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日本学術振興会
Japan Society for the Promotion of Science

PROGRAM BOOK

JSPS CORE-TO-CORE PROGRAM

International Workshop on Long-Term Monitoring and Data Analysis of Forest Resources and Environment

6th March 2017

Auditorium, Centre for Postgraduate Studies
Universiti Malaysia Sabah, Kota Kinabalu, Sabah

Jointly organized by
Faculty of Science and Natural Resources, UMS
Japan Society for The Promotion of Science

About the International Workshop

The Faculty of Science and Natural Resources, Universiti Malaysia Sabah (UMS) is hosting the Japan Society for the Promotion of Science (JSPS) Core-to-Core Program International Workshop on Long-term Monitoring and Data Analysis of Forest Resources and Environment. This one-day workshop is held at UMS, Kota Kinabalu, Sabah, Malaysia on Monday, 6th March 2017. The Core-to-Core program by the JSPS is implemented in collaboration with core institutions in five countries (Japan, Korea, Taiwan, Thailand, and Malaysia) that hold research sites in different climate and vegetation zones in Asia. 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 the core institutions. Invited speakers share knowledge and techniques on water and climate, ecosystem, management and monitoring and related issues. Poster presentations are also organized to exchange experiences with the invited speakers and other participants on various aspects of forestry.

Research Group Sessions

In the afternoon, three research group (RG) sessions are held in parallel. The general topics of the invited speakers in the research groups are as follows:

RG 1: Water & Climate

- Meteorological data management
- Hydrological data management
- Observation of discharge to determine H-Q equation
- Discussion and potential for long term monitoring station

RG 2: Ecosystem

- Toward the integration of long-term ecological research plots in JSPS-C2C network.
- Ambrosia beetles as new threats to forests in the world
- Insects as forest health indicators
- Forest dynamics based on Long Term Ecological Research (LTER)
- Discussion of potential monitoring and set up of LTER plots in Sabah

RG 3: Management

- Recovering forest carbon storage in hurricane-damaged sites through silviculture treatments
- Carbon offsetting credit projects
- Growth pattern of even-aged coniferous plantation in long-term experimental plots
- Above ground carbon stock estimation in agroforestry system using airborne LiDAR
- Does forest restoration lead to seedling recruitment?
- Understanding forest micro-environmental condition using airborne LiDAR

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FOREWORD BY THE VICE CHANCELLOR

Welcome to Universiti Malaysia Sabah (UMS). I am pleased to be with you here today at the “JSPS International Workshop on Long Term Monitoring and Data Analysis of Forest Resources and Environment", which is organized under the auspices of the Core to Core Program of the Japan Society for the Promotion of Science (JSPS), which involves collaborations of core institutions in five countries (Japan, Korea, Taiwan, Thailand and Malaysia).

UMS is proud to represent Malaysia as one of the five core institutions in this Asian collaboration effort under the Core to Core Program. I am informed that this program aims to promote the development of long-term research field stations for stable and continuous forest environmental monitoring and to establish a multilateral research cooperation network between the core institutions.

Beside of organizing this workshop, Dr. Phua, as the Kelvin Tan Aik Pen Forestry Chair, has initiated several collaborative activities at Long Pasia, Kalabakan and Crocker Range especially with The University of Tokyo. UMS is keen to sign a Memorandum of Understanding (MOU) and Memorandum of Agreement (MOA) with Graduate School of Agricultural and Life Sciences, The University of Tokyo. With these MOU and MOA, I hope the academic exchange between UMS and The University of Tokyo in general, and research collaborations at the selected areas in specific, will be intensified.

With that, I am pleased to officiate the JSPS international workshop. Thank you.

Sincerely

PROF. DATUK DR. MOHD HARUN ABDULLAH
Vice-Chancellor
Universiti Malaysia Sabah

WELCOME MESSAGE BY THE CHAIRMAN

It is my great pleasure to welcome all speakers and participants to the “JSPS International Workshop on Long Term Monitoring and Data Analysis of Forest Resources and Environment". I am indebted to our committed speakers especially those who come all the way from oversea to share knowledge and experiences related to the workshop theme.

For the morning session, two keynote presentations related to the workshop theme will be presented by Prof. Kamata and Dr. Maycock. Beside of sharing about long term forest inventory and monitoring data in The University of Tokyo Forests, Japan, Prof. Kamata will brief us about the JSPS Core to Core Program. Dr. Maycock on the other hand, will give us an overview of the permanent vegetation plot network in Sabah.

I am pleased to inform you that posters of related studies are also presented during the morning session for interactive discussion. For the afternoon sessions consist of three concurrent research group sessions. Research group 1 deals with Water and Climate, Research Group 2 is about Ecosystems and Research Group 3 focusses on Management. Research Group 1 has a plan to conduct hydrological or climate data processing session while Research Groups 2 and 3 plan to interact with participants through presentations of relevant case studies.

This workshop provides an ideal venue for acquiring new knowledge and discussion between the presenters and participant in exploring the way forward in long term forest inventory and monitoring in Sabah. To all speakers and participants, I look forward to your active participation in this workshop.

DR. PHUA MUI HOW
Chairman of the Organizing Committee
Professor (Kelvin Tan Aik Pen Forestry Chair)
Faculty of Science and Natural Resources
Universiti Malaysia Sabah

PROGRAM

INTERNATIONAL WORKSHOP ON LONG-TERM MONITORING AND DATA ANALYSIS OF FOREST RESOURCES AND ENVIRONMENT

Venue: Auditorium, Centre for Postgraduate Studies
Date: 6th March 2017

TIME		
0800	Registration and Poster Placement	
0900	Reciting *Doa* Welcoming Address by the Chairman *Dr. Phua Mui-How, Professor (Kelvin Tan Aik Pen Forestry Chair), Universiti Malaysia Sabah (UMS)*	
0915	Officiating Speech by the Vice Chancellor of UMS *Prof. Datuk Dr. Mohd Harun Abdullah*	
PLENARY PRESENTATIONS: Chairperson: Dr. Mohd. Hamami Bin Shari, Professor, UMS		
0930	**Plenary 1:** Introduction of the JSPS Project and Long-Term Monitoring and Inventory Data at the University of Tokyo Forests *Dr. Naoto Kamata, Professor, Director of The University of Tokyo Hokkaido Forest*	
1000	Souvenir Presentation and Photo Session Press Conference Coffee/Tea Break	
1030	**Plenary 2:** An overview of the Permanent Vegetation Plot Network in Sabah *Dr. Colin R. Maycock, Associate Professor, Faculty of Science and Natural Resources, UMS*	
1100	Poster Presentations	
1200	Lunch	
SESSION 1: Research Group (RG1) Water & Climate Venue: Seminar Room 3, 2nd Floor Chairperson: Dr. Kawi Bin Bidin, Professor, UMS		
1300 **1500**	RG1.1	Hydro-Meteorological Monitoring in Crocker Range Park, Sabah: Challenges & Potential *Maznah Binti Mahali, Luiza Majuakim, Wilter Azwal Malandi, Geoffary Gunsalam & Rozaidi Hassan*
	RG1.2	The Role of Floor Litters in Forest Water Cycle: An Experimental Study *Sangjun Im, Ye-eun Lee, Ghiseok Kim & Qiwen Li*

