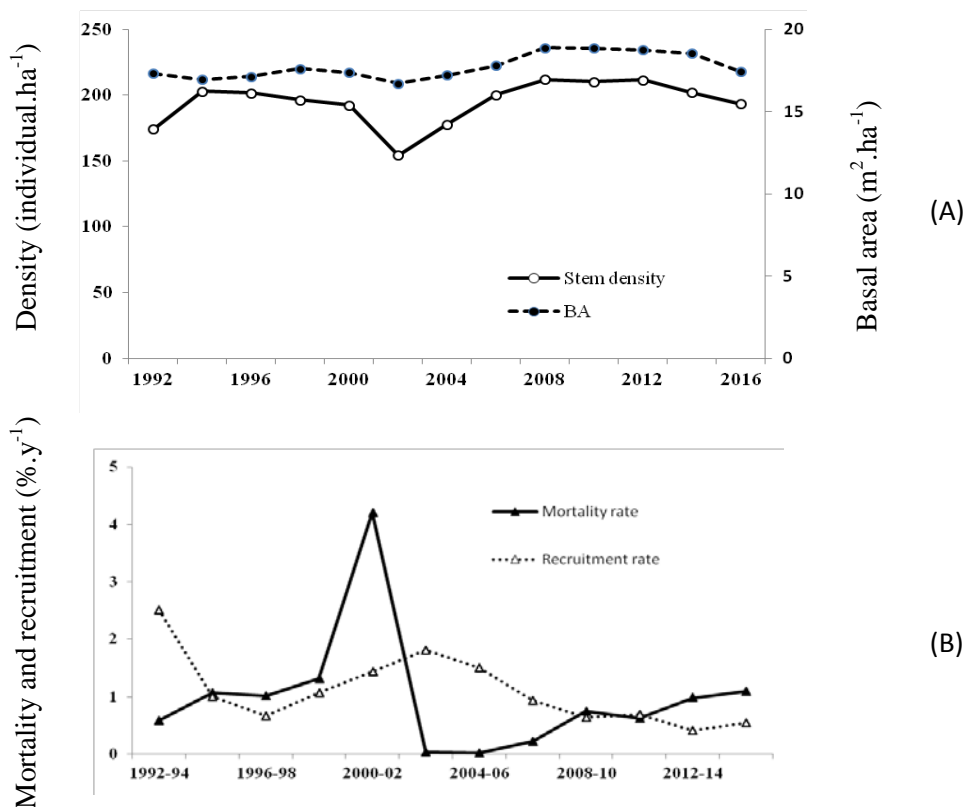
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### Abstract

Drought and fire are crucial factors on the regeneration of tropical seasonal forests. The study focused on the structural dynamics of a mixed deciduous forest at Mae Klong Watershed Research Station, western Thailand, with particular reference to role of fire and bamboo. All trees, DBH > 5 cm, in a 4-ha permanent plot were census and monitored every 2-yr since 1992 to 2016. The forest was characterized by low density and basal area. The average recruitment was higher than mortality during 24-yr period, 4.41 and 3.97 %·y<sup>-1</sup>, respectively. Successful regeneration of trees which survived competition with other plants could occur after die-back of bamboo when repeated forest fire did not occur in the subsequent years. Indicating both fire disturbance and bamboo life-cycle greatly influence on forest dynamics.



**Figure 1** The dynamics of stem density and basal area (A) and mortality and recruitment rate (B)

## **Bark and Ambrosia Beetle Composition in Logs of Various Tree Species at Long Mio, Sabah**

Maria Lourdes LARDIZABAL<sup>1</sup>, Naoto KAMATA<sup>2</sup> & Stephany SELVISTER<sup>3</sup>

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### **Abstract**

A study to compare the ambrosia and bark beetle composition between various log species at different circumference measurement was conducted on April, July and September 2017 at Ulu Padas Forest Reserve, Long Mio, Sabah, Malaysia. The association of the ambrosia beetles with the wood species and log circumference was also investigated. Beetles were sampled from logs using the Grab-and-Go method, which was adopted from Mason, (2015). This method involved collecting infested log samples from felled trees aged between 1 to 2 months, in a single site. In this study, log samples were taken from five tree species which were *Dacryodes* sp., *Agathis* cf. *bornensis*, *Melicope confuse* and *Mangifera indica*. Throughout this study, a total of 957 ambrosia and bark beetles from 43 morphospecies of 6 tribes were recorded from the five species of wood. The 957 individuals consists of 638 Scolytidae (26 morphospecies from 4 tribes) and 323 Platypodidae (17 morphospecies from 2 tribes). Beetles from the genus *Crytogenius* recorded the highest number of individuals with a total of 442 individuals, representing 46% of the total number of individuals collected. A total of 557 beetle individuals were collected from the *Agathis* sf. *Bornensis* logs, compared to the other log species. On the other hand, logs of the *Dacryodes* sp. recorded the highest diversity of bark and ambrosia beetles, with 17 morphospecies identified from this log species. Results from the PERMANOVA statistical analysis showed a highly significant difference of ambrosia and bark beetles species composition between the log species ( $P \leq 0.001$ ). Similarly, there was also a significant difference in the ambrosia beetles species recorded from the logs of different circumference sizes ( $P \leq 0.05$ ). However, the Pearson Correlation test resulted a negative relationship between the number ambrosia beetles individual collected from the various log circumference ( $r^2 = -0.176$ ). In contrast to that, there was a moderate positive relationship between the total number of species recorded with the logs circumference sizes in all the wood species ( $r^2 = 0.590$ ). As a conclusion, the log species influenced the species composition found in a log.

