海南大学 HAINAN UNIVERSITY

JAPAN SOCIETY FOR THE PROMOTION OF SCIENCE 日本学術振興会

# 第一届亚洲森林长期监测

# 国际研讨会

2019年11月11-14日

# Abstracts of

# JSPS Core-to-Core Program

# "1st International Symposium of Long-term Forest Monitoring Research in Asia"

*"The impact of current global changes on the Asian forest ecosystem and how the Asian forest ecosystem responds" and "organizing long-term forest monitoring training for young researches among countries in the Asian region"*

**November 11-14, 2019**

**Co-sponsored by:**

海南大学
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JAPAN SOCIETY FOR THE PROMOTION OF SCIENCE
日本学術振興会

**Supported by:**

**College of Forestry, Hainan University**

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College of Forestry, Hainan University

## Welcome from the Vice President of Hainan University

I am Xinwen Hu, the vice president of Hainan University. Firstly welcome everyone to attend this symposium. Forest is an ecosystem with the largest distribution area, the most complex composition structure and the most abundant biodiversity on land. It plays an important role in the global material and energy cycle, especially in regulating the global carbon balance, conserving water sources, reducing soil erosion, preventing wind and sand fixation and maintaining global climate stability. Till recently the industrial revolution, the burning of fossil fuels and land-use change and other human activities have led to more than half of the global forest reduction. Although countries began to restore forest area, the biodiversity of forest ecosystem in the world is still facing a great threat, among which the top four are all located in Asia. Therefore, it is urgent to carry out long-term forest monitoring in Asia, and at the same time, share the monitoring data to carry out cooperative research to explore the impact of current global changes on Asian forest ecosystems and how Asian forest ecosystems respond. However, although a long-term forest monitoring network has been established in many Asian countries, there is little exchange and cooperation among Asian countries. I would like to thank the University of Tokyo to summon Universities from China, Japan, South Korea, Thailand, Malaysia, Indonesia and Sri Lanka for convening an International Workshop on long-term monitoring of forests in Asia to discuss the following two topics: "the impact of current global changes on the Asian forest ecosystem and how the Asian forest ecosystem responds" and "organizing long-term forest monitoring training for young researches among countries in the Asian region". I believe that the convening of this seminar will contribute to forest protection in Asia. At present, in response to President Xi Jinping's instructions to build tropical rain forest national park, Hainan has established the tropical rain forest national park. Here, I sincerely hope that university forest plots of various countries can actively cooperate with Hainan University, which will also provide strong scientific and technological support for the construction of Hainan rainforest National Park. Finally, I wish the seminar a complete success.

Xinwen Hu
Vice President of Hainan University.

**Welcome from Prof. Naoto KAMATA: a Project Leader of JSPS Core-to-core Program**

I am Naoto Kamata, a project leader of the Japan Society for the Promotion of Science (JSPS) Core-to-core Program. As the Project Leader of the UTHF, I would like to express my sincere thanks to your great contribution to the project and welcome all of the participants to this Hainan Symposium. It is the first year of the second phase of the project. In the first phase (FY2016—FY2018), there were five members: The University of Tokyo, Seoul National University, National Taiwan University, Kasetsart University, and Universiti Malaysia Sabah. We have conducted many joint researches during the three years. We have published one book titled “Developing a network of long - term research field stations to monitor environmental changes and ecosystem responses in Asian forests” March 2019. Now we are editing a special issue in the Journal of Forest Research. Fifteen manuscripts are under review. It will also be published in June 2020.

Each university has long-term data on climate, hydrology, LTER study plots, and plantations. These basic data are valuable treasures for a field of our science. In this project, I would like encourage you and your students to collaborate with foreign researchers and students and compare your data with ones outside your location. In the second phase (FY2019—FY2021), we expanded our network wider that the first phase by including three new members: Haina University, University Sri Jayawardenapura, Universitas Gadjah Mada.

This Hainan Symposium is a kick-off meeting of the second phase. I hope this symposium will promote the future international collaborative research among the eight universities. I hope you will have a fruitful time here in Hainan.

**Prof. Naoto Kamata, Ph.D.**
Project Leader of the Japan Society for the Promotion of Science (JSPS) Core-to-core Program
Director, The University of Tokyo Hokkaido Forest

*: Japanese Fiscal Year starts from April and end in March next calendar year.

Tentative Schedule of JSPS C2C Symposium in Haikou Campus
(Leave Haikou at Nov. 15)

| | Nov.10,2019 (Sun.) | Nov.11,2019 (Mon.) | Nov.12,2019 (Tue.) | | Nov.13,2019 (Wed.) | Nov.14,2019 (Thu.) | | Nov.15,2019 (Fri.) |
|---|---|---|---|---|---|---|---|---|
| | | | Main program | option | | Main program | option | option |
| 6:00 | Arrive in Haikou | | | | | | | Leave Haikou |
| | | | | | | | | |
| 7:00 | | Breakfast | Breakfast | Breakfast & Hotel Check Out | | | | |
| | | | | | | | | |
| 8:00 | | Move to Campus & Registration | Move to Campus | | Breakfast | Breakfast | | |
| | | | | | | | | |
| 9:00 | | Symposium<br>Welcome Address Plenary Session | Research Group Session | | Excursion in Diaoluoshan Nature Reserve | Hotel Check Out & Move to Haikou | | |
| | | | | | | | | |
| 10:00 | | | | | | | | |
| | | | | | | | | |
| 13:00 | | | | | | | | |
| | | | | | | | | |
| 13:00 | | Move to Lunch | Move to Lunch | | | Lunch | Lunch & Hotel Check In | |
| | | | | | | | | |
| 13:10 | | Lunch | Lunch & Hotel Check Out | Lunch & Move to Airport | | Move to Airport | | |
| | | Move to Session | | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| 14:50 | Poster Session 1 | Campus tour | Leave Haikou | | Leave Haikou | Free Time |
| | | | | | | |
| 15:00 | | Leave Haikou & Move to diaoluoshan Nature Reserve | | | | |
| | | | | | | |
| 16:00 | Break | | | | | |
| | Poster Session 2 | | | | | |
| 17:00 | | | | | | |
| | | | | | | |
| 18:00 | | Free Time | | Dinner, go back to Haikou and check in the hotel | | Dinner |
| | Move to Banquet | | | | | |
| 19:00 | Banquet | Dinner | | | | |
| | | | | | | |
| 20:00 | | | | Free Time | | Free Time |
| | | | | | | |
| 21:00 | Free Time | Free Time | | | | |
| | | | | | | |

# Program of Oral Presentation and Index of Abstracts

*Please refer following abbreviated names of affiliation (in alphabetical order)
HU: Hainan University
KU: Kasetsart University
NTU: National Taiwan University
SNU: Seoul National University
UGM: Universitas Gadjah Mada
UMS: Universiti Malaysia Sabah
USJ: University of Sri Jayewardenepura
UT: The University of Tokyo
UTF: The University of Tokyo Forests

November, 11 (Mon)
15:00-17:00 Poster Sessions
Venue: The meeting room in the first floor of administration building, HU.

| | |
|---|---|
| **14:30-15:30** | Poster Session 1 with short oral presentation (PS1: Odd numbers) |
| **01** | WU, Tingting (HU) Variations of soil phosphorus fractions and microbial community structure among with the tropical forest succession in Hainan of China |
| **03** | XU, Wenxian (HU) Effect of green manure mulching on soil fertility and soil enzyme activity of young rubber plantation |
| **05** | TAN, Zhaoyuan (HU) The dilution effect of forest pest in tropical forest, Hainan, China. |
| **07** | JIANG, Yamin (HU) Nitrogen addition affects carbon use efficiency of microbes in nitrogen limitation soil |
| **09** | LIAO, lincong (HU) Variation and trade-offs in functional traits of *Bombax malabaricum* across different geographical regions and among varied tree sizes on Hainan Island |
| **10** | XIAO, Chuchu (HU) Vascular epiphyte biodiversity in tropical cloud forest of Hainan Island |
| **11** | YANG, Qi (HU) Reintroduction Prediction of seven wild plants with extremely small populations A case study at Hainan Island of China |
| **13** | JIANG, Kai (HU) Research on sports park and forest ecology |
| **15:40-16:40** | **Poster Session 2 with 3-min oral presentation (PS2: Even numbers)** |
| **02** | JIA, Gaohui (HU) The emission characteristics of non-microbial methane from soils in tropical rainforest |
| **04** | CUI, Yibin (HU) Control of temporal variations on soil respiration in a tropical lowland rainforest in Hainan Island, China. |
| **06** | LI, Qiwen (SNU) Post fire Effects on Structural and Hydrological Properties of Forest Soils |
| **08** | LI, Xuanru (HU) Foliar uptake of fog water and precipitation and suppressed transpiration determine The response of both forest and epiphyte to seasonal drought in a tropical cloud forest |
| **12** | HE, Qifang (HU) Isolation and identification of indole-degrading bacteria |
| **14** | JIANG, Chao (HU) Effects of monsoon on distribution patterns of tropical plants in Asia |
| **16:40-16:50** | **The award ceremony of very excellent poster presentation** |
| **16:50-17:50** | **Visiting History Museum of Hainan University.** |

| November 12 (Tue)<br>Research Group Session 1: Water & Climate (RG1)<br>Venue: Classroom 5-414, the fifth teaching building, HU<br>**8:30-12:30** | | |
|---|---|---|
| 8:30-8:35 | Introduction | |
| RG1-1<br>(8:35-8:55) | IM, Sang jun (SNU) SCS Curve Number Procedure Revisited for Experimental Forests of Different Climate Zones | p.28 |
| RG1-2<br>(8:55-9:15) | WILSON, Wong Vun Chong (UMS) Hydro-Meteorological Monitoring in Crocker Range Park, Sabah, Malaysia | p.29 |
| RG1-3<br>(9:15-9:35) | TUANKRUA, Venus (KU) Long Term Data for Flash Flood Forecasting using Antecident Precipitation Index in Upper Nan Watershed, Nan Province, Thailand | p.30 |
| 9:35-9:45 | Discussion of past collaborative researches | |
| 9:45-9:50 | Break | |
| RG1-4<br>(9:50-10:10) | CHANDRATHILAKE, Thilakawansha (USJ) Rainfall redistribution by Yagirala Forest Reserves; a secondary lowland tropical wet evergreen forest in Sri Lanka | p.31 |
| RG1-5<br>(10:10-10:30) | SURYATMOJO, Hatma (UGM) Dynamic changes of runoff and sediment yield in the small headwater catchments under intensive tropical forest management system, central Kalimantan, Indonesia | p.32 |
| RG1-6<br>(10:30-10:50) | ZHANG, Hui (HU) The key role of fog on tropical cloud forest, Hainan, China | p.33 |
| 10:50-11:00 | Break | |
| RG1-7<br>(11:00-11:20) | LAI, Yen-Jen (NTU) Exploring Spatiotemporal Patterns of PM2.5 in the Xitou Region, Central Taiwan | p.35 |
| RG1-8<br>(11:20-11:40) | NAINAR, Anand (Utokyo) Possible hydrological benefits from cypress plantation forests | p.35 |
| RG1-9<br>(11:40-12:00 | KURAJI, Koichiro (UTokyo) Effect of litter removal and logging trees on surface runoff in Ananomiya Experimental Watershed, Ecohydrology Research Institute, The University of Tokyo Forests | p.36 |
| 12:00-12:30 | Discussion of future collaborative researches | |