	RG1.3	Rainfall, Discharge, Rainwater and Stream Water Quality Monitoring in the University of Tokyo Forests *Koichiro Kuraji & Yuko Asano*
	RG1.4	Meteorological Observation in the University of Tokyo Forests *Toshihiro Yamada & Koichiro Kuraji*
	RG1.5	Haft Century of the Kog Ma Experimental Watershed, Chiang Mai province, Northern Thailand *Chatchai Tantasirin & Venus Tuankrua*
	RG1.6	Long-term meteorological observation and data management in NTUEF *Yen-Jen LAI, Fang-Hua CHU & Ming-Jer TSAI*
	Discussion on potential for long term monitoring station	
SESSION 2: Research Group (RG2) Ecosystem Venue: Seminar Room 4, 2nd Floor Chairperson: Dr. Maria Lourdes T. Lardizabal, Senior Lecturer, UMS		
1300 **1500**	RG2.1	Toward the integration of Long-term Ecological Research Plots in JSPS-C2C Network *Satoshi Suzuki*
	RG2.2	Ambrosia Beetles as New Threats to Forests in the World: Introduction of my researches in Japan and Asian countries *Naoto Kamata*
	RG2.3	Insect as Forest Health Indicator *Maria Lourdes T. Lardizabal*
	RG2.4	Long-term Ecological Research in University Forest of Faculty of Forestry, Kasetsart University, Thailand *Dokrak Marod*
	Discussion on potential monitoring and set up of the LTER plots in Sabah	
SESSION 3: Research Group (RG3) Management Venue: Seminar Room 5 & 6, 2nd Floor Chairperson: Dr Keiko Ioki, Senior Lecturer, UMS		
1300 **1500**	RG3.1	Recovering Forest Carbon Storage in Typhoon-Damaged Sites through Silviculture Treatments: A case Assessment at the UTokyo Hokkaido Forest *Toshiaki Owari*
	RG3.2	Introduction of Carbon Offsetting Credit Projects at the University of Tokyo Forests *Takuya Hiroshima*
	RG3.3	Growth Pattern of Even-Aged Coniferous Plantation in Long-Term Experimental Plots of the UTokyo Chiba Forest *Keisuke Toyama*
	RG3.4	Modelling and Mapping Agroforestry Plantation Aboveground Carbon Stock in Balung, Tawau, Sabah Using Airborne LiDAR Data *Daniel James, Phua Mui-How, Normah Awang Besar & Mazlin Mokhtar*

	RG3.5	Tropical Forest Restoration, Management and Monitoring *Darline E. Lim, Berhaman Ahmad, Colin R. Maycock, Ulrik Ulsted*
	RG3.6	Understanding Forest Micro-Environmental Condition using Airborne LiDAR in a Tropical Rainforest Restoration Site *Keiko Ioki, Shazrul Azwan Johari, Wilson V. C. Wong & Phua Mui-How*
	Discussion on potential research collaboration	
1500	Tea/Coffee Break	
1530	Wrap-up session by the Coordinators of Research Groups	
1630	Best Student Poster Prize Presentation	
1645	Closing Remarks	
1700	End of Program	

ABSTRACTS OF PLENARY PRESENTATIONS

PLENARY 1

Introduction of the JSPS project and long-term monitoring and inventory data at the University of Tokyo Forests

Naoto KAMATA[1]

[1]The University of Tokyo Hokkaido Forest, Graduate School of Agricultural and Life Sciences, The University of Tokyo, JAPAN, kamatan@uf.a.u-tokyo.ac.jp

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 researchers: 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.

PLENARY 2

An overview of the permanent vegetation plot network in Sabah

Colin R. MAYCOCK[1]

[1]Associate Professor, Faculty of Science and Natural Resources, Universiti Malaysia Sabah, MALAYSIA, sepilokdata@gmail.com

Permanent vegetation plots are an integral part of the long-term monitoring of forest ecosystems and are essential if we want to understand how forests respond to change. An extensive network of vegetation plots has been installed across the State by the Sabah Forestry Department, SEARRP, UMS, FMU holders and independent researchers. These plots vary in size from a few m^2 up to 160 ha and are disturbed across a wide range of forest types and altitudes. However, not all of the plots have been maintained and in some/many cases the original data is not readily available. This paper presents an overview of the vegetation plot network in Sabah and highlights some of the limitations with the existing plot network. The paper aims to highlight gaps in the existing plot network and facilitate discussions about what might be priority areas for new LTER plots in Sabah.

ABSTRACTS OF RESEARCH GROUP (RG) 1: WATER & CLIMATE

RG1.1

Hydro-meteorological monitoring in the Crocker Range Park, Sabah: Challenges & potential

Maznah Binti MAHALI[1], Luiza MAJUAKIM[2], Wilter Azwal MALANDI[1], Geoffary GUNSALAM[3] & Rozaidi HASSAN[1]

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[2]Institute for Tropical Biology & Conservation, Universiti Malaysia Sabah, MALAYSIA, majuakim@ums.edu.my

[3]Sabah Parks, MALAYSIA, ggduans@gmail.com

Being the headwater catchment for several major rivers, continuous microclimate and hydrology data readings within the CRP vicinity is of utmost important. This is to better understand the underlying factors that may be affected by the current climate change scenario (i.e. too much rain or long drought). However, maintaining meteorological and hydrological station as well as the data management for long term monitoring is not an easy task and acquire high commitment from the relevant individuals or agency. In this workshop, we would like to share our experience, the challenges that we faced as well as showing a few examples of research findings related to the data obtained from the monitoring stations in Mount Alab and Inobong, CRP.

RG1.2

The role of floor litters in forest water cycle: An experimental study

Sangjun IM[1], Ye-eun LEE[2], Ghiseok KIM[3] & Qiwen LI[2]

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[3]Department of Biosystems & Biomaterials Engineering, Seoul National University, KOREA, ghiseok@snu.ac.kr

Forest floor litter has an important role in the water cycle of forest watershed by intercepting rainfall and evaporating it into the air. The extent of stored water by leaf litter can vary according to rainfall (amount and intensity) and leaf litter characteristics. In this study, water storage capability of floor litter was experimentally examined with a portable rainfall simulator. Different types of leaf litter, coniferous and deciduous trees, were used to identify the influences of litter characteristics in water storage capacity. Coniferous tree includes *Pinus rigida, Pinus koraiensis*, and *Chamaecyparis obtuse. Alnus hirsuta, Quercus acutissima*, and *Quercus mongolica* were also taken for deciduous forest. Water holding capacity of deciduous leaf litter were larger than that of coniferous leaf litters. Water interception storage of litter can vary depending on rainfall intensity and duration. Intercepted rainfall was slightly increased as the intensity and duration of rainfall increase. Generally, water is more stored in a broadleaf litter than needle leaf litter. As a direct measurement of litter moisture would be very difficult, near infrared (NIR) spectrometry was introduced to indirectly observe the moisture content of litter. NIR spectra of different leaf litters (deciduous and coniferous forest) were first taken and used to develop the calibration models for determining moisture amount of NIR data. **Acknowledgment:** This research was supported by the Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Education (NRF-2015R1D1A1A02061769).