## **The proposed scheme of stand classification in Taiwan**

Ching-Feng Li<sup>1</sup>, Huan-Yu Lin<sup>2</sup>

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### **Abstract**

To select the right trees and plant them on the right sites is one of the highest guides in Silviculture. Stand classification meets this purpose that different stands should have different lists of trees to grow. The main forest types in Taiwan have been proposed by analysing the National Vegetation Database of Taiwan based on the floristic composition. How to connect this result with stand classification for the use of Silviculture is the critical question of this study. We select the published forest types whose distribution are highly corresponding to the climatic factors and model the vegetation-climate relationships by Random Forests (RF). Through the combination of high-resolution climate surfaces and the RF process, this model can be applied to map the potential distribution of climate-related forests in Taiwan. And the result of the potential vegetation map can be served as a draft for stand classification. The mean mismatch rate of our projection to the climate-related forest vegetation is 6.59%. Compare to these climatically related forests, most of the azonal forests are hard to be predicted by the high-resolution climatic surfaces since their distributions are mainly associated with succession and soil properties.

# **Research Group 3**



## Using historical management records and past aerial photos to reconstruct long-term growth of *Cryptomeria japonica* plantations

Toshiaki OWARI<sup>1</sup>, Seiji ISHIBASHI<sup>1</sup>, Takuya HIROSHIMA<sup>2</sup>, Keisuke TOYAMA<sup>1</sup>,  
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### Abstract

*Cryptomeria japonica* D. Don ('sugi' in Japanese) is one of the important plantation tree species in East Asia including Taiwan, South Korea, and Japan. National Taiwan University (NTU), Seoul National University (SNU), and the University of Tokyo (UTokyo) hold old *C. japonica* plantation stands, which were planted between 1890s–1920s. NTU and UTokyo have continuously been monitoring experimental plots in old *C. japonica* plantations every 5 years, whereas SNU just launched new monitoring projects in old plantations including *C. japonica*. Under the Core-to-Core Program of the Japan Society for the Promotion of Science (JSPS), researchers in three universities have sought opportunities for international collaborative research. We successfully received a research grant from JSPS, with the project title of "Quantitative reconstruction of long-term growth process for old *C. japonica* plantation stands using historical forest management records and past aerial photos". In this presentation, we briefly introduce our collaborative research plan.

## Local growth variations in Sugi plantations

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### Abstract

This study introduces the experimental site for various Japanese cedar (*Cryptomeria japonica*, known as Sugi) cultivars in the University of Tokyo Chiba Forest (UTCBF). In this site, 33 cultivars propagated by cuttings were planted in 1931, in total area of 0.83 ha. Among the 33 cultivars, 25 came from Kyushu where many cultivars traditionally existed by means of cuttings. Each cultivar was arranged in one or two rows along the slope from the bottom to the ridge. Measurements of DBH and height for all trees have been made almost every 10 years.

Currently this 88 years-old experimental plot showed the differences in tree growth among the cultivars. These growth differences were compared with the standard yield tables to check which cultivar could adapt to the local climate and environmental conditions in UTCBF.



## **Long-term Sugi growth at The Univ. of Tokyo Chiba Forest**

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### **Abstract**

The University of Tokyo Chiba Forest has 10 long-term experimental plots of coniferous plantations, where growth of standing trees have been monitored mainly since 1916. Seven of them are even-aged stands of Sugi (*Cryptomeria japonica*), most typical coniferous species of forestry in Japan.

The results obtained from these plots show that DBH, height and volume growth speeds have not declined yet, contrary to the standard growth given in the previous public research. Also, these results could be partly explained by the change of environmental conditions such as global warming. However, we must consider that volume estimation could be overestimated because of the inaccuracy of volume equation especially when trees are large. Also, the difficulties of thinning may have prevented from maintaining stand density appropriately.

## **Radial growth response of *Cryptomeria japonica* to air temperature and precipitation in SNU Nambu university forest, Korea**

Jong Bin JUNG<sup>1</sup>, Hyun Jung KIM<sup>1,2</sup>, Jong Woo KIM<sup>1</sup>, Ji Sun JUNG<sup>1</sup>, Pil Sun PARK<sup>1</sup>,

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<sup>2</sup> Seed Collection Team, Baekdudaegan National Arboretum, Republic of Korea

### **Abstract**

*Cryptomeria japonica* grows in warm and moist conditions and were widely planted in the southern part of Korea. Recent global warming is likely to expand the plantation range of this species toward north in Korea. Thus, information on the response of this species to new plantation range is required, however, the information on the growth of *C. japonica* in Korea is still limited. In this study, we conducted dendro-climatological analysis of *C. japonica* in the Nambu University Forest of Seoul National University, located in Gwangyang. Cores were extracted and treated using standard dendrochronological methods. Our results showed that *C. japonica* had a positive response to the summer precipitation. Current spring temperature also affected the growth of *C. japonica*. This implies that increasing summer rainfall and spring temperature would give a positive effect on radial growth of *C. japonica* in Korea.