| November 12 (Tue)<br>Research Group Session 2: Ecosystem & Biodiversity (RG2)<br>Venue: Classroom 5-415, the fifth teaching building, HU<br>**8:30-12:30** | | |
|---|---|---|
| **8:30-12:10** | **Presentation from each university** | |
| RG2-1<br>(8:30-8:50) | FUKUI, Dai (Utokyo) Acoustic monitoring of bats as a forest indicator | p.38 |
| RG2-2<br>(8:50-9:10) | DING, Tzung-Su (NTU) Temporal Dynamics in Bird Altitudinal Distribution in the Experimental Forest of National Taiwan University | p.39 |

| | | |
|---|---|---|
| RG2-3 (9:10-9:30) | LEE, Woo-Shin (SNU) The Long-term variation of spring temperature and egg-laying dates of nestbox-breeding Varied Tits (Sittiparus various) in South Korea and Japan | p.40 |
| RG2-4 (9:30-9:50) | KAMATA, Naoto (Utokyo) My long-term researches on forest insects | p.41 |
| RG2-5 (9:50-10:10) | RAHAYU, Sri (UGM) MONITORING THE GUMMOSIS SYMPTOM ON INVASIVE Acacia decurrens Willd. AFTER MOUNT MERAPI ERUPTION IN YOGYAKARTA, INDONESIA | p.42 |
| RG2-6 (10:10-10:30) | TAN, Zheng Hong (HU) Ecosystem physiology of tropical forests: findings from monitoring networks | p.43 |
| RG2-7 (10:30-10:50) | SINGHAKUMARA, BMP (USJ) Restoration pathways for rain forest in southwest Sri Lanka: a review of concepts and models | p.44 |
| RG2-8 (10:50-11:10) | GUAN, Beeing Tzuang (NTU) Long-term Tree Species First Leafing and Flowering Trends at the Tokyo University Hokkaido Forest | p.45 |
| RG2-9 (11:10-11:30) | MAROD, Dokrak (KU) Impacts of Climate Changes on Forest Dynamics at Doi Suthep-Pui National Park, Chiang Mai Province, Northern Thailand | p.46-47 |
| RG2-10 (11:30-11:50) | MARIPA, Rhema D. (UMS) Ecophysiology of drought-induced Dipterocarps | p.48 |
| RG2-11 (11:50-12:10) | ZHANG, Hui (HU) Why tropical forest has the highest drought-induced tree mortality | p.49 |
| **11:50-12:30** | **Discussion of future collaborative researches** | |

November 12 (Tue)
Research Group Session 3: Management (RG3)
Venue: Classroom 5-416, the fifth teaching building, HU
**8:30-12:30**

| | | |
|---|---|---|
| **8:30-11:50** | **Presentation from each university** | |
| RG3-1 (8:30-8:50) | PARK, Pil-Sun (SNU) Long-term monitoring sites of Seoul National University Forests | p.52 |
| RG3-2 (8:50-9:10) | TOYAMA, Keisuke (UTokyo) Academic utilization of various records in the University of Tokyo Chiba Forest | p.53 |
| RG3-3 (9:10-9:30) | HIROSHIMA, Takuya (UTokyo) Growth prediction variability according to observation period of long-term data in old Sugi (*Crypromeria japonica*) planted stands | p.54 |
| RG3-4 (9:30-9:50) | OWARI, Toshiaki (UTokyo) Long-term growth trends of *Cryptomeria japonica* plantations at The University of Tokyo Forests and National Taiwan University Experimental Forest | p.55 |
| RG3-5 (9:50-10:10) | WANG, Chieh-Ting (NTU) An Experiment of Mixed Deciduous-Coniferous Forests to Rehabilitate *Cryptomeria japonica* Plantations | p.56 |
| 10:10-10:30 | Break | |
| RG3-6 | WIDIYATNO (UGM) Enrichment Planting Increases Genetic | p.57 |

| | | |
|---|---|---|
| (10:30-10:50) | Diversity Of Secondary Lowland Dipteroarp Forests In Indonesia | |
| RG3-7 (10:50-11:10) | MAID, Mandy (UMS) GENOMIC DIVERSITY OF *Acacia mangium* AND *Acacia auriculiformis* NATURAL GERMPLASMS USING SNP MARKERS | p.58 |
| RG3-8 (11:10-11:30) | WANTHONGCHAI, Kobsak (KU) Prescribed Fire Behavior and Management in Khuan Khreng Peat Forest, Nakhon Si Thammarat Province, Thailand. | p.59 |
| RG3-9 (11:30-11:50) | PERERA, Priyan (USJ) Ensuring the Sustainability of Sri Lanka's Wood-based Industries for a Circular Bio-economy | p.60 |
| **11:50-12:30** | **Discussion of future collaborative researches** | |

| | |
|---|---|
| **12:30-14:00** | **Lunch** |
| **14:00** | **Leaving for Excursion** |

November 13 (Wed)

**8:30-12:00: Excursion in diaoluoshan National Reserve**

**12:00-13:30: Lunch**

**13:30-17:00: Excursion in diaoluoshan National Reserve**

**17:30-18:30: Dinner**

**18:30: Go back to Haikou**

November 14 (Thu)

Leaving for Haikou

**8:30-**

# Symposium

# A long-term data in the University of Tokyo Forests and JSPS Core-to-core project

Naoto KAMATA[1]
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**Abstract**

Under changing environments, long-term monitoring and inventory data are important to detect temporal changes in environments and ecosystems. There have been so many attempts that aimed long-term research or monitoring. However, many of them have stopped due to the retirement of responsible researchers. On the other hand, university forests own various kinds of long-term data because they can obtain data as organizations, which is useful for forest research and education. The most typical one is meteorological data. Meteorological Agency in each country has been accumulated meteorological data for long. However, their observatory stations are normally located in urban areas so that data obtained by them need to be corrections before applying to forest research. On the other hand, university forests are normally located in remote areas so that climate data that have been obtained by university forests can be used for forest researches. The University of Tokyo Forests (UTF) consists of seven regional forests. The seven forests have accumulated basic long-term data that are available for researches and education: LTER plots, other stand plots, meteorological and hydrological data, bird community, plant and vertebrate inventory, and others. Since 2016, we teamed up with other university forests in Asian countries and started to share data and knowledge that have been accumulated in each university. We would also introduce activities of the network.

# The Participation of Hainan University in the JSPS Core-to-Core Program

SONG Xi-Qiang1, REN Ming-Xun2
1 College of Forestry, Hainan University
2 College of Ecology and Environment, Hainan University

**Abstract**: Based on a continuous collaboration over the past three years between Hainan University and the University of Tokyo, Hainan University has been included into the Japan Society for the Promotion of Sciences (JSPS) Core-to-Core Program, Asia-Africa Platforms, entitled ‘A research hub of long-term forest monitoring field centers on environmental changes and ecosystem responses: Collaborating for data, knowledge, and young researchers’. We reviewed the origin, involved scientists, planned activities of Hainan University in the Program and pointed out the future collaboration in this huge Program and other related collaborations, such as student and young scientist exchanges, Summer/Winter Camp, applying a new project from Chinese government.

# Introduction to National Taiwan University Experimental Forest and its Contributions in the Phase I of the JSPS Core-to-Core Project

Biing T. GUAN[1]
[1]School of Forestry & Resource Conservation, National Taiwan University
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**Abstract**

Located in central Taiwan, with an elevation from 290 to 3,952 m and an area *ca*. 1% of Taiwan, National Taiwan University Experimental Forest (NTU EXPF) is long in history and rich in natural resources. In this presentation, I will briefly introduce NTU EXPF, including its history, environment, and natural resources. I will also address NTU EXPF research activities in forestry, wildlife conservation, biomaterial utilizations, and social dimensions. The activities and contributions in the Phase I of the JSPS Core-to-Core project included establishing a climate classification map of Asian university forests using Worldclim Database (RG1); analyzing the University of Tokyo Hokkaido Forest long-term phenological observations to understand the influences of natural climate variability and assess the impacts of recent warming on various tree phenophase developments (RG2); comparing sugi growths, stand dynamics, responses to various management regimes, and $CO_2$ sequestration capabilities in different parts of Asia (RG3).

# Introduction of the Forest Sciences Department and University Forests of Seoul National University, Korea

Sangjun IM[1]

[1]Department of Forest Science & University Forests, Seoul National University, KOREA, junie@snu.ac.kr

**Abstract**

Seoul National University (SNU) was founded in 1946 as the first national university of Korea and, as of 2019, consists of 15 college, 1 graduate school, and 11 professional graduate schools. The College of Agriculture & Life Sciences (CALS), SNU, is a leading institution specializing in agricultural education and research, and has 8 departments offering 17 major and interdisciplinary programs. The Department of Forest Sciences of CALS specializes in nurturing forests and the sustainable use of forest resources which include the direct and indirect uses of forest products. 17 faculty members have served in the department to identify and resolve important problems in biology, conservation, management, and utilization of forest resources and to disseminate research results to the scientific community, resource user-groups, and the general public.

Seoul National University Forests (SNUF) was established in 1913 in order to contribute to education and research of forest science and forestry. SNUF has three forests in the mid and southern part of South Korea: Chilbosan University Forest, Taehwasan University Forest, and Nambu University Forest. Chilbosan University Forest (CUF) is located in Suwon-si and Hwaseong-si in Gyeonggi-do. In CUF, education and research on raising seedlings and trees are ongoing inside nurseries and greenhouses. Research on urban forestry is also ongoing. Taehwasan University Forest (TUF) is located in Gwangju-si in Gyeonggi-do. TUF has a flux tower that can measure carbon, air and matter cycling, and also has a debris barrier for hydrological research. Nambu University Forest (NUF) is located in Gwangyang-si and Gurye-gun in Jeollanam-do. NUF is a large forested area with 16,213 ha and thus profitable to conduct research. NUF has 880 sites for permanent vegetation monitoring, and research installations such as hydrological facilities and an observation garden.