RG1.3

Rainfall, discharge, rainwater and stream water quality monitoring at the University of Tokyo Forests

Koichiro KURAJI[1] & Yuko ASANO[2]

[1]The University of Tokyo Chiba Forest, Graduate School of Agricultural and Life Sciences, The University of Tokyo, JAPAN, kuraji_koichiro@uf.a.u-tokyo.ac.jp

[2]The University of Tokyo Chichibu Forest, Graduate School of Agricultural and Life Sciences, The University of Tokyo, JAPAN, yasano@uf.a.u-tokyo.ac.jp

Hydrological observation in the University of Tokyo Forests was initiated at the University of Tokyo Chiba Forest (UTBF) in 1913. This observation was stopped by the Great Kanto Earthquake in 1923. In the Ecohydrology Research Institute (ERI), the hydrological observation was started from 1923 until now and this 93-year record is one of the longest continuous record of hydrological observation in Japan. The first data paper was published in 1976 reported daily rainfall and discharge data in ERI from 1930. The rainwater and stream water quality monitoring was initiated in 1993 at UTBF, ERI, The University of Tokyo Hokkaido Forest (UTHF), The University of Tokyo Chichibu Forest (UTCF) and Arboricultural Research Institute (ARI). Now these observations are organized under the Hydrology and Water Quality Division, Fundamental Data Development Committee, The University of Tokyo Forests. Eight discharge observation sites, 5 rainwater and 7 stream water quality monitoring sites are in service as of March 2017. Today, we publish an annual data paper every year. All data are open on the Website after publishing the data paper.

RG1.4

Meteorological observation in the University of Tokyo Forests

Toshihiro YAMADA[1] & Koichiro KURAJI[2]

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[2]The University of Tokyo Chiba Forest, Graduate School of Agricultural and Life Sciences, The University of Tokyo, JAPAN, kuraji_koichiro@uf.a.u-tokyo.ac.jp

The University of Tokyo Forests have long history more than 110 years of meteorological observation, and now the observation is organized under Meteorology Division, Fundamental Data Development Committee, The University of Tokyo Forests. Our meteorological observation sites were divided into two classes, class I and class II. We have five class I sites and nine class II sites in service as of March 2017. The committee is responsible for class I sites only, and class II sites are responsible by each local University Forest. We are preparing the guideline for observation and maintaining the equipment to keep the quality of data. Monthly Meteorological Paper, which reporting daily data are open on the Website approx. 2 months after observation. The first data paper was published in 1930 reported data in 1923 in the Bulletin of the University of Tokyo Forests. Today, we publish Annual Meteorological Paper every year, reporting monthly data.

RG1.5

Haft century of the Kog Ma Experimental Watershed, Chiang Mai province, Northern Thailand

Chatchai TANTASIRIN[1] & Venus TUANKRUA[2]

[1]Assistant Professor, Department of Conservation, Faculty of Forestry, Kasetsart University, Bangkok, 10900, THAILAND, fforcct@ku.ac.th

[2]Lecturer, Department of Conservation, Faculty of Forestry, Kasetsart University, Bangkok, 10900, THAILAND, ffor.venus@gmail.com

The Kog Ma Experimental Watershed is situated within Doi Sutep-Pui National Park in Chiang Mai province, northern Thailand. It is located at an altitude of 1,250-1,600 MSL. It has an area of 64.46 ha and is covered by hill evergreen forest with a canopy height of 25-40 m. Various research topics were carried out by the Department of Conservation, Faculty of Forestry, Kasetsart University since 1965. More than 40 topics were published in the Kog Ma Watershed Research Bulletin covering the study on ecological and hydrological of this watershed ecosystem. Due to lack of financial support, the project was terminated in 1985. The research activities started again in 1996 collaborated with the GAME-T project. Since February 1997, the hydrological and meteorological parameters were measured. A 50-m meteorological tower has been built. Instruments for measuring meteorological parameters, such as radiation, wind velocity, and air temperature, have been installed on the tower.

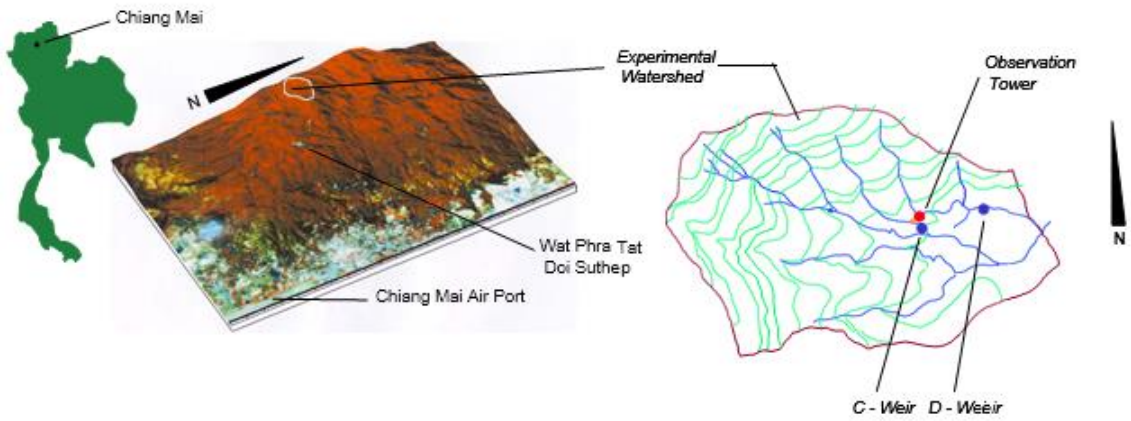

Figure 1. Location of the Kog Ma experimental watershed

RG1.6

Long-term meteorological observation and data management in NTUEF

Yen-Jen LAI [1], Fang-Hua CHU[1,2] & Ming-Jer TSAI[1,2]
[1]Experimental Forest, National Taiwan University, REPUBLIC of CHINA, alanlai@ ntu.edu.tw
[2]School of Forestry and Resource Conservation, National Taiwan University, REPUBLIC of CHINA

For collecting long-term climate data of the Experimental Forest NTU (NTUEF), there are starting with 6 manually meteorological stations along with the division offices operated since 1923 according to the oldest records. However, some locations shifted due to changes of the management policies and the administration re-organized. Nowadays, there are 6 automatically meteorological stations left which locate at Jhushan, Xitou, Qingshuigou, Shuili, Neimaopu and Heshe. An integrated system for automatic data collection, first-stage QC procedure and monthly report generation was established in 2015. All data of these stations are pulled back to the headquarter every day. Since Xitou is the hotspot of NTUEF, a preliminarily analysis based on Xitou data showed the mean temperature was 17.05 ºC from June 2005 to May 2013, which was 0.7 ºC warmer than the 1980s. A more dramatic trend in the past 10 years may be accompanied with a very rapid development in Xitou region driven by tourists. The further observations by ground based meteorological stations and remote sensing technology are on-going.