## **A Study on Annual Increment of Teaks in Plantations for Supporting Forest Management Goals**

Kritsadapan PALAKIT<sup>1</sup> & Khwanchai DUANGSATHAPORN<sup>2</sup>

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### **Abstract**

According to the sustainable forest management, the useful methods in managerial decision-making and planning are necessary to keep the balance among ecological, economic and socio-cultural approaches. The linear programming (LP) and simulation models are helpful to illustrate the economic interrelationship among rotation length, adopted period for conversion to sustainable yield and net present value of the forest. Annual increments and yields of teaks derived from tree-ring analysis could be used as database for the management planning by using LP. The management alternatives were formulated as a linear programming model to specify the cutting program which was maximized the sustainable yield as the approximately equal production of growth and harvest.

**Key words:** Dendrochronology, Linear equation, Power equation, Sustainable Forest Management

## **Estimation of aboveground biomass in forest rehabilitation area using Landsat time-series data**

Wilson V. C. WONG<sup>1</sup>, Syazwani Nisa ANUAR<sup>1</sup>, Mui-How PHUA & Keiko IOKI<sup>1</sup>  
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### **Abstract**

Spatio-temporal estimation of aboveground biomass (AGB) is critical to monitoring the carbon dynamics in forest area. In this paper, we demonstrated the use of Landsat time-series data in estimating AGB at Innoprise-IKEA Tropical Forest Rehabilitation Project (INIKEA) located in Sabah, Malaysia. We analysed eight grey level co-occurrence matrix (GLCM) based texture measures (i.e., mean, variance, homogeneity, contrast, dissimilarity, entropy, second moment, and correlation), associated with four different window sizes (3x3, 5x5, 7x7 and 9x9), and five bands in estimating AGB for year 1999 and 2017. Our result showed that the estimated mean AGB had increased in year 2017 over 1999. The utilization of Landsat time-series data in AGB estimation can potentially facilitate the forest carbon monitoring system in rehabilitation area.

## **Stand Development and Annual Aboveground Net Primary Production with Japanese Cedar and *Taiwania* Plantations in Xitou**

Chih-Hsin Cheng

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### **Abstract**

Forest management strategies that maximize carbon (C) stocks serve as the possible means to reduce global warming. In this study, we aimed to quantify the C pools dynamic in the Japanese cedar and *Taiwania* plantations in Xitou, central Taiwan, and test their age-related patterns. The stands were selected across the chronosequence with stand age ranged from 37 to 90 years for Japanese cedar plantations and from 22 to 73 years for *Taiwania* plantations. The C pools in living tree biomass, ground vegetation, litter layer, woody debris, snag (standing dead trees) and soil organic carbon (SOC) were examined. The results showed that living tree biomass C pools ranged from 164.3 Mg C ha<sup>-1</sup> to 270.3 Mg C ha<sup>-1</sup> in Japanese cedar plantations and from 93.6 Mg C ha<sup>-1</sup> to 268.1 Mg C ha<sup>-1</sup> in *Taiwania* plantations. Total ecosystem C stocks which summed from each individual C pools ranged between 220 and 347 Mg C ha<sup>-1</sup>. Of the measured forest components, the living tree biomass C and SOC were the dominated C pools and accounted for 95% of total ecosystem C pools, while the ground vegetation and dead organic matter C pools only represented a small portion (< 4%) of total ecosystem C pools. A clear increasing trend of living biomass C pools with stand age could be found in both plantations. However, no significant age-related pattern was observed for other C pools. Our results indicated that both Japanese cedar and *Taiwania* plantations have high ecosystem C stocks and could continue to sequester C but only in living tree biomass. The data of aboveground net primary production will be present during the meeting.

## **Characterization of growth in a *Taiwania cryptomerioides* clonal seed orchard in Xitou, Taiwan**

Chieh-Ting Wang<sup>1,2</sup>, Yung-Chih Chen<sup>1</sup>, Hong-Chyi Jhou<sup>1</sup>, Fu-Lin Kuo<sup>1</sup>

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### **Abstract**

*Taiwania* (*Taiwania cryptomerioides* Hayata) is one of the most economically important conifers native to Taiwan. It is a fast-growing species in Taiwan and produces quality wood. Thus, *Taiwania* is one of the most important plantation tree species selected by the government since 1967. To produce quality seeds for plantations, the first generation of *Taiwania* clone seed orchard including 248 grafted trees from 17 regions was established at Chitou, Experimental Forest of the National Taiwan University, Nantou, Taiwan in 1966. The effect of seed orchard was investigated in 1992, 2009, and 2016. There were 122 trees remained in the orchard in 2016. The mean height, breast-high-diameter of trees grafted in 2016 was 21.79m and 52.1cm, respectively. The seed production of the clone orchard will be addressed.

## **A Close-Range Photogrammetry System with Spherical Panorama for Sampling and Tree Measurement**

**Tzeng Yih Lam**

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### **Abstract**

This study is the first to adapt stereoscopic imaging to measure tree distance and diameter under forest canopy with spherical panoramas. The proposed stereoscopy method requires two spherical panoramas taken at a known distance directly on top of each other. Twenty-three plots were randomly established in planted forests. Sample trees were selected with a small basal area factor (BAF) for diameter at breast height and horizontal distance measurement. Only fully visible trees were used in the analysis. Results showed that precision decreased with increasing distance from a plot center but could be accurately and precisely estimated within 10 m. For tree diameters, better accuracy and precision was achieved either a tree was within 5 m away or its diameters were less than 20 cm. Maintaining the required vertical displacement between panoramas was challenging due to difficult terrain and heavy equipment. Advancement in photography equipment will improve shooting of spherical panorama.