# FACULTY OF FORESTRY UNIVERSITAS GADJAH MADA, YOGYAKARTA, INDONESIA

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**Abstract**

Faculty of Forestry Universitas Gadjah Mada is one of the best and the oldest Forestry Study Program in Indonesia. Established on 1963, this faculty consist of 98 lecturers, and with 250 students intake annually, a total of 1,150 students were active in this year. It has four departments (i.e. Forest Management, Silviculture, Forest Conservation, and Forest Product Technology) and three Study Programs (i.e. undergraduate, master program and doctoral program). It has a vision to be the best institution of higher education in tropical forestry in Indonesia and respected in the world, with its mission to produce high-quality graduates with superior competence in the field of sustainable tropical forestry and having integrity in addressing the challenges of the communities. With joining the JSPS project we expect that the faculty will have good opportunity to accelerate the mission and widen good cooperation and networking with other country, especially with the member of JSPS-C2C Project's countries.

# Forestry Education at the University of Sri Jayewardenepura, Sri Lanka

Balangoda M.P. SINGHAKUMARA, Priyan PERERA & Thilak CHANDRATHILAKE

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**Abstract**

The University of Sri Jayewardenepura is one of the fifteen universities in Sri Lanka, located in Colombo suburbs. In 1983, the University was identified as a partner organization to the World Bank funded national project to handle the professional forestry training component. As a result, Masters' degree in Forestry was introduced in 1984 and consequently, the Department of Forestry & Environmental Science was established in 1996 with the introduction of undergraduate courses in the discipline. The Department at present conducts BSc general and honours degrees courses, postgraduate courses such as MSc, M.Phil. and PhDs. The Department maintains a 100-acre forest and a field research station at Yagirala Forest. Key achievements of the Department include conducting an annual International Forestry and Environment Symposium since 1995, publication of the biannual Journal of Tropical Forestry and Environment since 2011, establishments of the Centre for Sustainability in 2013; a body for environmental extension, research and community outreach, and opening a dedicated research centre - Centre for Forestry and Environment in 2016.

# Faculty of Forestry (KUFF)

# "Activities and Future Collaboration

# in Kuff Research and Training Stations"

Kobsak WANTHONGCHAI[1], Sakhan TEEJUNTUK[1], Nattawat KLANGSAP[1]
& Narinthorn JUMWONG[1]

[1]Faculty of Forestry Kasetsart University, THAILAND, fforksw@ku.ac.th

Kasetsart University, faculty of forestry (KUFF) has 8 research and training stations covering most of forest ecosystem in Thailand. Each station has unique in terms of ecosystem and infrastructure for supporting research and training. "Doi Pui" and "Wang Nam Khiew" research station have long been serving for watershed management and long term ecosystem study with University Forest Consortium group, respectively. These are related to the group of RG 1 and RG 2 of the University Forest Consortium. However, the RG 3 research group, of which focusing on forest management, is not much well promoted. In this regards, KUFF would like to propose "Sanam Chai Khet" research and training station to be the research site for RG3 group, especially for those researchers who are interested in economic forest management. Economic forest plantation research that meet the "sustainable forest management scheme" will be promoted and implemented. Therefore, KUFF are very welcome the University Forest Consortium members to join with our mission in this research station.

# Forestry Education and Research in Universiti Malaysia Sabah, Malaysia

Wilson V. C. WONG[1], Maria Lourdes LARDIZABAL[1], Mui-How PHUA[1]
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**Abstract**

Forestry programmes in Universiti Malaysia Sabah (UMS) was founded in 1996 with the establishment of School of International Tropical Forestry (SITF) and introduction of four Bachelor of Forestry Science programmes (i.e. International Tropical Forestry (HG19), Nature Park & Recreation (HG20), Forest Plantation and Agroforestry (HG23), and Wood Technology and Industry (HY11)). Currently, UMS does not have an experimental forest and field-based learning has been conducted mainly in the UMS Kota Kinabalu Campus and other nearby forest area managed by state agency (e.g. Kawang Forest Reserve, Crocker Range Park and Kinabalu Park). Research activities are conducted in various forest areas such as Long Mio, Crocker Range Park and Kabili-Sepilok Forest Reserve. With the cooperation and support of various stakeholders, forestry education and research in UMS will continue to expand and fulfil the needs of industry and society.

# Poster Presentation

# Variations of soil phosphorus fractions and microbial community structure among with the tropical forest succession in Hainan of China

Tingting Wu[1,2], Qiu Yang[1], Gaohui Jia[1], Tianyan Su[1], Yide Li[3], Dungang Wang[1,2], Huai Yang[3], Han Mao[1], Wenjie Liu[1*], Jinchuang Wang[1,2*]

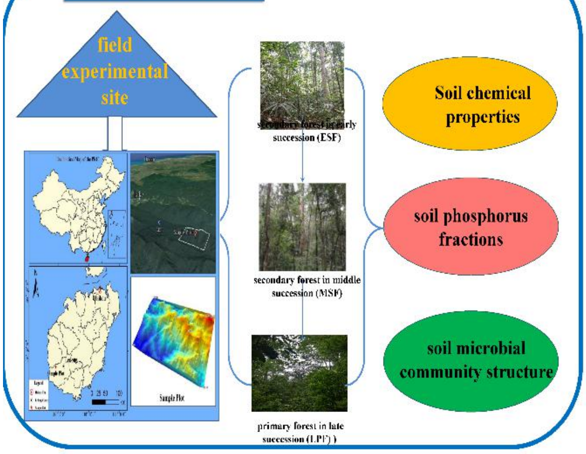
1. College of Ecology and Environment, Hainan University, Haikou, 570228 Hainan, China; 2. Institute of Environment and Plant Protection, Academy of Tropical Agricultural Sciences, Haikou 571101, China; 3. Jianfengling Long-term Research Station for Tropical Forest Ecosystem, Research Institute of Tropical Forestry, Chinese Academy of Forestry, Guangzhou 510520, China

## Introduction

Phosphorus (P), one of essential macronutrients for plants, is often thought to be the most limiting nutrients to primary production in tropical forests, because of the low availability of soil inorganic P (Pi) and highly weathered tropical soils. P is found in soils in inorganic forms (Pi) and organic forms (Po) and plants and microorganisms have developed a broad range of mechanisms to enhance the acquisition of labile P. Therefore, understanding the distribution and forms of P can provide insight for characterizing soil P availability.

In tropical regions, deforestation and other anthropogenic activities have transformed many primary forests in secondary forest successional gradients, which made the soil chemical and biological properties differed in rainforest under succession stage, and, thus, in P fraction dynamics. However, the information on soil P cycling and their transformation mechanisms along the different forest succession in still unclear, especially the effects of the seasonal changes on the transformation mechanism of P fractions mediated by microorganisms and physicochemical properties have not been extensively studied.

## Materials and Methods




## Results

**Table 1** Changes of soil chemical properties in different successional stages of Jianfengling tropical montane rainforest under wet and dry seasons.

| | Wet season | | | Dry season | | |
|---|---|---|---|---|---|---|
| | LPF | MSF | ESF | LPF | MSF | ESF |
| pH | 4.63± 0.08Aa | 4.49= 0.02Aa | 4.74± 0.06Aa | 4.48± 0.2Ba | 4.43= 0.05Ba | 4.32= 0.12Ba |
| TN (g/kg) | 1.92± 0.33Ba | 1.12.= 0.33Bb | 0. 75± 0.5Bb | 2.44± 0.24Aa | 2.00= 0.13Ab | 1. 84= 0.33Ab |
| TP (mg/kg) | 142.85− 14.49Ba | 125.27+ 11.24Bb | 96.61− 4.37Bc | 219.85− 14.12Aa | 213.79+ 11.35Aa | 158.13+ 19.19Ab |
| AK (g/kg) | 1.84+ 0.57Ba | 1.08= 0.25Bb | 0. 96± 0.27Bb | 2.37+ 0.33Aa | 1.71− 0.16Ab | 1.91− 0.3Ab |
| SOC (g/kg) | 25.2± 0.63Aa | 12.49= 2.31Bb | 20.93= 3.59Aa | 16.44± 1.98Ba | 15.98± 0.71Aa | 15.92= 0.97Ba |
| $NO_3^-$ (mg/kg) | 5.05± 0.45Ba | 2.29= 1.16Bb | 2.88± 0.55Bb | 15.12± 1.79Aa | 11.81± 1.81Ac | 13.99= 1.29Ab |
| $NH_4^+$(mg/kg) | 22.81+ 0.5Aa | 19.82− 0.45Ab | 16.15− 1.15Ac | 5.01+ 0.39Bb | 5.17− 1.02Bb | 8.78− 0.82Ba |
| AP (mg/kg) | 60.34+ 4.45Ba | 59.77− 5.57Ba | 61.97− 10.41Ba | 65.41+ 4.97Ab | 73.79+ 3.15Aa | 65.36− 3.73Ab |

The most soil nurtients decreased with the forest succession. In addin, soil nutrients in dry season were higher than that in wet season along the rainforest succession.

**Table 2** The PLFA (u mol (g OC)$^{-1}$) microbial community composition among the three forest succession stages and under wet and dry seasons.

| | Wet season | | | Dry season | | |
|---|---|---|---|---|---|---|
| | LPF | MSF | ESF | LPF | MSF | ESF |
| G+ | 29.67± 0.91Aa | 19.03± 0.23Ab | 26.27= 3.48Aa | 13.84= 2.49Bba | 15.35± 0.64Ba | 10.71= 2.34Bb |
| G- | 31.07. ±0.42Aa | 18.61.± 0.93Ac | 23.44= 0.94Ab | 14.14= 0.29Bab | 17.06± 1.75Ba | 12.53= 2.44Bb |
| G+/G- | 0.95± 0.02Aa | 1.02± 0.04Aa | 1.13= 0.19Aa | 0.98± 0.17Aa | 0.90= 0.06Ba | 0.86± 0.16Ba |
| total B | 64.28± 1.78Aa | 39.59± 1.26Ac | 52.95= 3.38Ab | 28.74= 2.66Bba | 33.20± 2.44Ba | 25.55= 5.19Bb |
| F | 1.86+ 0.22Aa | 1.43+ 0.33Aa | 1.95− 0.34Aa | 1.66+ 0.45Ba | 0.62− 0.23Bb | 1.00+ 0.33Bab |
| F/B | 0.03± 0.00Ba | 0.04± 0.01Aa | 0.04= 0.01Aa | 0.06± 0.01Aa | 0.02= 0.01Bc | 0.04± 0.01Ab |
| A | 5.89± 0.93Aa | 3.36± 1.27Ab | 4.38= 0.00Aab | 3.14± 0.27Ba | 0.97= 0.23Bc | 2.63± 0.49Bb |
| AMF | 2.06± 0.31Aa | 0.93± 0.31Bb | 2.00= 0.76Aa | 1.24± 0.13Ba | 1.23= 0.029Aa | 0.80± 0.168Bb |
| total PLFA | 74.09± 2.84Aa | 45.31± 2.80Ac | 62.48= 4.17Ab | 39.19= 4.66Ba | 39.30± 8.64Ba | 35.43= 5.24Bb |

The total biomass of microbial communities during the wet season was significantly higher than that in the dry season for the three successional forests.