ABSTRACTS OF RESEARCH GROUP (RG) 2: ECOSYSTEM

RG2.1

Toward the integration of long-term ecological research plots in JSPS-C2C network

Satoshi SUZUKI[1]
[1]The University of Tokyo Chichibu Forest, Graduate School of Agricultural and Life Science, the University of Tokyo, JAPAN, s-suzuki@uf.a.u-tokyo.ac.jp

One of the missions of the RG2 in the JSPS-C2C project is integrating and analyzing data obtained from long-term ecological research plots in the project network. The first step of the mission is sharing a list of plots and their meta-data, which have already prepared. The next step is: how should we integrate and analyze the data? What questions should be addressed? How can we differentiate our research network from another network study? In this session, I would like to overview the list of plot meta-data, and discuss the next steps.

RG2.2

Ambrosia beetles as new threats to forests in the world: Introduction of my researches in Japan and Asian countries

Naoto KAMATA[1]
[1]The University of Tokyo Hokkaido Forest, Graduate School of Agricultural and Life Sciences, The University of Tokyo, JAPAN, kamatan@uf.a.u-tokyo.ac.jp

Ambrosia beetles are known as farming insects, which carry, cultivate, and feed on symbiotic fungi. Secondary ambrosia beetles shifting to attack and kill healthy-looking trees have been increasing in the world. *Platypus quercivorus – Raffaelea quercivora* complex cause mass mortality in Fagaceae trees only in Japan (Japanese oak wilt: JOW). No incidence of JOW was found in other countries even though *P. quercivorus* exists. *Platypus quercivorus* and *R. quercivora* were sampled from Asian countries. Then, factors influencing % mortality by the JOW were determined from a viewpoint of plant-fungus-insect interactions. Another topic is bark and ambrosia beetle community. To determine the community structure, ethanol-baited traps and bait logs (branches) of different orders of plants were set in a forest. A few species showed a one-year cycle, but not all. However, the community showed a clear one-year cycle. Negative relationships were found between phylogenetic distance of host plants and community similarity.

RG2.3

Insect as forest health indicator

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Insects in general are small to tiny creatures that can be found inhabiting various parts of the environment and forest ecosystem. Being small in size, various insect species are able to live together in smaller spaces and interact with other living organisms. However, some insect species require specific habitat and food source to live. These groups of insects are sensitive to any changes that happens in the environment, which makes them good agents that can indicate the health status of a forest ecosystem. Among the common group of beetles that are usually used as terrestrial forest health indicators include the Lepidoptera, Coleoptera, and Diptera group. While in the freshwater aquatic ecosystem, insects from the Ephemeroptera, Plecoptera, Trichoptera and currently, Diptera group are used as water quality indicators. Long term monitoring studies on these groups of insects can provide good information on the health status of a forest ecosystem.

RG2.4

Long-term ecological research in University Forests of Faculty of Forestry, Kasetsart University, Thailand

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University forests under corresponding of Faculty of Forestry cover in various ecosystems in Thailand. It provides a good opportunity for long-term ecological research, LTER, especially forest dynamics based on environmental changes. In LTER plots, all trees with a diameter larger than 2 cm were tagged, measured and identified which monitoring will be done every two years. In northern Thailand, Huai Kog Ma, HKM, watershed area in Doi Suthep-Pui National Park, Chiang Mai province, has a long history for hydrology research since 1963 and mainly covered by montane evergreen forest. In 2009, large permanent plot, 16 ha, was established in HKM. High species diversity was found, 213 species, 137 genera and 64 families. The dominance Family was Fagaceaec, oak trees, followed with Lauraceae and Theaceae. While, LTER plots the tropical seasonal forests was done at the Sakaerat Environmental Research Station, Nakhon Ratchasima province, north eastern Thailand. A 16 ha in the dry evergreen forest, DEF, was established since 2005, in addition, several 1 ha plots were also set up in the deciduous dipterocarp forest, DDF. High species diversity was higher in the DEF than DDF. Tree species in Dipterocarpaceae were the dominance family in the top canopy, but only deciduous Dipterocarpaceae found in the DDF.

Figure 1. The main university forest in northern (A; montane forest) and north eastern Thailand (B and C; dry evergreen forest and deciduous dipterocarp forest, respectively).

ABSTRACTS OF RESEARCH GROUP (RG) 3: MANAGEMENT

RG3.1

Recovering forest carbon storage in typhoon-damaged sites through silviculture treatments: A case assessment of the UTokyo Hokkaido Forest

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Typhoons cause sudden carbon reduction in forests, but silviculture treatments can be effective for quickly regenerating and restoring typhoon-damaged sites. This study assessed how silviculture treatments affect the carbon balance after typhoon damage at the University of Tokyo (UTokyo) Hokkaido Forest. Carbon storage in trees and underground vegetation was examined in 25-year-old stands, where scarification and plantation occurred just after typhoon damage. The amount of carbon stored varied according to silviculture treatment. Among three scarification treatments, a scarified depth of 0 cm (understory vegetation removal) led to the largest amount of carbon stored. Among four plantation treatments, the largest amount of carbon was stored in a *Larix* hybrid *(L. gmelinii* var. *japonica* × *L. kaempferi*) plantation. The plantation of *Abies sachalinensis* was not successful at accumulating carbon. Results indicate that silviculture treatments should be performed in an appropriate way to effectively recover the ability of carbon sequestration in typhoon-damaged forests.

RG3.2

Introduction of carbon offsetting credit projects in the University of Tokyo Forests

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A carbon offsetting credit of Japan Verified Emission Reduction (J-VER) was developed in 2008 by the Ministry of the Environment, Japan. By the end of 2012, J-VER had been issued 631,066 t-CO_2 with 250 projects in total, which gained the second share in the domestic carbon offsetting markets. UTokyo enacted the environmental action plan to realize low-carbon campuses, which aimed to 50% reduction from reference CO_2 emission of 136,000 t-CO_2 in 2006 by energy-saving and other measures including carbon offset. In these circumstances 5 UTokyo Forests of Chiba, Hokkaido, Chichibu, Ecohydrology Research Institute (ERI) and Arboricultural Research Institute (ARI) had been successfully certified J-VER projects for the removal by forest sinks accelerated thinning since 2011and had been issued a total of 2,536 t-CO_2 credits from 125 ha thinning sites. This amount of credits contributes 2% reduction to the 50% CO_2 reduction goal of the UTokyo Action Plan to low-carbon campus.

RG3.3

Growth pattern of even-aged coniferous plantation in long-term experimental plots of the UTokyo Chiba Forest

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The UTokyo Chiba Forest has 10 long-term experimental plots of coniferous plantations, where growth of standing trees has been monitored mainly since 1916. The data collected there has made clear patterns of standing tree growth and mortality. These plots are located in even-aged stands of Sugi (*Cryptomeria japonica*) and Hinoki (*Chamaecyparis obtusa*), which are both typical coniferous species suitable for house and building material in Japan. Even in Sugi stands where tree density is relatively low, slight self-thinning is still observed. However, DBH, height and volume growth speeds have not declined yet in all plots. There are another 11 plots which have been abolished because of typhoon damage or harvesting. It suggests that for large-scale and long-term evaluation of plantation growth, dynamics of both individual-tree-scale growth and stand-scale growth should be well considered.