# Poster Session





## **Estimation and Prediction of Maximum Tree Height and Crown-damaged Trees Ratio in different age Japanese Cedar Plantations at Xitou**

Ching-Peng Cheng<sup>1</sup>, Chiang Wei<sup>2</sup>, Tsung-Ming Tsao<sup>3\*</sup>

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### **Abstract**

In the survey record, the maximum tree height of plantations are often in the limelight. However, the crown-damaged trees are also in the limelight when drawing the height-DBH curve. This study aims to predict maximum tree height and crown-damaged trees ratio across 13 age classes in Japanese cedar (*Cryptomeria japonica*) plantations at Xitou. The expanded allometric equation and discontinuous piecewise allometric equation were used to predict the maximum tree height and crown-damaged trees ratio. The results showed that 0 %-46.7 % of total stands were damaged, and the percentage of damaged trees was not correlated with age in this study. Survey record in this study, there were six different types of damaged crowns, which effect from wind damaged or Rodentias (squirrel). In addition, maximum tree height of four age classes (61, 81, 85, 97) were predicted at 26.4 m, 27.9 m, 29.0 m, and 31.7 m, and crown damaged trees ratio were 29.51 %, 27.54 %, 24.36 %, and 4.96 %, respectively. The results of this study provided a better understanding of crown-damaged trees at Xitou.

**【Key words】** Tree height, Maximum tree height, Crown-damaged trees ratio

## **Situation of Utilization in Thinned Wood in Taiwan-A Case Study on the Experimental Forest of National Taiwan University (EXFO-NTU)**

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### **Abstract**

The EXFO-NTU area is about 32,770 hectares. *Cunninghamia lanceolata*, *Cryptomeria japonica* and *Taiwania cryptomerioides* are the mainly species in nearly 11,000 hectares of afforestation. About 2,500 to 3,000 M<sup>3</sup> of timber is produced annually from the thinning operation in EXFO-NTU. To expand the value of diversified utilization of thinned wood, in addition to various traditional wood processing, and includes a students practice field for the use of wood, development of composite board, laminated timber and cross-laminated timber (CLT) processing, grading of engineering wood, wood structure design and application, and using domestic thinned wood to develop the cultural and creative products in the Wood Utilization and Practice Factory of the EXFO-NTU. This diversified operations model is also the best demonstration of business unit in Taiwan.

## **Development of molecular marker in *Cinnamomum kanehirae* Hayata for taxonomic identification**

Chia-Chen Wu<sup>1</sup>, Shu-Hwa Chang<sup>1</sup>, Cheng-Kuen Ho<sup>1</sup> & Fang-Hua Chu<sup>2</sup>

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### **Abstract**

*Cinnamomum kanehirae* Hayata (Lauraceae), an endemic and highly valuable tree species in Taiwan, is famous for its natural characters. Because of increasing demands for culturing *Antrodia cinnamomea*, a valuable medicinal fungus growing naturally inside the *C. kanehirae* trunk, the natural populations of *C. kanehirae* decrease rapidly in wild due to illegal overcutting (Liao et al., 2010). The natural regeneration of *C. kanehirae* also decreases because seed germination is very few. In order to understand more *C. kanehirae* genetic information, we reported the complete chloroplast (cp) genomic sequence and simple sequence repeat of *C. kanehirae* (Wu et al., 2015). Recently, rare, obvious suspicious *C. kanehirae* hybrid seedling (*C. kanehirae* x *C. camphora*) appear in the market. In this study, we used low-coverage sequencing (Illumina platform) and GATK software to discover InDel (insertion/deletion) region between some *Cinnamomum* species in Taiwan and validated selected InDel markers to identify *C. kanehirae* hybrid clones and closely related species (*C. camphora*, *C. micranthum* and *C. osmophloeum*). Thus, these InDel markers in this study will provide more information for assistance of understanding the relationships of *Cinnamomum* species as well as genetic and evolutionary studies in the future.

## Phenological Study of *Castanopsis* (D. Don) Spach (Fagaceae) in Taiwan

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### Abstract

The family Fagaceae contains the most dominant species in Taiwan's natural hardwood forest and is considered one of the most important families in Taiwan. This research aimed to provide information on the flowering and fruiting time of native *Castanopsis* (D. Don) Spach species of beech family. Such information can be useful to plan seed collection and mass seedling production in the nursery. The genus contains about 138 species, which are today restricted to tropical and subtropical eastern Asia. A total of 10 species are native to Taiwan, with 1 endemic. The peak time of flowering time was in April (9 species flowering), while the lowest level was in November (no species flowering). The peak time of fruiting time was in November to December (9 species fruiting), while the lowest level was in June to August (no species fruiting). According to the phenology calendar constructed, November to December were considered to be the appropriate time to collect fruit of *Castanopsis* in Taiwan. The phenological phases of *Castanopsis* showed a cycle per year or per two years.