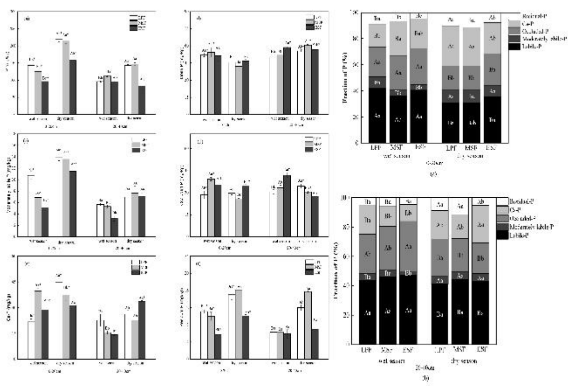


**Fig. 1** Concentrations and the percentages of total P present as the labile P (b), moderately labile P (c), occluded P (d), Ca P (e), and residual P (f) in the three successional forests at two soil depths under the wet and dry season. Values are means− standard errors(n =3). At each soil depth, means followed by different lowercase letters represent differences in forests at different succession stages and uppercase letters represent differences in successional forests during wet and dry seasons, both of them were significantly different at P < 0.05. * indicates significant difference in soil depth. LPF: primary forest in late succession, MSF: secondary forest in middle succession, ESF: secondary forest in early succession.

The conversion of P fraction during the wet season was mainly affected by changes in microbial community structure, while in dry season it was mainly driven by changes in soil nutrients.

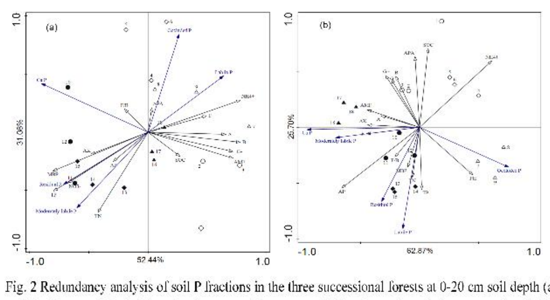


Fig. 2 Redundancy analysis of soil P fractions in the three successional forests at 0-20 cm soil depth (a) and 20-40 cm soil depth (b) under the wet and dry season. LPF: primary forest in late succession, MSF: secondary forest in middle succession, ESF: secondary forest in early succession.

The conversion of P fraction during the wet season was mainly affected by changes in microbial community structure, while in dry season it was mainly driven by changes in soil nutrients.

# The emission characteristics of non-microbial methane from soils in tropical rainforest

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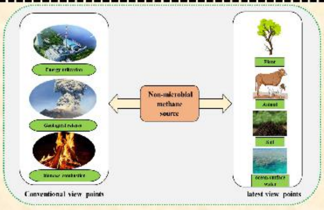
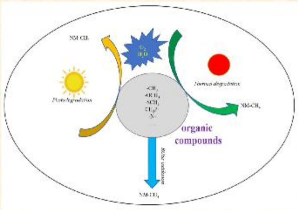
## Abstract

Non-microbial methane ($CH_4$) from soil emission plays a significant role in carbon cycling and global climate change. However, the roles of the soil non-microbial $CH_4$ from tropical rainforest remain highly uncertain because of limited study. The sample soils collected from Jianfengling tropical rainforest in Hainan, China, was sterilized by high-pressure steamer. Then the non-microbial $CH_4$ emission rates of from soil incubation experiments were detected under four treatments that are as follows, different temperature (30 °C, 40 °C, 50 °C, 60 °C, 70 °C), soil water contents (0%, 5%, 10%, 30%, 50%, 70%, 100%, 200%), oxygen condition (aerobic and anaerobic), and hydrogen peroxide (·OH) (0%, 0.1%, 0.25%, 0.5%, 1%, 2%). At the same time, we also studied the relationship between non-microbial $CH_4$ emissions and soil organic carbon (SOC). The results of our study have shown that the increase of temperature (from 30 to 70 °C), suitable soil water contents (from 0 to 100%), and ·OH (from 0 to 2%) could all significantly promote the emission rates of non-microbial $CH_4$ from soil by the growth of 0.04-5.41 ng/g(dw)/h, 0.60-11.18 ng/g(dw)/h, and 2.63-28.13 ng/g(dw)/h after 24 h incubation respectively. However, the excessive amount of soil moisture (200%) will inhibit the emission of soil non-microbial $CH_4$ Under the condition of 60 °C. The amounts of soil non-microbial $CH_4$ emission showed a linear relationship with the incubation time in a short time (<24 h), but the logarithmic curve was found in the results of 8 days incubation. In addition, the soil non-microbial $CH_4$ would be completely discharged (emission rate was closed to 0) at 229 h from the logarithmic model results. Moreover, the emission rate of soil non-microbial $CH_4$ under aerobic condition was significantly higher than that of under anaerobic condition, and there was a significantly positive correlation between SOC contents and non-microbial $CH_4$ emission rate ($P$<0.01). This study reveals that the soil in tropical rainforest with high SOC contents could produce non-microbial $CH_4$ under certain conditions, and the results support two production mechanisms, one is thermal degradation and the other is free radicals.




## Introduction

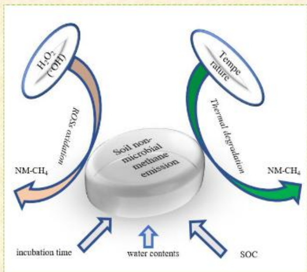
Non-microbial methane is the instantaneous reaction product of organic compounds under environmental pressure. It may play an important role in accurately estimating regional greenhouse gas budgets.

A series of studies have shown that there are three main mechanisms of non-microbial methane: photodegradation, thermal degradation and free radical (ROS) mechanisms.

Tropical rainforests have important ecological functions and the study of non-microbial methane in their soil is of great significance.

## Methods

We firstly sterilized the soil with high-pressure steam to eliminate the influence of microbial $CH_4$. Next, effects of temperature, water contents and $H_2O_2$ on $CH_4$ emissions were examined, aerobic and anaerobic non-microbial $CH_4$ emissions were measured at different temperatures. Finally, we selected different soils to measure non-microbial $CH_4$ emissions and analyze their SOC content, which was used to examine the relationships between non-microbial $CH_4$ emission and SOC.




## Results

**Fig 1. Soil $CH_4$ emission (60 °C), (a) Emission flux of soil non-microbial $CH_4$ within 24 h; (b) Emission flux of soil non-microbial $CH_4$ within 192 h; (c) Soil non-microbial $CH_4$ emission rate fitting**

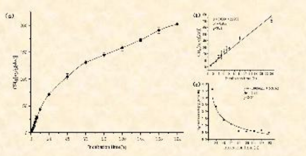


**Fig 2. The emission rates of non-microbial $CH_4$ in tropical rainforest soil at 30-70 °C under aerobic and anaerobic conditions**

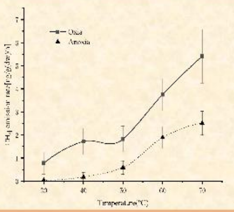


**Fig 3. The emission characteristics of non-microbial $CH_4$ in tropical rainforest soil under different soil water contents (0%, 5%, 10%, 30%, 50%, 100%, 200%)**

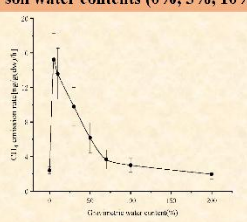


**Fig 4. The emission characteristics of non-microbial $CH_4$ in tropical rainforest soil with different mass concentration (0, 0.1%, 0.25%, 0.5%, 1%, 2%) of $H_2O_2$ solution**

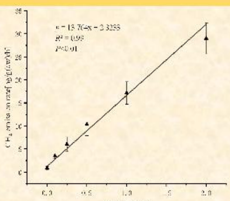
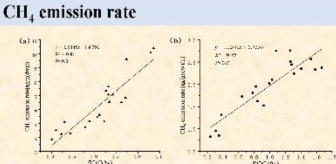


**Fig 5. The relationship between SOC in soil and non-microbial $CH_4$ emission flux (70 °C). (a) Tropical rainforest soil CH4 emission rate; (b) Rubber forest soil $CH_4$ emission rate**



1. Non-microbial $CH_4$ could be released by tropical rainforest soils under certain conditions.
2. There are at least two non-microbial $CH_4$ emission mechanisms in tropical rainforest soil (thermal degradation and free radical mechanism).
3. Moisture did not always promote soil non-microbial $CH_4$ emissions.
4. The emission rate of soil non-microbial $CH_4$ was affected by soil organic carbon at first 24 hours.

Highlights

## Acknowledgements

We are grateful for the sampling assistance given by the relevant personnel of Jianfengling National Nature Reserve, Hainan, China. Warm thanks are also given to Xiang Peng and Juelei Li who give providing language help and writing assistance. We acknowledge financial support provided by the National Natural Science Foundation of China [grant numbers 41663010]; the Natural Science Foundation of Hainan Province [417050, 418MS019]; Hainan University Research Startup Project [grant numbers kydq1604, kyqd1605].

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# Effect of Green Manure Mulching on Soil Fertility and Enzyme Activities in Young Rubber Plantation

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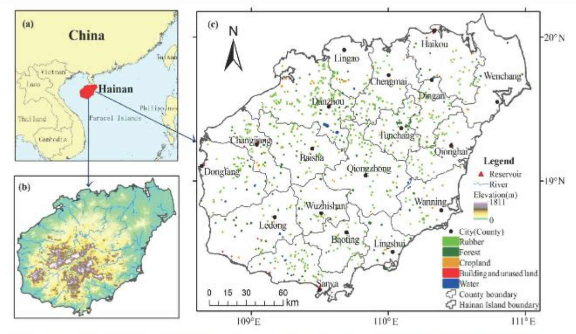
Hainan University

## 1. Introduction

The natural rubber, a strategic resource of modern times, is an important raw material for many rubber-based industries and widely used for military, transport, medical purposes. The rubber tree is one of the main economic species available in many tropical countries ,and is one of the main artificial ecosystem types in Hainan Island.