Photo1. Gobōzawa plot (0.54ha 111-year-old sugi stand) with the highest tree heights

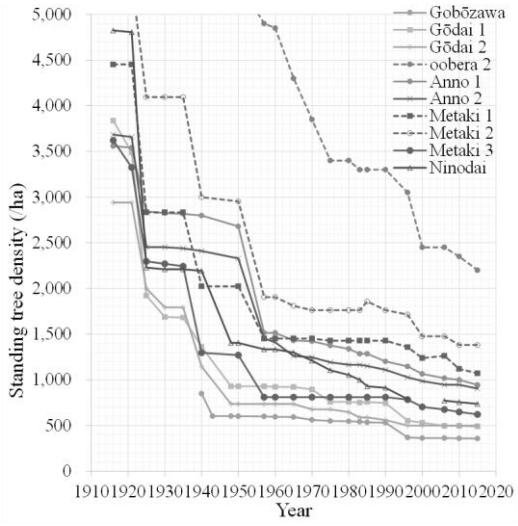

Figure 1. Shift of standing tree density

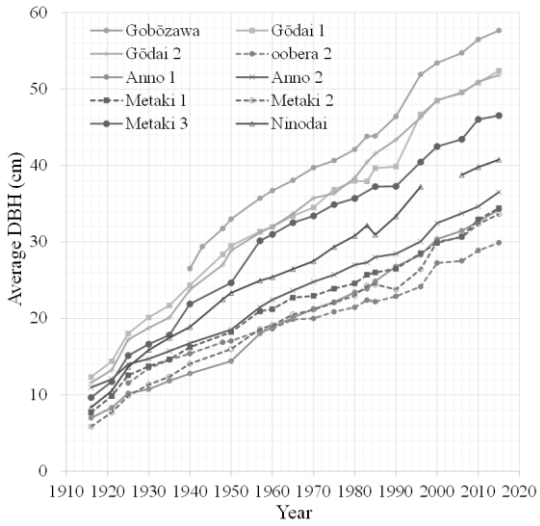

Figure 2. Shift of average DBH

RG3.4

Modelling and mapping Agroforestry plantation aboveground carbon stock in Balung, Tawau, Sabah using airborne LiDAR Data

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Agroforestry plantation offers a compromise solution in climate change mitigation with the potential in sequestering a considerable amount of carbon. The use of LiDAR technology in aboveground carbon (AGC) stock estimation provides an accurate and promising method of mapping AGC over landscape levels. Focusing on the Agroforestry plantation in Balung, Tawau, Sabah, this study aims to investigate the ability of LiDAR data in AGC stock estimation using plot-level approach. 20 sample plots had been established in the teak-based Agroforestry plantation comprising of 3 types of polyculture systems with different intercropping crops. Two types of regressions were used to generate the AGC estimation models. The results showed that linear-regression model led to a better prediction performance with the ability to explain 88% of the AGC data variance in the Agroforestry plantation (adj-R^2_{cv}=0. 84, $RMSE_{cv}$%=13. 45). This study demonstrates that LiDAR data were able to assist in the AGC estimation of the Agroforestry plantation at high accuracy.

RG3.5

Tropical forest restoration management and monitoring

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Most forest restoration efforts to date have focused on implementation monitoring, while information on the success of effort in restoring forest ecosystems and increasing biodiversity is lacking. This study assesses the ecosystem functioning and resilience of enrichment planting of the INIKEA Forest Rehabilitation Project. Since its inception in 1998, the INIKEA has seen around 12,400 ha of forest restored through a mixture of techniques; namely gap and line enrichment planting and canopy liberation. The main aim of the study is to examine the seedling densities within the oldest treated compartments to see if there are differences in seedling densities among the three different treatments and an unplanted control. Two 16 ha sampling plots were established in each of the four forest types (line, gap, liberated and control). Within each plot all potential mother tree (DBH >25cm) was enumerated. Seedling densities within the plots were determined in 36 circular plots laid out along a 200 x 200 m grid installed within the centre of each 16 ha plot. Mean seedling density varied from 2 to 10 seedlings m^{-2}, with significantly more seedling being recorded in the treated plots. The mean density of potential mother tree varied between 40 and 79 trees ha^{-1}, with the lowest densities found in the untreated control site. The preliminary results suggest forest restoration leads to an enhancement of seedling recruitment and that long term monitoring to evaluate forest restoration success with adaptive monitoring approach is important.

RG3.6

Understanding forest micro-environmental condition using airborne LiDAR in a tropical rainforest restoration site

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Canopy structure and light availability are among the critical factors for tree growth and survival. Also, topographical features control quantities of moisture, nutrients, and air and ground temperatures at sites. Diverse microenvironment created by these physical factors may affect the regeneration processes and site suitability in secondary forests. Airborne light detection and ranging (LiDAR) is a remote sensing technology that provides three-dimensional information of forest spatial structure. The Carnegie Airborne Observatory campaign in 2016 acquired airborne LiDAR data at high spatial resolution that is able to obtain canopy structure and topographical information at fine-scale. In this study, we attempt to investigate 1) whether airborne LiDAR data are able to characterize forest structural/microenvironmental properties which are important to tree growth and survival, and 2) the relationship between topographic / micro-topographic condition and the growth responses / site suitability at a restored tropical rainforest.

ABSTRACTS OF POSTER PRESENTATIONS

PO01

Discharge dynamics across a gradient of different land-use histories in the wet/humid tropics (Sabah, Malaysian Borneo)

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Changes in discharge dynamics across a gradient of land-use history are relatively unexplored in the tropics. Five catchments of differing land-use history in the Brantian (Virgin Jungle Reserve, twice-logged forest, multiple-logged forest), Kalabakan (oil palm) and Segama (primary forest) river basins in Sabah were instrumented with water depth sensors connected to solar-powered dataloggers. Rating curves derived from dilution gauging and the Manning equation were used to convert 5-minute depth data to discharge. In the oil palm catchment,the lowest baseflow and stormflow duration may be due to flashy runoff and reduced infiltration, throughflow and groundwater of bench-terraced oil palm terrain; lowest peakflows may result from lower relief; and lowest water yield may result from high transpiration of mature oil palm. The highest values of peak discharge, water yield and stormflow duration recorded for the multiple-logged forest catchment may result from its higher relief and low tree density (and hence low transpiration).