## Molecular Identification of Individuals in *Chamaecyparis formosensis* and Population Genetics Analysis

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### Abstract

Single sequence repeat (SSR) and expressed sequence tag-simple sequence repeat (EST-SSR) primers were developed for *Chamaecyparis formosensis* to identify individuals, assessing genetic diversity and population genetic structure. On the basis of the SSR enriched genomic libraries and the transcriptome data of *C. formosensis*, 300 primer pairs were selected for initial confirmation, of which 19 polymorphic SSR and 8 polymorphic EST-SSR loci in 92 individuals were chosen (Table). The number of alleles observed for these 27 loci ranged from 1 to 17. The observed and expected heterozygosity ranged from 0.000 to 1.000 and from 0.000 to 0.898, respectively. These SSR loci have high power individual abilities, discrimination equal to 0.9999999999998209. Samples from 92 individuals were analysed by STRUCTURE and the result suggests two subpopulations: one for south-eastern area and another for the other 3 geographical areas (Figure).

Table: Characteristics of 19 SSR and 8 EST-SSR loci developed in *Chamaecyparis formosensis*.

SSR Locus				
Cred35	Cred47	Cred88	Cred211	Cred220
Cred224	Cred225	Cred226	Cred229	Cred231
Cred236	Cred242	Cred248	Cred249	Cred250
Cred253	Cred260	Cred262	Cred264	
EST-SSR Locus				
Cred276	Cred277	Cred280	Cred281	Cred295
Cred297	Cred298	Cred299		

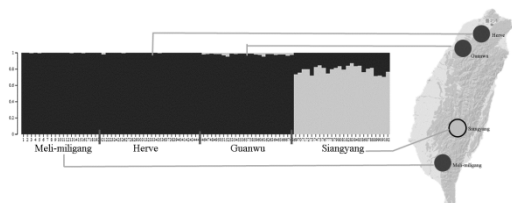


Figure: On the basis of STRUCTURE analysis, 4 geographical populations were categorized into 2 genetic populations.

(The work was financially supported by Ministry of Justice, Taiwan under grant no. 106-1301-05-04-01.)

## **The Stress Recovery Effect of Forest Bathing on Middle-Aged Female: A Case Study in Aowanda National Forest Recreation Area (ANFRA)**

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### **Abstract**

This study investigated the restorative effects of forest bathing program, targeting at middle-aged women. Sixteen middle-aged ( $46.88 \pm 7.83$  years) female participants were recruited for a 2-day/1-night forest bathing program in Aowanda National Forest Recreation Area (Nanto, Taiwan). Psychological and physiological responses were measured before and after the program. Psychological indices were measured by POMS and STAI questionnaires. Physiological indicators included pulse rate, systolic/diastolic blood pressure, and salivary  $\alpha$ -amylase. The results showed that the negative mood states (i.e., confusion, fatigue, anger-hostility, tension) and the anxiety level were significantly declined after visiting forests. In contrast, the positive mood state-vigor was improved after the program. Regarding the physiological responses, a significant decrease in systolic blood pressure response was found after the program. In sum, the 2-day/1-night forest therapy program benefits to mental health and systolic blood pressure among the middle-aged female group.

## **A Study of Recreation Carrying Capacity of Lan Son Camping Area, Phu Soi Dao National Park, Thailand**

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### **Abstract**

This research aims to investigate the camping characteristics and recreation carrying capacity. Specifically, Recreation Opportunity Spectrum (ROS) was used in the study and physical carrying capacity and psychological carrying capacity of Lan Son Camping Area, Phu Soi Dao National Park, Thailand were assessed. Data were collected with an inventory of recreational settings and tourist survey. The hiking trail led to the campsite was 6.243 kilometers long ranging from 639 to 1,597 meters above mean sea level. The site's ROS was semi-primitive non-motorized. Physical carrying capacity limited by drinking water was 165 persons per day. Regarding to psychological carrying capacity calculated from relationship between use level and mean perceived crowding graph was 199 persons per day. Thus, recreation carrying capacity was 165 persons per day.



## **The Value and Importance in Forest Management for Utilization of Domestic Plantation Timber in Taiwan**

Song-Yung WANG<sup>1</sup>, Chia-Ju LEE<sup>2</sup>, Yung-Chih CHEN<sup>3</sup>, Ming-Jer TSAI<sup>4</sup> & Min-Jay CHUNG<sup>5\*</sup>

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### **Abstract**

This study revealed 15 reasons for utilizations of domestic plantation timber in Taiwan. They are each 1. wood contributes to the 5R of “Large Resource Circulation”, 2. use of wood for energy saving and carbon reduction, 3. reduce carbon footprint of wood products, 4. produced and consumed domestically, 5. woody building is the concept of urban forest and carbon storage. 6. building a healthy and natural living space, 7. wood can adjust temperature, humidity and absorbs UV light, 8. wood decorations can reduce the higher acoustic pressure, 9. Wood release the relaxing aroma of essential oils, 10. woods have moderate temperature, hardness, and texture, 11. wooden environment can reduce “mites” reproduction, 12. wood interior decoration can hide the danger of “Radon”, 13. wood floor can prevent slipping and falling and 14. improve the value of domestic afforestation and tending, 15. establish a domestic timber industry and increase employed population.

## **Integrated stand management plan for pest control, forest regeneration and environmental education**

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### **Abstract**

The Japanese cedar plantations located in Xitou, NTU Experimental Forest, has suffered from squirrel damage for a long time. Trapping and poisoning were the most common approaches to control squirrel population to reduce tree crown damages. However, this report looks into dynamics of squirrel damages and silvicultural treatments and trying to raise public awareness. To identify severity of squirrel damage, a damage index will be presented in this report. In addition, two Taiwanese native species, *Chamaecyparis formosensis* and *Chamaecyparis obtusa* var. *formosana*, are potential tree species for regenerating current plantations by gradually replacing the Japanese cedar. Furthermore, in order to select proper sites for planning future silvicultural treatments and regeneration, environmental data from three flux towers in Xitou will be collected and permanent plots will be established for drafting a forest management plan.