Due to high chemical fertilizer application but low efficiency of fertilizer utilization of rubber tree, rubber plantation has resulted in a lot of ecological environmental problems The decrease of soil fertility and the imbalance of nutrient supply of rubber trees have become one of the main bottlenecks in the stable yield of natural rubber and the sustainable development of rubber plantation.

Green manure mulching is one of the effective ways to increase soil organic matter, enhance soil microbial activities and alleviate soil acidification. However, the effect of Kudzu vine (*Pueraia montana*) mulching on soil chemical properties is still poorly understood in tropical region. China. Therefore, the objective of this study was to investigate the effect of Kudzu vine mulching on soil fertility and enzyme activities during young rubber planation in Hainan Island.




## 2. Material and Methods

**2.1 Study Site:** The experimental area is located in the young rubber plantation of Xilian Farm of Danzhou Haijiao Group, Hainan Province (19° 1'7.32"N, 109° 57'36"E, The altitude is 127 meters). It is located in the northwest of Hainan Island.The soil type of the test area is the brick red soil developed by the granite, and the sandy clay loam is the main.

**2.2 Sample Collection:** Soil samples were randomly collected from each plot. Three soil samples were randomly gathered within each plot by using a 5 cm diameter stainless steel cylinder. The soil samples were then separated into two sections; the first section was sieved throughout a 2 mm net instantly and stored at 4 °C until analysis of nitrate nitrogen ($NO_3^-$-N), ammonium nitrogen ($NH_4^+$-N), and soil Enzyme activities : the second one was air-dried and passed through a 0.25 mm sieve for soil organic carbon (SOC), soil pH, total phosphorus (TP), and total nitrogen (TN). The soil pH was determined in a 1:2.5 soil: water mixture.

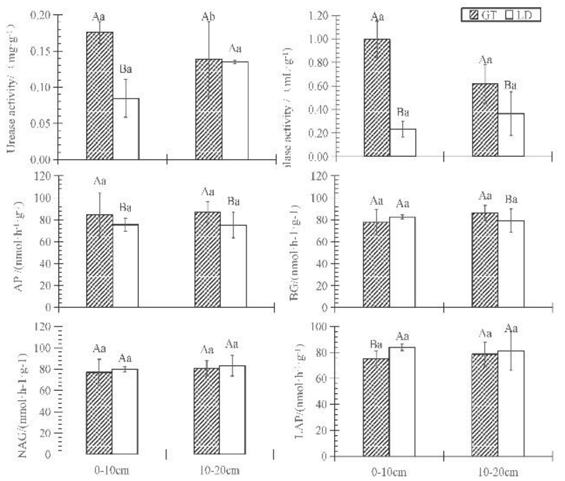
## 3. Results and Discussion

**3.1 Soil physical and chemical properties:** Planting Pueraria lobelia has different effects on soil physical and chemical indexes. The soil pH in 0-10 cm soil layer was significantly higher than that in bare soil, and there was no significant difference between 10-20 cm soil layer and bare soil, but there was significant difference between the same soil layer and the same soil layer ($P$<0.05).

| | Soil Depth (cm) | Soil moisture (%) | pH | SOC ($g\cdot kg^{-1}$) | Tioal N ($g\cdot kg^{-1}$) | Total P ($g\cdot kg^{-1}$) | $NH_4^+$-N ($mg\cdot kg^{-1}$) | $NO_3^-$-N ($mg\cdot kg^{-1}$) | C/N | C/P | N/P |
|---|---|---|---|---|---|---|---|---|---|---|---|
| GT | 0-10 | 18.55Aa | 5.39Aa | 23.87Aa | 2.36Aa | 0.28Aa | 12.77Aa | 10.75Aa | 9.82Aa | 81.72Aa | 8.40Aa |
| | 10-20 | 16.93Aa | 5.09Bb | 21.31Bb | 2.27Aa | 0.29Aa | 13.24Aa | 7.03Ab | 9.34Aa | 74.91Bb | 8.09Aa |
| LD | 0-10 | 15.41Bb | 5.00Bb | 22.54Aa | 2.11Aa | 0.25Ab | 14.40Aa | 6.50Ab | 9.89Aa | 88.96Aa | 9.41Aa |
| | 10-20 | 14.87Bb | 5.34Aa | 20.45Ab | 2.08Aa | 0.21Ab | 13.15Aa | 8.64Aa | 9.42Aa | 108.47Aa | 8.67Aa |

Planting Pueraria lobate increased SOC content, but there was no significant difference between the same soil layers. The TN content declined with the increase of soil depth. The content of TP in topsoil decreased by planting Pueraria lobelia, but it was higher than that in bare soil with the same soil layer. After planting Pueraria lobelia, the amount of $NH_4^+$-N in 0-10 soil layer was lower than that in bare soil, and $NO_3^-$-N content in 10-20 soil layer was significantly higher than that in bare soil, and $NO_3^-$-N content in 0-10 soil layer was significantly lower than that in bare soil, and the difference between the same soil layers was significant ($P$<0.05), and the content of $NH_4^-$-N in 0-10 soil layer was significantly higher than that in bare soil layer ($P$<0.05). Compared with the bare land, the soil carbon-nitrogen ratio (C/N), carbon-phosphorus ratio (C/P) and nitrogen-phosphorus ratio (N/P) in different soil layers decreased after planting Pueraria lobelia, and the decrease of 10-20cm soil layer was more obvious, but except for the carbon-phosphorus ratio (C/P) in 10-20cm soil layer, the other did not reach the significant level.

**3.2 Soil enzyme activities :** The activity of soil enzyme in the 0-10 soil layer was significantly increased by the planting of Gattan, the activity of the enzyme was 2.08 times of that of the naked ground, and the difference between different soil layers was significant ($P$ <0.05). The activity of the catalase (AP) in the soil increased dramatically, the activity of the soil acid phosphatase (AP) increased, and the activity of the 4-grape-glucoamylase (BG) was different between the different soil layers. But the 10-20 soil layer is higher than the bare ground. The variation trend of NAG and LAP was consistent, and the soil NAG and LAP activity of distinct soil layers were reduced and the difference between different soil layers was not significant.




**3.3 Correlation analysis between soil physiochemical character and enzyme activities in pueraria lobata mulch and bare land of two communities:** in the soil covered with Pueraria lobelia, soil catalase, urease and acid phosphatase were positively correlated with SOC and $NO_3^-$-N, catalase was negatively correlated with soil total phosphorus, urease was negatively correlated with $NH_4^+$-N, acid phosphatase activity was positively correlated with pH, positively correlated with soil total phosphorus, and negatively correlated with $NH_4^-$-N. In bare soil, soil catalase activity was negatively correlated with SOC and $NO_3^-$-N, soil urease activity was negatively correlated with SOC and total phosphorus, soil acid phosphatase activity was positively correlated with total phosphorus, soil β-1, 4-glucosidase, The activities of β-1,4 N-acetylglucosaminidase and L-Leucine aminopeptidase were negatively correlated with $NO_3^-$-N ($P$<0.05).

| | | SOC | $NH_4^+$-N | $NO_3^-$-N | pH | Total P | Total N |
|---|---|---|---|---|---|---|---|
| GT | Catalase | 0.673* | -0.124 | 0.658* | 0.042 | -0.552* | -0.329 |
| | Urease | 0.547* | -0.783** | 0.638* | -0.099 | -0.147 | -0.120 |
| | AP | 0.590** | -0.597** | 0.567* | 0.659* | 0.797** | -0.267 |
| | BG | 0.095 | -0.182 | 0.213 | 0.014 | 0.014 | -0.091 |
| | NAG | 0.257 | -0.315 | 0.320 | 0.240 | 0.013 | -0.153 |
| | LAP | 0.256 | -0.196 | 0.310 | 0.125 | 0.045 | -0.138 |
| LD | Catalase | -0.549* | -0.397 | -0.621** | -0.312 | -0.010 | 0.145 |
| | Urease | -0.587* | -0.219 | 0.336 | -0.061 | -0.608* | 0.101 |
| | AP | 0.259 | 0.083 | -0.224 | -0.211 | 0.708** | -0.130 |
| | BG | 0.088 | 0.122 | -0.569* | -0.424 | -0.156 | 0.008 |
| | NAG | -0.094 | -0.055 | -0.536* | -0.331 | -0.270 | 0.078 |
| | LAP | 0.235 | 0.169 | -0.585* | -0.205 | -0.145 | 0.039 |

## 4. In summary

The comprehensive analysis showed that the planting of Pueraria lobate green manure in young rubber garden could effectively improve soil fertility and soil enzyme activity, improve the soil microenvironment of rubber garden.Pueraria lobate significantly increased the activities of catalase, urease, AP and BG in soil layer, and decreased the activities of BG and LAP in soil。The research results serve as a theoretical basis for the formulation of scientific and reasonable rubber garden mulching management.

# Controls of temporal variations on soil respiration in a tropical lowland rainforest in Hainan Island, China

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[1]Hainan University, China; [2]Peking University, China

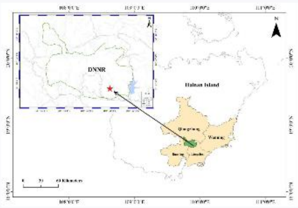
## Abstract

The mean soil carbon dioxide ($CO_2$) efflux rate was 2.52 ± 0.23 SE μmol $CO_2$ $m^{-2}$ $s^{-1}$, ranging from 1.42 to 3.94 μmol $m^{-2}$ $s^{-1}$. The temporal variations of soil respiration showed an obvious seasonal pattern related to soil temperature (0–5 cm depth, $p$<0.01) and soil moisture (0–5 cm depth, $p$<0.05), with no significant diurnal variation. We tested different regression models to explore the relationship between soil respiration and environmental factors. Soil respiration had a better fit with soil temperature than with soil moisture in single-factor models. At different temperatures, the $Q_{10}$ values from different models changed in rather different ways. We found that the mixed quadratic model composite of soil temperature and moisture had the best-fitting effect ($R^2$=0.74) on soil respiration and could better explain the seasonal variation. In a certain soil moisture range close to 15%, soil respiration increased with soil temperature. However, soil respiration became restricted when the moisture was greatly higher or lower than this value. Furthermore, at low soil temperatures (lower than 16 °C), higher soil moisture could decrease soil respiration rapidly. Thus, soil respiration in a tropical lowland rainforest is co-controlled by soil temperature and moisture.

## Introduction

In this study, the temporal variations at monthly time scale and its determinants of soil respiration were investigated in a tropical lowland rainforest in Hainan Island, and further we tested different regression models of the relationship between soil respiration and environmental factors.