PO02

Water level-discharge relationship in the Shirasaka Experimental Watersheds, Ecohydrology Research Institute, The University of Tokyo Forests

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In 1948, two adjacent experimental watersheds were established in Akazu Research Forest, Ecohydrology Research Institute (ERI) (Gomyo and Kuraji, 2016). The catchments consist of North Creek and South Creek, and the catchment areas (ha) are 1.186 and 1.419 respectively. The water level and discharge measurement was conducted 14 and 19 times in the North Creek and South Creek, respectively. On site, we measure the water level by the point gauge and measure discharge by plastic bag or bucket. We measure time and the volume of water by stopwatch and cylinder respectively to calculate the discharge. Then we optimize the coefficient of the theoretical equation by root mean square error. Finally, we obtain the following equation.

$$Q_N = 0.7636 \times H_N^{2.5}$$
$$Q_S = 0.8305 \times H_S^{2.5}$$

where QN is discharge in the North Creek [m3 sec-1], QS is discharge in the South Creek [m^3 sec^{-1}], HN is water level in the North Creek [m] and HS is water level in the South Creek [m]. The limitation of this method is that the discharge data during high water level is practically difficult to obtain in the field.

PO03

A study on runoff and soil erosion in selective logged forest Danum Valley Sabah, Malaysia

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This study on soil loss and runoff using close system runoff plot was carried out in selectively-logged forest in Danum Valley Lahad Datu Sabah. The purpose of this study was to quantify the effect of forest disturbance on runoff and sediment production within the forest patches, and to better understand the key controlling factors. Runoff plots were set up in forest areas with different levels of logging disturbances, i.e. logged slope, skid trail, and undisturbed/control area. The magnitude of runoff and soil loss from skid trail plot was found to be the highest (7.04 kg ha^{-1} yr^{-1}), followed by logged slope (3.7 kg ha^{-1} yr^{-1}) and control plot (3.03 kg ha^{-1} yr^{-1}). Physical properties of soil (ie: soil compaction) appeared to be an important factor that determines the magnitude of soil loss.

PO04

Water quality monitoring using Black flies (Diptera: Simuliidae) in Ranau and Tambunan District, Sabah

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Black flies play an integral role in organic matter processing in lotic ecosystem, and are also bio-indicator for water quality. This study investigates the relationship between water quality parameters and the black flies abundance. Pupa of black flies was collected from twelve sampling sites around Ranau and Tambunan from October 2015 until September 2016. The water quality parameters (pH, temperature, total dissolves solid and dissolve oxygen) were recorded using a multi parameter probe. A total of 13305 black flies was collected from nineteen species. Principal Component analysis (PCA) indicates two principal components that have eigen values >1.0 and accounted 69.8% of the total variability of physiochemical condition. PC1 reveals that the black flies abundance was significantly positive to water pH, total dissolve solid, velocity, conductivity and width. PC2 indicates 22.8% variability of black flies abundance was associated positively with water temperature, dissolve oxygen and water depth. The Spearman test shows that, pH was strongly positive relationship with the total pupa number (rs = 0.611, p = 0.01). There was a strong, negative relationship between temperature and total pupa number (rs = -0.55, p = 0.03). Total dissolve solid also show a strong, negative relationship with total pupa number sampled (rs = -0.741, p = 0.03).

PO05

Estimating raw water monetary value generated by two small stream catchment in the Crocker Range Park, Sabah

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A short-term study was conducted in an effort to give a monetary value to the raw water generated by two small catchments in the Crocker Range Park, Sabah. The time taken for the stream water to reach a certain volume was used to estimate the stream discharge. Measurements were taken at the outlet point of the stream flow gauge using a plastic bucket and a stopwatch. The volume of water collected in the bucket was then measured using a measuring cylinder. During every measurement, the water level at the point was determined. Water level-discharge relationship was then established. Within September to December 2016, 5 and 6 readings were taken at Mount Alab and Inobong substation, Crocker Range Park respectively. The water yield per year from each catchment was calculated based on the readings and finally, using the management and operating costs for the area in a year, estimated cost for 1m^3 of raw water generated by Mount Alab catchment is RM0.0009 and RM0.001 for Inobong catchment.

PO06

Change of altitudinal vegetation zones comparing past and present time periods in the high elevation montane forest at Mount Kinabalu, Sabah

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As climate changes globally, this study was carried out to compare the altitudes that subalpine montane plants were presently occurring at with a historical account conducted in 1979 by Smith. 2091 individuals of 59 species were observed using a stratified random sampling method conducted from 3260-4095 meters. Data analysis was carried out using Estimates and SPSS to produce rarefaction curves and paired samples t-test results which indicated a shift upwards of the lower boundary in the present account (Mean = 3350.17 ± 115.227) compared to that of the historical account (Mean = 3300.66 ± 65.533) p = 0.04 and a decrease in the upper boundary in the present account (Mean =3719.62 ± 299.14) compared to the historical account (Mean = 3860 ± 195.92) p = 0.002. In conclusion, this implies that the range shift is significant over time, and that long term monitoring should be carried out for Mount Kinabalu.

PO07

Dendrochronological potential of some indigenous tree species in Sabah and their application in Forestry

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Dendrochronology or the discipline of analyzing annual growth rings of trees to capture time series information recorded in the variability of annual tree rings as a function of time and space has been applied to study the history of environmental factors. Core wood samples from eight tropical tree species and four coniferous tree species were collected from Trus Madi Forest Reserve and Mt. Kinabalu, Sabah respectively. One hundred and twenty six core wood samples from 63 trees were collected, analyzed and categorized as trees with no rings, indistinct rings and distinct rings. Among the lowland species *Vitex pinnata* had distinct rings. All of the coniferous species, *Agathis borneensis, Dacrycarpus imbricatus, D. imbricatus v. patulus* and *Phyllocladus hypophyllus* produced distinct rings. Further study is needed to establish cross-matching among samples of the same species for those with distinct rings.

PO08

Diversity and ecology of ferns on Mount Alab, Crocker Range Park, Sabah, Malaysia

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This study was conducted to investigate the fern diversity in a tropical mountain forest of Mount Alab, Crocker Range Park, Sabah. Eight quadrats of 400 m2 were set up in a line transect at an elevation of 1,800 m to 1,900 m ASL. The quadrats were positioned at an interval of 100 m along the transect line. Thirtyfive taxa belonging to 12 families of ferns were observed, representing 4.1% of the currently recorded 804 species of ferns in Sabah. Polypodiaceae and Hymenophyllaceae were highly diverse and commonly found within the area. Most of the species in these two families are epiphytes and thrive in cool, moist habitats such as fallen logs and stumps, which provide suitable substrate and niches for epiphytic ferns. *Selliguea taenita* (Polypodiaceae) dominated most habitats as epiphytes and terrestrial ferns. Hymenophyllaceae is a potential indicator for climate change as species of this family are sensitive to desiccation caused by increased temperature. Fluctuation in abundance and species diversity of Hymenophyllaceae may provide a warning sign in the event of climate change such as global warming.