## **The Basic Properties of Charcoal Prepared from *Zelkova serrata* After Extraction**

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### **Abstract**

In this study, the yields, element contents, pH values, thermogravimetry analysis and specific surface area of those charcoals from un-extracted and different solvents extracted *Zelkova serrata* twigs were evaluated. The elements analysis results showed that C, H, O, N elements of five kinds twig all appear extremely significant differences. The results showed that the yields were 30.76, 29.92, 29.95, 30.69, 30.78%, and the specific surface area were 258.01, 298.60, 305.80, 316.38, 308.31 m<sup>2</sup>/g of charcoals made from un-extracted and hot water, methanol, ethanol and acetone extracted *Z. serrata* twigs, respectively. The specific surface area by four solvents extracted charcoals were higher than that of untreated one. All of the adsorption-desorption isotherms of five charcoals corresponded to a Type IVa isotherm are given by mesoporous adsorbents. The pH value were 10 of five charcoals. It is useful for increased pore structure of the waste solvents extracted *Z. serrata* twigs for preparing charcoal.

## **Community Compositions of Ant in Tree, Floor and Litter under Adjacent Natural broad-leaved Forest and Plantions in Fenghuang mountain, Xiotu**

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### **Abstract**

There were three neighboring forest ecosystems ( natural broadleaf forest, artificial cryptomeria forest and artificial bamboo forest ) in Fenghuang mountain, Xitou Nature Education Area, and the different forest ecosystem affected the biological community structure and function. The ants were simple and useful biological indicators because of their high diversity, number of individuals, large biomass, easy to collect, distribute widely and important position in terrestrial ecosystems. The study planned to survey the ant diversity by winkler bags, pitfall traps and circle trunk pitfall traps in the three neighboring forest ecosystems in Xitou Nature Education Area, and investigated the relationship between the ant diversity and the different forest ecosystems. The result displayed that the highest ant species number and richness in natural broadleaf forest. The Significant difference in the ant colony composition meant the different ecosystems be developing in these three forest ecosystems. There were the highest richness and abundance of ants in winkler bags, except some ant species only found by pitfall traps. So using the two collection method together would make complete ants colony composition. The ant species by using circle trunk pitfall traps could find out which ant species in ground floor and leaf litter were found in bush layer.

**Keywords:** Biological Indicator, Ant, Winkler bags, Pitfall traps, Circle trunk pitfall traps

## **A system dynamics modelling approach for timber production management**

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### **Abstract**

The Forest Bureau of Taiwan recently surveyed the plantation forests managed for their timber production. Among different species, Japanese cedar (*Cryptomeria japonica*) occupied more than half of the total forest stocks, and their ages have already achieved rotation. To provide timing framework for timber harvest, we designed a system dynamics model to estimate stand volumes for each age class from 2008 to 2016. We gathered data from the yearbooks of Forestry Statistics, including area, standing volume, and timber production. Presumed cutting was operated on 31-40 age-class; our model showed that with very limited reforestation, the intrinsic death rate along with decreased growing rate would result in a declined stock of Japanese cedar forests rapidly. Should there be regeneration, this model can be used to predict the regeneration status of native species like red cypress, recommended by the current forest policy, in available forest lands for effective and sustainable management.

## **The Investigation of Macrofungus in the Taiwan cypress Ecological conservation zone at the experiment forest of NTU**

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### **Abstract**

The investigation of macrofungus in 2016 was performed twice a month in Fong-Hung Mountain. Seventeen macrofungus were identified including 5 genus 6 species of Appylophorales, 5 genus 5 species of Agaricales, 2 genus 2 species in Xylariales, 2 genus 2 species of Heterobasidiomycetes, , and 2 genus 2 species in Pezizales. Among these macrofungus, dominant species are *Ganoderma applanatum*, *Echinodontium taxodii*, *Stereum ostrea*, which appeared more than 9 months a year. Moreover, species such as *Microstoma floccose*, *Sarcoscypha humberiana*, and *Xylaria aemulans* are rare to find which appeared only one month a year.

## **Chromosome Analysis of Four Poplar Species using Fluorescence *in situ* Hybridization**

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### **Abstract**

Since the genus *Populus* represents fast growth and model species of trees, it has been considered as one of the most valuable tree genus in South Korea and for other countries. However, the studies about its chromosomes have been limited. We have analysed the chromosome structure of four poplar species: 1) *P. tremula* var. *daurica*, 2) *P. alba*, 3) *P. tremula* var. *glandulosa*, and 4) *P. alba* × *Populus tremula* var. *glandulosa*. Root samples were collected from cuttings, and fixed to store in a refrigerator. After that, samples were examined by DAPI (4',6-diamidino-2-phenylindole) staining and fluorescence *in situ* hybridization (FISH) using universal 45S rDNA and 5S rDNA probes. As expected, their karyotypes were similar to each other because their genetic relations are very close. All of the species had a set of the chromosome of  $2n = 2x = 38$ , and they had one pair of 45S rDNA locus and one pair of 5S rDNA locus. Karyotype formulas were 1)  $2n = 28m + 8sm (2sat) + 2st$  in *P. tremula* var. *daurica*, 2)  $2n = 26m + 10sm (2sat) + 2st$  in *P. alba*, 3)  $2n = 28m + 10sm (2sat)$  in *P. tremula* var. *glandulosa*, and 4)  $2n = 28m + 8sm (2sat) + 2st$  in *P. alba* × *Populus tremula* var. *glandulosa*.