## Methods




The field campaign was conducted in Diaoluoshan National Nature Reserve (DNNR, 18°40′ N, 109°54′ E, elevation 255 m). We used different single-factor regression models and bivariate models to test the relationship between soil respiration and environmental factors.

## Results

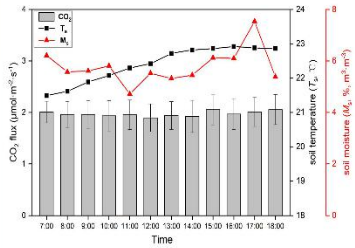



Fig. 1 Diurnal dynamics of soil respiration ($CO_2$ flux) and soil temperature ($T_s$) and soil moisture ($M_s$).

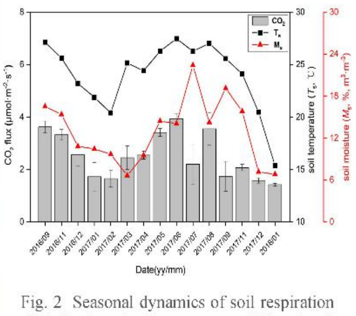



Fig. 2 Seasonal dynamics of soil respiration ($CO_2$ flux) and soil temperature ($T_s$) and soil moisture ($M_s$).

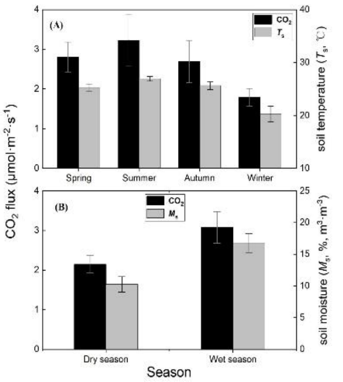



Fig.3 Soil respiration in different seasons were compared with soil temperature (A) and soil moisture (B).

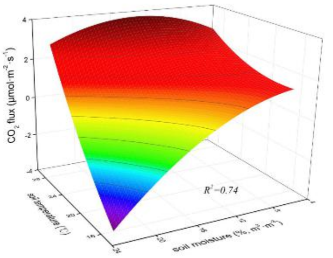



Fig. 5 The co-control of soil moisture and temperature on soil respiration.

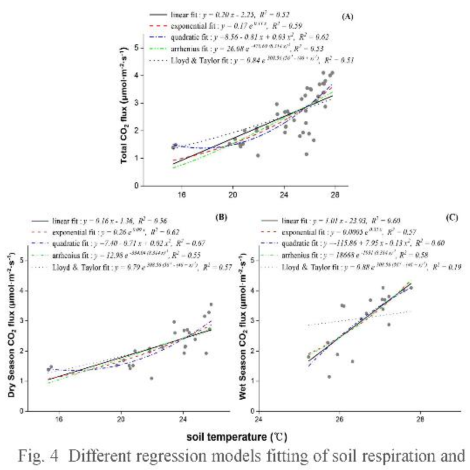



Fig. 4 Different regression models fitting of soil respiration and soil temperature.

Tab.1 Q10 values of each model at 10°C and 20°C.

| Equation | Total | | Dry season | | Wet season | |
|---|---|---|---|---|---|---|
| | $Q_{10}$ at 10°C | $Q_{10}$ at 20°C | $Q_{10}$ at 10°C | $Q_{10}$ at 20°C | $Q_{10}$ at 10°C | $Q_{10}$ at 20°C |
| Linear: | NA | 2.14 | 7.67 | 1.87 | 0.27 | NA |
| Exponential: | 3.00 | 3.00 | 2.46 | 2.46 | NA | NA |
| Quadratic: | 1.26 | 2.58 | 0.52 | 3.42 | 0.18 | NA |
| Arrhenius: | 16.96 | 2.57 | 7.46 | 1.95 | NA | 11.76 |
| Lloyd & Taylor: | 2.30 | 1.85 | 2.30 | 1.85 | 2.36 | 1.80 |

NA means negative value or Q10 > 20.

# THE DILUTION EFFECT OF FOREST PEST IN TROPICAL FOREST, HAINAN, CHINA

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## INTRODUCTION

The relationship among biodiversity, ecosystem function and ecosystem service is complex, which is an important research direction of community ecology. As the loss of biodiversity has increased, so has the attention and research on them. One of the relationship between biodiversity and ecosystem services is also getting more attention——how does biodiversity affect the occurrence of plant community pests.

Current studies have shown that plant diversity has two opposite effects on the occurrence of pests: dilution effect and amplification effect, while most forest ecosystems show amplification effect. And most of the current research is on trees, not pests themselves. They did so by defining a severity index, which is based on the percentage of damage to branches, twigs, leaves or areas of discoloration in the crown, which is inaccurate. Because tree damage is not necessarily caused by pests, but may also be affected by environmental factors and other plants and animals.

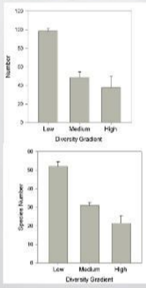


*FIG. 1*

The number of pests and species varied with the diversity gradient.

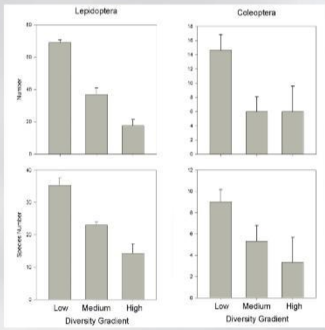


*FIG. 2*

The number of lepidoptera(left) and coleoptera(right) pests and species varied with the diversity gradient.

## MATERIALS AND METHODS

At present, Hainan province forest pests are very serious. This study takes tonggu mountain tropical forest in Wenchang city, Hainan province as the research object. Through diversity survey, nine 20×20 m quadrats were established in three different diversity sites to catch insects.

## THE RESULTS SHOWED THAT THE PEST IN TONGGU MOUNTAIN TROPICAL FOREST SHOWED A DILUTION EFFECT RATHER THAN A MAGNIFICATION EFFECT, WHICH WAS DIFFERENT FROM MOST STUDIES.

# Post fire Effects on Structural and Hydrological Properties of Forest Soils

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## Abstract

A fire is one of the most dangerous events that lead to irreversible consequences on forest environment. All organic matters over and near the ground surface can burn in a fire. Combustion of forest fuels causes significant changes in soil structures and properties. Fire-induced repellent layer plays an important role in controlling runoff and erosion processes after a fire. Therefore, an intensive survey on soil structure and hydrologic characteristics is needed to further examine the effects of fire on water movement and soil erosion. In this study, spatial and temporal patterns of soil properties were observed on forest lands, affected by the 2019.04.04 fire. Soil texture, degree of ash layer, and soil water repellency were measured according to fire severity and fire type. Molarity of an Ethanol Droplet (MED) test was implemented to measure the degree of soil water repellency for burnt soils. Through the field investigation, the results showed that soil properties changed with high heat, but the influences reached only a few centimetres near the soil surface. The extent and pattern of soil hydrophobicity have close relations to fuel types and fire intensities. The severities of soil water repellency in July and August were not significantly different.

**Keywords:** Post fire effect, soil property, soil water repellency, MED test

Acknowledgement: This study was carried out with the support of ´R&D Program for Forest Science Technology (Project No. 2017061B10-1919-AB01)´ provided by Korea Forest Service(Korea Forestry Promotion Institute)

# Nitrogen addition affects carbon use efficiency of microbes in nitrogen limitation soil

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**Introduction**

Nitrogen deposition increase has influences on tropical forest soil carbon sequestration capacity. And microbes play important role in soil carbon cycling. Nitrogen addition affects microbe nutrients use efficiency and thus carbon cycling. Four key extracellular enzymes 1,4-β-glucosidase (BG), leucine aminopeptidase (LAP), 1,4-β-N-acetylglucosaminidase (NAG) and acid/alkaline phosphatases (AP) can be used to quantitative the simultaneous microbial C, N, and P acquisition. We tested the influences of nitrogen addition on the four enzymes ratios, vector length and vector angle to reveal carbon cycling under nitrogen addition context.

**Material and Methods**

0-10cm soils, collected from a montane tropical rain forest in Jianfengling, Hainan province were sieved by two mm filtering before indoor cultivation. We set seven treatments, control, nitrogen addition (including three concentration gradient, 25Kg N ha-1yr-1(N1),50 Kg N ha-1yr-1 (N2) and 100 Kg N ha-1yr-1(N3)), nitrogen and 13C tagged glucose addition(25Kg N ha-1yr-1+13C-glucose,50 Kg N ha-1yr-1 +13C-glucose and 100 Kg N ha-1yr-1+13C-glucose). Each treatment had three repeats. 13C-glucose was 1mg for 1g soil. Soil moisture were adjusted and kept to 35% of field water capacity for the duration of the experimental procedure. 20g soils in centrifuge were cultivated in incubator under 20 °C and collected after 10, 20 and 40 day cultivation. The effects of incubation time and treatments on enzymes ratios, vector length and angle were compared using analysis of variance (ANOVA).

**Results and Discussion**

We caclutated vector angle of all the samples and found they are all smaller than 45°, which means a nitrogen limitation occurs in our plots. And with time expand, microbes nitrogen limitation under all treatemnts aggrabated at the end of 40 days compared with the beginning.

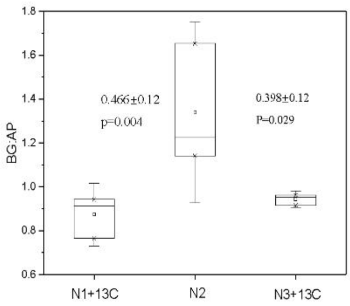


Figure1. BG: AP under different treatments for the experiment duration

N2 addition exacerbate the microbes demand on C compared with P. In other words, 13C-glucose addition reduces microbes demand on C. N1, N3 and N2+13C addition had no significant effects on BG: AP ratios, that is acquisition on C and P. In nitrogen limitation soil, microbes need more energy source C and nitrogen addition would result in more C to be consumed.

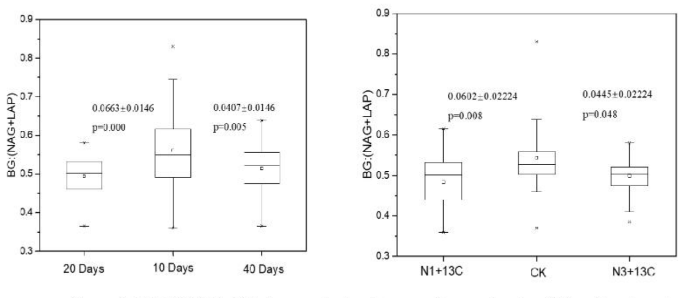


Figure 3. BG:(NAG+LAP) changes during the procedure and under different treatments

Soil microbes secrete more extracellular enzyme to achieve more nitrogen compared with carbon with incubation time expand. 13C-glucose addition might meet microbe energy demand and lead to strongly nitrogen demands (Figure 3). Compared with nitrogen addition along, nitrogen and 13C-glucose together prime microbes demands for carbon and this demands increase with nitrogen addition concentration.