PO09

Osmotic potential at the turgor loss point of *Shorea pauciflora* King (Oba Suluk)

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Wilting leaf is one of the symptoms of low water balance inside a plant cell. When there is not enough water available for the plant to function properly, the cell will start to lose its turgidity. Most plant species will close their stomata to prevent further water loss, while others remain open and tolerate with dehydration by adjusting their osmotic potential. The wilting characteristic is important to determine the adaptation of dipterocarp seedlings to drought effect in the forest. With the increasing threat of drought events in the South East Asia region due to El Niño, the response of dipterocarps seedling to drought stress is important to understand their adaptability. A study on the effects of gradual water stress on the turgor loss points of Oba Suluk (*Shorea pauciflora* King) seedling had been carried out in the greenhouse of the Faculty of Science and Natural Resources. About 100 seedling of 1.5 years old with a mean height of 41.58 cm and base diameter of 3.24 mm of *S. pauciflora* were studied for a duration of three months. Three watering treatments by 100%, 80% and 60% had been given to the seedlings, and their water relations were studied in every 2 weeks. Results showed that there was a significance difference of predawn and midday water potentials between treatment and control seedlings with $p = 0.0005$ and $p = 0.018$ respectively. The osmotic potential at turgor loss point, however, did not show any difference between treatments.

PO10

Factors influencing diversity of Gaya Island's understory birds population

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Gaya Island harbour terrestrial and marine wildlife. However, scarce study has been done on factors influencing the diversity of birds that act as an important indicator for the island's ecosystem health. This study aims to determine the effect of vegetation and noise factors on understory birds. The methods used were mist-netting, ring banding, noise mapping and strip transect sampling. Diversity indexes were used to analyze the obtained data. Species diversity is slightly higher in the low anthropogenic noise zones, although there was no significance difference between the two zones. Meanwhile, vegetation factor also showed impact on understory birds. Therefore, further study needed to be done to obtain representative data to be used as a guideline by the Sabah Park management.

PO11

The species diversity of Black flies (Diptera: Simuliidae) in Ranau and Tambunan District of Sabah

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Black flies play an important role in the freshwater ecosystem as a biological indicator, as the black flies prefer clean water area to breed. This study is an entomology research which focuses on the species diversity of black flies (Diptera: Simuliidae) in Ranau and Tambunan District of Sabah. There were 12 sampling stations chosen. Larvae and pupae were manually collected from substrates sampled in between rocks with fast flowing water. A total of 12 data sets were collected over a period of 12 months (October 2015 to September 2016). This study has so far recorded 19 species of black flies. Among the 19 species recorded, *Simulium (Gomphostilbia) alienigenum* was the first specimen found in Malaysia especially in Sabah. All the 19 species of black flies recorded in this study belong to three subgenus which are; Simulium, Nevermania and Gomphostilbia. The diversity index ranged between 0.45 to 1.68, indicates that the diversity of blackflies in the rivers sampled were low. The dominance index value that ranged between 0.23 to 0.98, indicated that the black flies species were not evenly distributed in all study sites. As a conclusion, the biodiversity index score shows that, the species diversity in 12 selected areas in Ranau still low, which is only 19 species of Simuliidae had been recorded.

PO12

A brief review on Agarwood (Gaharu) resin uses, demand and market value

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Agarwood/Gaharu the scented resinous wood of Thymelaeaceae family is highly valued because of its aromatic oil extracted from the genera *Aquilaria*, *Gyrinops*, *Aetoxylon* and *Gonystylus* trees, which can be found in the natural tropical forest and plantations from Himalaya to Papua New Guinea. There are many uses of the scented agarwood resin, mainly for perfumery, incense, medicinal purposes, cosmetic, ritual and cultural practice. The agarwood is sold in oil, woodchips/blocks and powder form. The various uses and purposes of agarwood has created a high demand of the products in the global market, which only 10% of the market demand can be supplied by the producing countries. The agarwood products from Malaysia are exported to Asian countries, Arab countries and Europe. The agarwood market values are prized based on the grade and the grading is based on form, shape, odour and colour. The agarwood is considered as the most expensive wood in the world and the market value is increasing every year. In the 3rd quarter of 2016, the average prices of agarwood in Brunei, Cambodia, China, Indonesia, Laos, Myanmar, Thailand and Vietnam was USD185-USD647/tola (1 tola=12 ml) of oil, USD3,146-USD6,029/kg of woodchips and USD425-USD2,086/kg of powder. Particularly, in Malaysia agarwood were USD224 (RM997)/tola of oil, USD6,029 (RM26,829)/kg of woodchips and USD577 (RM2,568)/kg of powder. The agarwood is a forest product which market value is increasing every year due to high demand in the global market.

PO13

A review of medicinal resources from the Sabah tropical forests

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The tropical forest had been said to be a medicinal treasure trove and potentially the largest drug resource on this planet; however, the search to acquire drugs from indigenous tropical plants remains tenuous. Medicinal plants have probably been used in Sabah since time immemorial, well before allopathic medicine was first introduced in the state. Medicinal plants used by various ethnic groups have undergone some degree of documentation. The tropical rain forests of Sabah are rich in species of plants with medicinal potential. Botanical studies show that among the 6500 plant species native to Sabah, the inhabitants use at least 1300 as medicinal plants. The local herbal medicine market has undergone a substantial growth. Regulatory efforts by the Ministry of Health and some research activities of local tertiary institutions aim to ensure herbal medicines translate into quality, efficacious and safe products for human use.

PO14

Supply of ecosystem services with changing weather conditions-Focusing on provisioning and cultural services

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Ecosystem service is defined as the benefits people obtain from ecosystems or the aspects of ecosystems used for improving quality of human life (MA, 2005). Climate change directly affects ecosystems and natural resources, which can indirectly impact on human health, security, livelihoods and poverty with changing ecosystem services (IPCC, 2014). Especially, communities who live in marginal areas and whose livelihoods depend on natural resources are vulnerable to climate change (IUCN, 2008). This study aims to analyze the potential impacts of climate change on ecosystem services which can affect the livelihoods of local communities. Provisioning service such as non-timber forest products (NTFPs) and cultural service such as eco-tourism are important income sources to local people. Thus, we analyzed changes of NTFPs production and forest visitors with changing weather conditions in Korea, with consideration for geographical and socio-economic factors. We collected data by searching statistics on Korea Forest Service database from 1990 to 2015. In case of provisioning service, we analyzed panel data at the county level. In the case of cultural service, we analyze time series data of forest visitors. The results will be used to develop local communities' strategies for adapting to climate change.

PO15

Mapping Ecosystem Services Supply: Integrating the matrix model approach with robust thematic analysis in Sabah, Malaysia

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Valuing the ecosystem services (ES) has contributed substantially to the acquirement of knowledge regarding the status of the environment. However, disputes over the standardized approaches used to quantify ES have become a contentious topic debated by many scientists and decision makers. Therefore, this study focuses on developing a transparent analysis to identify the potential supply of ES which could be found in landscapes surrounding a tropical forest area. Then, generate relevant indicators for a holistic assessment of ES in tropical forests. For a more detailed process, the first step of assessing the potential supply is executed by generating a land cover map of the area being evaluated. Then, an intensive systematic expert-based data extraction using a thematic analysis approach was conducted to identify the potential supply of ES and its relevant indicators. Subsequently, validation using site-based experts was performed to translate the textual corpuses data into a "Matrix Model" table presenting the potential supply of ES. Finally, the result of integrating the "Matrix Model" approach with robust thematic analysis produced a more transparent evaluation and mapping process. In addition, the results offer a constructive and illustrative outcome that could encourage the making of better informed policies in the future.