## **Phylogenetic Analysis, Metabolites Profiling, and Bioactivities Investigation of *Antrodia salmonea***

Chieh-Yin Chen<sup>1</sup>, Chiang-Her Yen<sup>2</sup>, Sheng-Yang Wang<sup>3</sup> & Fang-Hua Chu<sup>4</sup>

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### **Abstract**

Fruiting bodies of *Antrodia salmonea* (AS, syn. *Taiwanofungus salmoneus*), an endemic brown-rot Polyporaceae fungus in Taiwan, are similar to *A. cinnamomea* (AC, syn. *A. camphorata* or *T. camphoratus*), which is known for its various good biological activities and high value. In this study, we successfully used the internal transcribed spacer (ITS) sequence located in rDNA to identify AS and AC (nucleic acid homology: 85%). It could distinguish between AS and AC by fingerprints, especially since two compounds, antcin M and methyl antcinate K, were only present in the AS fingerprint. We also compared the morphological observations, metabolites, and bioactivity of AS and AC fruiting bodies. No acute oral toxicity by acute oral test of mice demonstrated the safety of EtOH extracts from AS. AS possessed more anti-inflammatory activity than AC. Therefore, for safety reasons, we recommend a toxicological evaluation and biological activity investigation of *A. salmonea* for use as an alternative to *A. cinnamomea*.



## **Extraction of bioactive ingredients from fruiting bodies of *Antrodia cinnamomea* assisted by high hydrostatic pressure**

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### **Abstract**

The aim of this study was to use high hydrostatic pressure treatment to enhance the extraction efficiency of the active components from the fruiting bodies of *Antrodia cinnamomea*, and compare with those obtained by shake and ultrasonic extraction methods. The conditions of high pressure extraction (HPE) at 600 MPa of treatment yielded triterpenoids and adenosine concentrations of 410.41 mg/100 mL and 0.47 mg/100 mL, respectively, which did not differ significantly from those with the two other treatments—shake extraction at 180 rpm for 8 h and ultrasonic extraction at 50 Hz for 60 min. SEM micrographs revealed that high-pressure caused morphological damage to the mycelium, such as distortion and disruption of mycelial cells, and increased the mass-transfer effectiveness of the solvent and solute. HPE can be employed as an efficient extraction technique for production of bioactive ingredients that might have a potential application in food and related industries.

## **Two *Adelges* galling-aphids (Hemiptera: Adelgidae) on spruce in Taiwan**

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### **Abstract**

Adelgidae is a small family of Hemiptera with 65 species and 5 subspecies worldwide, exhibiting complex life cycles with cyclical parthenogenesis and including up to five distinct generations on the primary or secondary hosts. In the past eight decades, only one *Adelges* species, i.e. *A. tsugae* Annand, had been recorded on the secondary host, *Tsuga chinensis* var. *formosana*, on high elevations in Taiwan. Recently two type of adelgid galls were found on the primary host, *Picea morrissonicola*, the one was induced by *A. tsugae* and the other one was induced by an unknown *Adelges* species. In the present study, the morphological data of gallicolae migrantes and gall information of these two adelgid species are provided. Depending on analyses of the mitochondrial COI gene sequences, it showed that the unknown *Adelges* sp. did not cluster together with other identified species.

**Mitogenomic phylogeny of Limenitidini butterflies (Nymphalidae, Limenitidinae): revealing better phylogenetic relationships among Asian *Limenitis* and *Athyma* butterflies**

Li-Wei Wu<sup>1\*</sup>, Hideyuki Chiba<sup>2</sup>, David C. Lees<sup>3</sup>, Yasuhiro Ohshima<sup>4</sup>, Ming-Luen Jeng<sup>5</sup>

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**Abstract**

The phylogenetic relationships of the nymphalid butterfly tribe Limenitidini are best known for the genera *Limenitis* and *Adelpha*, model taxa for evolutionary processes such as Batesian mimicry and rapid adaptive radiations. Whereas these American limenitidines have received the most attention, phylogenetic relationships of their Asian relatives are still controversial and largely unexplored. To clarify the phylogenetic relationships of these Asian Limenitidini, a total of 53 representatives were sampled. Our results show that some of the *Athyma* taxa are embedded within the genus *Limenitis*, whereas the genus *Tacola*, previously considered to be a synonym of *Athyma*, needs to be recognized as a valid clade. Importantly, we also show that the *Limenitis* and *Adelpha* are sister groups, confirming the relevance of Asian lineages to global studies of *Limenitis* evolution.