These results showed in nitrogen limitation soil, nitrogen addition would aggravate microbes demands for nitrogen and more carbon consumption. Nitrogen deposition in tropical forest might leads carbon loss.

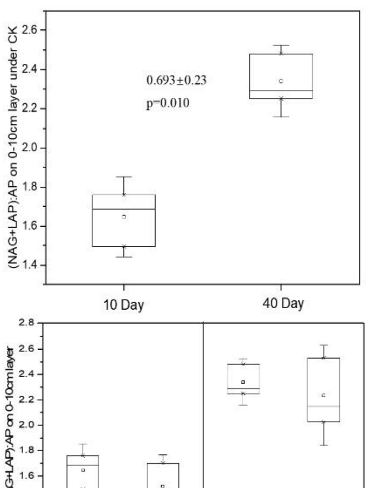


Figure2. (NAG+LAP): AP changes of control samples during the procedure

As the incubation time increases, microbes consumed more nitrogen compared with P. nitrogen and 13C-glucose addition could not significantly ease this demand, microbes still have strong demand for N. In N limitation soil, nitrogen addition will increase soil microbes N demands.

# FOLIAR UPTAKE OF FOG WATER AND PRECIPITATION AND SUPPRESSED TRANSPIRATION DETERMINE THE RESPONSE OF BOTH FOREST AND EPIPHYTE TO SEASONAL DROUGHT IN A TROPICAL CLOUD FOREST

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*Clouds may primarily affect tropical cloud forest plant ecology in the seasonal dry season by suppressing plant transpiration, adding water to the soil and directly foliar uptake of fog water. However, nearly no research has witnessed all these effects in tropical cloud forests. Here, we use isotope (δ2H, δ18O and δ13C) and plant transpiration related leave anatomy traits to testify these three effects in the seasonal dry season in a tropical cloud forest in Hainan island, China. We found suppressed transpiration and foliar uptake of fog water and precipitation keep water status for both forest and epiphyte species in the dry season. Thus, both tree and epiphyte species are vulnerable to drought and climate change.*

## Abstract

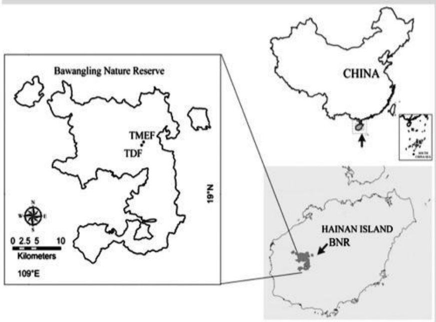
## Introduction

Here in a tropical cloud forest in Hainan island, China, we aim to use isotope (δ2H, and δ18O) to quantify 1) whether fog water can increase soil water availability in the dry season; and 2) whether foliar uptake of fog water is common for all tree and epiphyte species in the dry season in tropical cloud forest . We also use leaf anatomic traits to testify whether cloud can result in suppressed transpiration in the dry season. Finally, we expect to use δ13C to investigate whether tree and epiphyte species have different water use efficiency in dry and wet season in tropical cloud forest.

## Methods

The study site is in the national reserve of tropical cloud forest in the Bawangling Nature Reserve (BNR; 109°05′-109°25′E, 18°50′-19°05′N), Hainan Island, South China . Isotope (δ2H and δ18O) quantified by community weighted mean trait metrics (CWMjk), Then, a Bayesian stable isotope mixing model performed by MixSIAR package in R to partitioning the relative contribution of fog water, rain and soil water.

Wilcoxon rank sum tests was used to test whether there exist significant differences in the seven leaf anatomic traits and leaf water use efficiency represented by δ13C for both tree and epiphyte species between dry and wet season. We also compared whether there are significant variations in leaf water use efficiency between tree and epiphyte species in both dry and wet season.



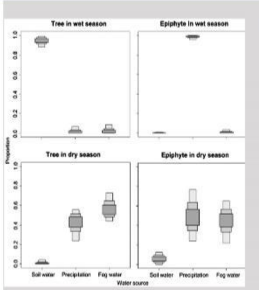



**Fig. 1.** Partitioning of the relative contribution of soil water, fog water and precipitation to both epiphytes and tree species in a tropical cloud forest in the peak wet and dry season. Means derived from the MixSIAR mixing model.

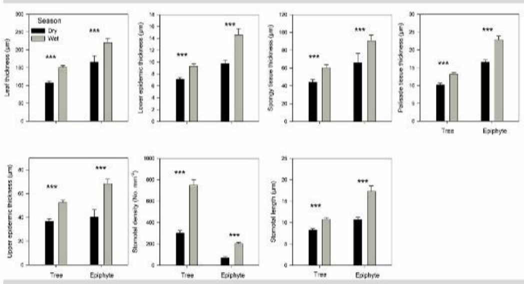


**Fig. 2.** The differences in seven leaf anatomic traits () between the peak dry and wet season, for all tree and epiphyte species. *** indicates P<0.001 based on Wilcoxon signed-rank tests.

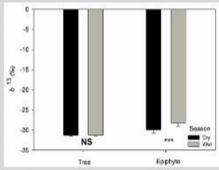


**Fig. 3.** The differences in leaf water use efficiency indicated by C13 between the peak dry and wet season for all tree and epiphyte species. *** and NS (non-significant) indicates P<0.001 and P>0.05 based on Wilcoxon signed-rank tests.

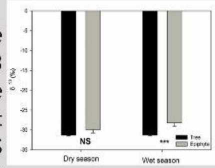


**Fig. 4.** The differences in leaf water use efficiency indicated by C13 between tree and epiphyte species in the peak dry and wet season respectively. *** and NS (non-significant) indicates P<0.001 and P>0.05 based on Wilcoxon signed-rank tests.

## Results

# VARIATION AND TRADE-OFFS IN FUNCTIONAL TRAITS OF BOMBAX MALABARICUM ACROSS DIFFERENT GEOGRAPHICAL REGIONS AND AMONG VARIED TREE SIZES ON HAINAN ISLAND

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## Introduction

lant functional traits are core attributes shared by plants (Cornelissen et al., 2003). In addition to externally visible morphological traits (Mott, Gibson, & O'Leary, 1982), the functional traits also include intrinsic physiological and biochemical traits (McIntyre, Lavorel, Landsberg, & Forbes, 1999). Differences in leaf morphology, anatomical structure and water use of plant populations in different geographical regions were observed as previously described (Gratani, Meneghini, Pesoli, & Crescente, 2003). Temperature, precipitation and soil properties are the main factors leading to differences in these functional traits (Miyazawa & Lechowicz, 2004; Meng, 2007).Great Tits (Parus minor) and the Nutrients allocation in different plant structures and physiological activities often differ in limited environmental resources (Weiner, 2004) to increase growth, survival, and reproduction in a given environment (Wright, & Westoby, 1999; Wright et al., 2007)., which is called trade-offs of plant functional traits (Pang, Yu, Tu, Sun, Luo, Miao, & Wu, .2015).

## Material and Methods

We selected a total of 30 plants in Hainan Island(Figure 1). The B. malabaricum plants were divided into large- (average diameter of 120 cm) and small trees (average diameter of 20 cm).

We selected to determine 16 functional traits related to water and photosynthesis.

Principal component analysis (PCA)

Pearson' s correlation

A two-way ANOVA analysis

Model Type II Regression

## Results and Discussion

the principle functional traits of B. malabaricum were LTh (0.94), LE (0.89), GCL (0.81) (the first principal component), SA (0.82) (the second principal component) and KS (0.85) (the third principal component) (Table 1).A correlative analysis shows that there were significant correlations among the principle functional traits of B. malabaricum. There was a significant correlation between LTh, GCL, LE and most other functional traits (Figure 2).A two-way variance analysis showed that GCL, LTh, and LE were significantly affected by geographical regions ($P<0.05$);According to the standard spindle regression analysis the LE-LTh of B. malabaricum show significant correlations in four geographical regions and tree size(Danzhou, $P=0.04$, slope = 1.57; Qionghai, $P=0.01$, slope = 1.19; Qiongzhong, $P=0.02$, slope = 3.21; Haikou, $P<0.01$, slope = 0.55; large tree, $P<0.01$, slope=1.46; small tree, $P<1.28$, slope <0.78; Figure 3, Figure 4).The water supply of B. malabaricum was limited as such that the plant leaves were thickened to increase their water storage capacity. Baoting had a higher temperature throughout the year and the plant transpiration rate was higher. The traits of B. malabaricum may also be affected by many other factors such as water, temperature, light, $CO_2$ concentration, and physical and chemical properties of the soils (Li, & Bao 2005).The B. malabaricum tree enhanced the photosynthesis rate by increasing the number of mesophyll cells, accumulating more energy for the formation and maintenance of the tree structure, and increasing the leaf thickness.The vascular tissue in the mesophyll ensures smooth progress of photosynthesisThe latitude in Haikou is high with lower light intensity compared to the other four regions. The roots of large B. malabaricum trees may be vulnerable to decomposition because of their higher age, which impacts the water absorption.


Figure 1. Overview of the research area

| Functional Traits | Principle Component 1 | Principle Component 2 | Principle Component 3 |
|---|---|---|---|
| KS ($Kg\,m^{-1}s^{-1}MPa^{-1}$) | -0.07 | 0.10 | 0.85 |
| SA ($cm^2$) | 0.28 | 0.82 | 0.36 |
| SV ($mm^3$) | 0.05 | 0.77 | 0.31 |
| KL ($10^{-4}Kg\,m^{-1}s^{-1}MPa^{-1}$) | -0.05 | 0.03 | -0.11 |
| SD (per $mm^2$) | 0.06 | -0.41 | 0.75 |
| GCL (per $mm^2$) | 0.81 | 0.05 | -0.22 |
| SAI (%) | 0.70 | -0.31 | 0.23 |
| SLA ($mm^2$/mg) | -0.60 | -0.16 | -0.12 |
| UE (μm) | 0.76 | -0.24 | -0.10 |
| PT (μm) | 0.75 | -0.38 | 0.28 |
| ST (μm) | 0.37 | 0.42 | -0.80 |
| PT/ST (%) | 0.14 | -0.46 | 0.74 |
| LE (μm) | 0.89 | 0.12 | 0.01 |
| LTh (μm) | 0.94 | -0.01 | -0.20 |
| ChC (SPAD) | 0.10 | -0.22 | -0.28 |
| Proportion rate (%) | 0.30 | 0.18 | 0.15 |
| Cumulative variance (%) | 0.30 | 0.48 | 0.63 |

Table1. Results of the Principle component analysis (PCA) of functional traits of Bombax malabaricum in Hainan Island.

| Functional traits | Tree size | | geographical region | | Tree size: geographical region | |
|---|---|---|---|---|---|---|
| | F value | P value | F value | P value | F value | P value |
| GCL (per $mm^2$) | 0.03 | 0.88 | 7.00 | <0.05 | 2.04 | 0.13 |
| LE (μm) | 8.13 | <0.05 | 10.51 | <0.05 | 8.58 | <0.05 |
| LTh (μm) | 8.01 | <0.05 | 13.67 | <0.05 | 17.10 | <0.05 |

Table 2. Results of the Two-Way ANOVAs analysis of functional traits of B. malabaricum.