PO16

A study on the contributions of ecosystem services and sustainable forest management implementation towards the local community in Long Pasia, Sipitang

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This study was conducted to examine the relations between forest ecosystem services and the local community of Long Pasia, Sipitang, Sabah. The village is located in the remote area, in the South-West of Sabah, near the Kalimantan Indonesia boundary. It is surrounded by forests that managed under the forest management unit (FMU) as to achieve the objectives of the sustainable forest management (SFM) policy that is currently adopted in the state. The study was done through convenience household sampling with the distribution of questionnaires to a total of 81 respondents. The results showed that many people still depend on the forest for various purposes, particularly on forest food, housing materials and other non-timber forest products. Most of the respondents agree that the forest ecosystem services are highly significant to their livelihood. These include the habitat for fauna and flora, food provision, regulation of local climate, purification of water and air and ecotourism function. The community perceived the contribution of SFM implementation is still at trivial. The contributions are related to the provision of employment, socio-economic development and welfare of the people. The communities of the village agree that forest management is a shared responsibility that must involve the local community in addition to the role of governments, community leaders and the FMU holders.

PO17

Willingness to pay amongst the community to determine conservation value of an eco-tourist destination in Sabah

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Willingness to pay is the foundation of the economic theory of value. The idea is, if something is worth having, then it is worth paying for. The study aimed to determine the conservation value of tourist destination based on willingness to pay for conservation fee amongst the local community living around selected tourist destination in Sabah. Based on the experience of the local community, an appropriate fee for conservation can be determines. The Contingent Valuation Method (CVM) is one of the methods used for non-market valuation to determine the appropriate pricing. Respondents were asked the maximum amount that they are willing to pay for the nonmarket goods such as scenery, trees, seeing wildlife, aesthetic and etc. available at the destination. This study provided an estimate of the mean values for setting the price for conservation fee and etc. This study presents implications for policy makers to guide future management of tourist destination. Thus the results of this study facilitate in establishing an efficient and realistic pricing policy.

PO18

Capability of aerial Photogrammetry in supporting long-term monitoring of forest resources in a tropical rainforest environment

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Monitoring forest resources such as forest carbon and biodiversity require high accuracy and robust assessment in spatial scale. Aerial Photogrammetry is potentially cost-effective under certain condition in supporting long-term monitoring of forest resources. Three-dimensional information in dense points now can be derived in automation using structure from motion (SfM) technique. Additionally, reflectance information is valuable for certain forestry purpose. However, photogrammetric points are limited in deriving digital terrain model (DTM) or forest floor in a dense forest environment. This limitation can be overcome with the combined use of airborne laser scanning (ALS) dataset. Ongoing development in technological innovation, technical and operational issues of aerial Photogrammetry is promising to offer improved support in long-term monitoring of forest resources.

PO19

Effects of nursery practices on *Eucalyptus pellita* seedling growth

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Eucalyptus pellita, also known as red mahogany is a fast growing species and recommended as a potential species to be planted commercially in forest plantation in Malaysia. Availability and sustainability of seedlings are essential in forest plantation development. Thus, nursery practices are very important in producing the seedlings to the plantation. The objective of this study is to identify the best practice for seed germination and seedling growth of *E. pellita* under basic conditions. The study used a completely randomized design, testing 12 treatments for germination media and growing media. Each treatment was replicated four times. Three different growth media combinations were used, which are 100% cocopeat, 70% cocopeat + 30% top soil and 50% cocopeat + 50% top soil, where each of this growth media were added with different rates of agroblen fertilizer with amounts 0 kg/m^3, 8 kg/m^3, 12 kg/m^3 and 16 kg/m^3. The combination of 70% cocopeat + 30% top soil was the best media for germinating *E. pellita* seed (63%). The best media for height growth, collar diameter growth and root-shoot ratio of *E. pellita* seedlings was the combination of 50% cocopeat + 50% top soil added with 16 kg/m^3 of agroblen fertilizer.

PO20

The responds of Kinabalu Park bird diversity towards traffic noise

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Kinabalu Park is well-known for its diversity of the bird's population. Bird watching activity has become one of the main attractions in Kinabalu Park. Due to the popularity of this park, many tourists visit this Park and directly contribute to the increasing traffic flows of vehicles in the park. Hence, this research was conducted to study the response of bird diversity towards traffic noise in Kinabalu Park. Two methods employed were, i.e., traffic noise mapping and bird survey. The traffic noise mapping involves identifying High Traffic Noise and Low Traffic Noise. Bird survey was done by using the point count method. Data was analyzed using Diversity t-test. The result shows that the diversity of bird's in Control Site was significantly higher than those at Low Traffic Noise ($t = -2.3803$; $df = 629.06$; $p = 0.017597$*) and High Traffic Noise (t= -4.8247; df=645.21; p=1.7513E-06**). As a conclusion, Kinabalu's Bird population diversity doesn't do well in areas with High Traffic Noise.

PO21

Estimates of the economic value of urban trees using Thyer Method

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Urban tree planting provides ecosystem services in terms of environmental, social and economic aspects. However, the ecosystem services derived from urban tree planting is not easily quantified from the economic perspective. As a result, urban tree planting program is difficult to justify for long term social welfare and sometimes has been ignored by policy makers. Methods for determining its economic value have been developed and employed by many researchers to quantify the economic value of urban trees, particularly in developed countries. This study employed the urban tree valuation method, namely Thyer method to evaluate five hundred and three urban trees in Kuala Lumpur, Malaysia. Field observations were carried out to record tree species, age, circumference, height, tree volume, crown diameter and tree characteristics. The results revealed that *Pterocarpus indicus* had the highest value with an estimated mean tree value of RM972,660 per tree. The mean value per tree as calculated by Thyer method was RM435,851. The economic value of urban trees differs with respect to physical and qualitative characteristics of the tree.

PO22

Potential compounds of *Aglaia variisquama* (Meliaceae) leaves with insecticidal properties detected using GC-MS

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Public awareness towards the safety of insecticide application has prompted studies on plant based insecticides as an alternative to chemical insecticides. *Aglaia variisquama* (Meliaceae) was studied for its potential insecticidal compounds using gas chromatograph-mass spectrum (GC-MS). One Kg of *Aglaia variisquama* leaves was extracted with chloroform for 72 hours (three days) and filtered. The chloroform was then removed by using a rotary evaporator to get the pure crude extract. The potential compounds of *Aglaia variisquama* detected by GC-MS analysis was confirmed by using National Institute Standard and Technology (NIST) database. The GC-MS analysis show 50 compounds recorded from the crude extract with the highest peak of the GC-MS graph analysis was represented by lupenone compound. Lupenone have proven to have a potential as a plant based insecticide.

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Remote Sensing Platform for River Water Monitoring

Parameter :

- Biochemical Oxygen Demand (BOD)
- Chemical Oxygen Demand (COD)
- Ammonical Nitrogen (NH3-N)
- pH
- Dissolved Oxygen (DO)
- Total Suspended Solid (TSS)
- Turbidity
- Depth
- Ammonia
- Nitrate
- Chloride

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