## **Spatial and temporal variation of SR in *Cryptomeria japonica* plantation forest in central Taiwan**

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### **Abstract**

The aim of this study was to investigate temporal and spatial variation of SR (SR) of plantation in central Taiwan. We also study the mechanism of SR processes and environment impact. The results showed that the average SR amount was  $6.70 \text{ Mg C ha}^{-1} \text{ year}^{-1}$ . Soil temperature was significantly related with SR rate in temporal variation, indicated that soil temperature was the domain factor controlling SR rate. In the rainy season, SR rate was low when soil water content was high. However, in the dry season, SR rate was still low in the wetter plot. It indicated that water-saturated soil and restriction of gas diffusivity are not the primary influence factor for SR rate. Soil water content is not significant related with SR rate, but soil water content co-varying with other physiochemical properties are impact in temporal and spatial variation of SR rate.

**Difference between the transpiration rates of Moso bamboo (*Phyllostachys pubescens*) and Japanese cedar (*Cryptomeria japonica*) forests in a subtropical climate in Taiwan**

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**Abstract**

Bamboo forests have been expanding rapidly in Asian countries for the past 50 years, involving the replacement of other vegetation types by bamboo. We used the sap-flux method to estimate the stand transpiration ( $E$ ) of Moso bamboo and Japanese cedar forests in Taiwan. As was for Japan, annual  $E$  for bamboo (478 mm) was higher than that for cedar (122 mm). The comparison of canopy conductance suggest a significant change in  $E$ , regardless of different climates, when Japanese cedar forests are replaced by Moso bamboo forests.

## **Comparison of cardiac and vascular hemodynamics before and after walking exercise in forest and urban environments**

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### **Abstract**

Cardiovascular hemodynamics are important indices for the cardiovascular health assessment. The aim of this study was to compare the cardiovascular function of participants before and after walking in forest and urban parks. We invited four healthy volunteers, with an average age of 35 years, living in Taipei who were joining a 6-day/5-night forest trip to the Xitou forest to investigate the health effects of forest trip on their cardiovascular function by using the DynaPulse 200M monitoring device. Results showed that the baseline and paired differences of systolic blood pressure, central end-systolic pressure, heart rate, and cardiac function including maximum rate of pressure change in the left ventricle and cardiac output in participants were lower before and after walking in forest park than those in urban park. This study provides evidence of the potential beneficial effects of walking exercise in a forest environment on cardiovascular function.

## **The Phenology of *Diplazium dilatatum* Blume in Xitou**

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### **Abstract**

The phenology of *Diplazium dilatatum* Blume was studied in the Xitou Nature Education Area of central Taiwan, from July 2013 to June 2016. Phenological events, including fronds emergence, expansion, senescence, spore maturation and spore release were documented. Most of 10 plants, fertile fronds emerged during March to May, whereas sterile fronds emerged during July to September. The average time of fronds fully span were greater than 2 months. The average life span of fertile fronds was ca. 23 months, and slightly longer than sterile fronds (ca. 21 months). The average length of fertile fronds was not significantly greater than sterile fronds. There are linear positive correlation between sterile fronds emerged and environmental factors (temperature and rainfall). Spore maturation were major in June to November, and significant positive correlated to temperature.

## **The Investigation of Soil Bacterial Communities among Three Forest Types in the Experimental Forest, NTU**

Chiou-Pin CHEN<sup>1</sup>, Hong-Chyi JHOU<sup>1</sup>, Chieh-Ting WANG<sup>1</sup> & Yung-Chih CHEN<sup>1\*</sup>

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### **Abstract**

Soil microbial communities play critical roles in the ecological and biochemical processes in the terrestrial ecosystems; the different forest types affect the composition of bacterial communities. Therefore, we used barcoded pyrosequencing technique to analyse soil bacterial communities in bamboo, *Cryptomeria* plantations and comparing with adjacent natural forest in the Experimental Forest, National Taiwan University. The result shows, the total richness of three forest types is 137,231, *Cryptomeria* plantation had the highest richness (53,577), and Nature forest had the lowest (51,165). The phyla Proteobacteria and Acidobacteria predominated among the three forest soils. The 10 most abundant operational taxonomic units (OTUs) comprised about 44% of all sequences and were mainly Acidobacteria and  $\alpha$ -Proteobacteria. The forest types impacted the distributions for some of these OTUs. The results elucidate the ecological effects of forest management; it provided a good reference for developing new policies and further studies.



**The Investigation on Soil Properties and Nutrients Contents in the  
Distribution Area of Bunun Tribe Ethnobotanical Plant-*Alianthus*  
Prickly Ash (*Zanthoxylum ailanthoides* Sieb. & Zucc.) in Sinyi Township,  
Nantou County**

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**Abstract**

The sustainable management of Bunun ethnobotanical plant, *Alianthus* Prickly Ash (*Zanthoxylum ailanthoides* Sieb. & Zucc.), relies on soil qualities; therefore, five study sites in Duigaoyue, Heshe and Neimaopu tracts of the Experimental Forest, NTU, were selected for studying soil properties and nutrients content of *Alianthus* Prickly Ash in Bunun tribe domain. The results showed all soils were sandy loam to sandy clay loam and were strongly acid to neutral (pH 5.2-7.1) with low electrical conductivity (EC). The distribution of total nitrogen and cation exchange capacity (CEC) were influenced by organic carbon content. Available P content was very low and Ca was the dominant exchangeable cation in all study sites. The amount of available Fe, Mn, Cu and Zn ranged from 18.3-215.1, 38.5-164.7, 0.32-3.14 and 1.84-21.7 mg kg<sup>-1</sup>, respectively. In order to understand the nutrient status of *Alianthus* Prickly Ash, the leaves should be collected for nutrient analysis in the future.