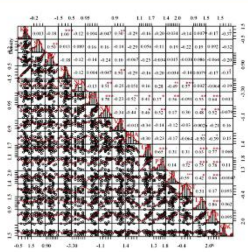

Figure 2. Pearson correlation analyses of functional traits of B. malabaricum in Hainan Island KS, specific branch hydraulic conductivity; SA, sapwood area; SV, sapwood volume; KL, specific leaf hydraulic conductivity; SD, stomatal density; GCL, guard cell length; SAI, stomatal area index; VD, vein density; SLA, specific leaf area; UE, upper epidermis thickness; PT, palisade tissue; ST, spongy tissue; PT/ST, ratio of the thickness of spongy tissue to palisade tissue; LE, lower epidermis thickness; LTh, leaf thickness; ChC, chlorophyll content.

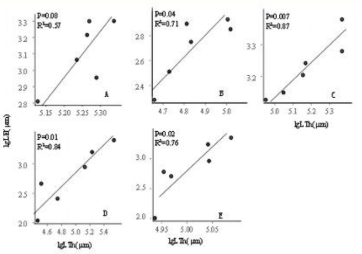

Figure 3. Standardized major axis regression of functional trait pairs of B. malabaricum across geographical distributions.A, Baoting; B, Danzhou; C, Haikou; D, Qionghai; E, Qiongzhong. LE represents lower epidermis thickness; LTh stands for leaf thickness.

# Vascular Epiphyte Biodiversity in Tropical Cloud Forest of Hainan Island

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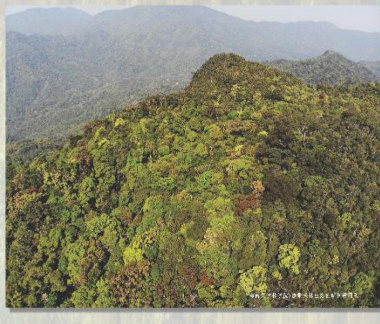
## Introduction

Tropical cloud forests include all higher-elevation forests growing in the humid tropics of America, Africa and Asia that are frequently covered by cloud or mist.Epiphytes, plants that derive support but not nutrients from their host trees, are a component of many forest ecosystem.



The tropical cloud forest in Hainan island is the original forest surrounded by clouds all the year round, which over 1200 meters above sea level.Through field investigation, "species-quadrat asymptote" was selected to fit the minimum sampling area of vascular epiphyte plant community in tropical cloud forest, and the species diversity of vascular epiphyte plant was analyzed.

## Material and Methods

In 2012, 21 20m × 20m sample lands were set up in the tropical cloud forest, with a total area of 0.84hm2 and a distance of more than 50m between the sample lands. A total of 9323 individual trees (109 species) were investigated.

DBH, tree height, undershoot height and epiphytes on the surface of 667 host plants (67 species) with DBH ≥5cm in 21 plots were investigated from September 2018 to June 2019.According to Johannson's (1974) method, each survey tree was divided into dry area and crown area, and the species name, number of plants, epiphytic height, epiphytic location and epiphytic matrix of vascular epiphyte in each area were recorded in detail.Vascular epiphyte surveys were performed primarily with binoculars, combined with sampling rods and single-rope climbing techniques (Perry, 1978).According to Sanford (1968) 's definition method, a group of the same species with obvious boundary with another group can be classified into different strains.Mixed of different species;Benavides et al., 2005;Zotz, 2007;Wolf et al., 2009).

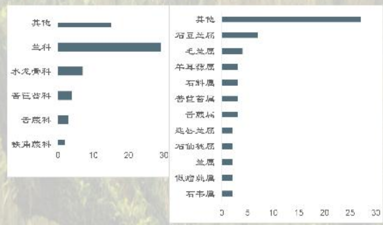


**Fig 1:Species Richness Distribution Across Different Families**

Four different vascular epiphyte undershoot heights (30cm, 50cm, 110cm, 200cm) were randomly investigated with 20cm × 20cm wire mesh within 2 meters from the base of the trunk, with a total of 1,450 quadrate plants.

## Results and Discussion

- Through species diversity analysis of the sample plot, 3,681 individuals, 60 species of 38 genera, 20 families and 10 rare and endangered species were recorded in the vascular epiphyte plants in the tropical cloud forest.In general, there are abundant species of epiphytic vascular plants in the tropical cloud forest in bawangling nature reserve.This study is of great practical significance for biodiversity conservation and ecological environment restoration in hainan island.
- The species composition by family observed in this study followed a worldwide trend of many species concentrated within Orchidaceae. (Fig 1)
- When the community contained 95% species diversity, the minimum quadrat number was 19, the host number was 400, and the 20 × 20cm quadrat number was 800.(Fig 2 a b c)
- Epiphyte species richness and abundance generally decreased from the TZ, ICZ and MCZ to the OCZ of the host trees.(Fig 3)
- Epiphyte abundance significantly differs, but epiphyte species richness does not differ among the five orientations when all the host trees collectively studied in tropical cloud forests, with the abundance and species richness of epiphytes encircling the trunk (all direction orientation) highest while both were lowest for north-oriented epiphytes.(Fig 4)
- All individuals with different diameters were taken together, epiphyte species richness and tree diameter are positively correlated across the six host tree species.(Fig 5)

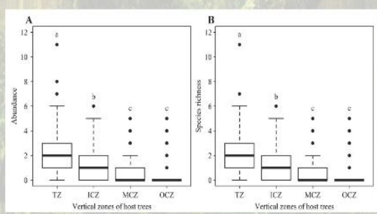



**Fig 3: Distribution of vascular epiphytes among host crown zones**

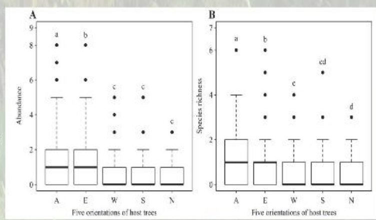



**Fig 4: Distribution of vascular epiphytes among epiphytic orientations**

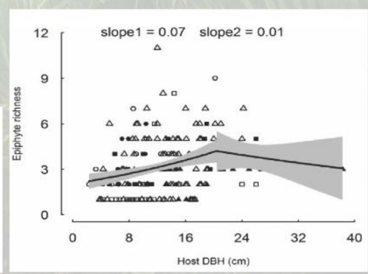



**Fig 5: Relationships between vascular epiphyte species richness and host tree diameter.**

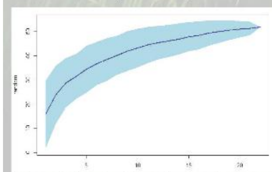


**Fig 2a: Distribution of vascular epiphyte plants in 20× 20m Plot**

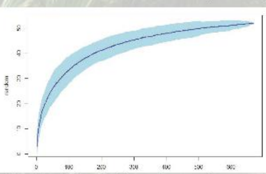


**Fig 2b: Distribution of vascular epiphyte plants in Host**

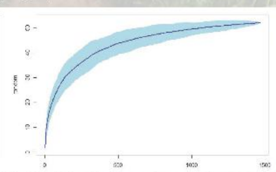


**Fig 2c: Distribution of vascular epiphyte plants in 20× 20cm Subplot**






# Reintroduction Prediction of seven wild plants with extremely small populations： A case study at Hainan Island of China

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## Introduction

The reconstruction area of endangered plant populations were selected in theirs neighbourhood or history area, which were lacking a relatively comprehensive selection and planning that based on a certain theoretical model approach. Support vector machine (SVM) model, have a better performance when dealing with small samples of high-dimensional data, had been use to predict reintroduction area based on the results of our investigation. In this study, 7 wild plants with extremely small populations(WPESP) had been investigate in Hainan island, and a systematic method to predict reintroduction area had been proposed and tested. We expected that our study made the technical route of reintroduction more completed, and provided a complete case for predicting and planning reintroduction area of other endangered plant.

## Material and Methods

Modelling data include species distribution data of WPESP, climate data, terrain data and vegetation data in Hainan island. Species distribution data from the result of field surveys. 7 WPESP are *Hopea hainanensis, Chieniodendron hainanense, Horsfieldia kingii, Oxystophyllum changjiangense, Dendrobium hainanense, Dendrobium sinense, Dendrobium tomentosum.* Climate data have 68 data layers from worldclim database. 8 terrain data layers is calculated from elevation data by ArcGIS 10. Vegetation data from Forestry Department in Hainan Province.

A total of 108 plots were established covering areas of tropical rainforest, tropical monsoon forest, mangrove forest, tropical coniferous forest, tropical evergreen and semi-evergreen shrubs, semi-natural vegetation, and artificial vegetation. Plots were mainly distributed in the central and southern mountainous areas because of their rich rare and endangered wild plants (Figure 1).

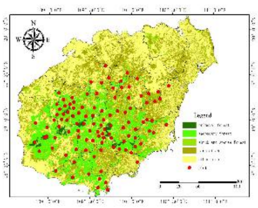


Fig1. The type of forests in Hainan island and plot distribution

WPESP reconstruction area wrer predicted by Libsvm toolbox based on Matlab. The SVM models were assessed by Area under the curve (AUC) values. The AUC values obtained from 0.9 to 1 denoted models with high performances.

To verify the results of SVM model prediction, principal components analysis (PCA) was first used to assess the 68 variables to reduce the dimension of factors. The two first axes of this analysis showed an eigenvalue >1 and described 92.0% of the variance; the variables that exhibited higher factor loadings as most representative in the island were kept: Annual Mean Temperature, Temperature Seasonality, Max Temperature of Warmest Month, Min Temperature of Coldest Month, Annual Precipitation, Precipitation Seasonality, Precipitation of Wettest Quarter, Precipitation of Driest Quarter, and Altitude. Finally, we compared the difference analysis between the mean environmental data of selected variables of species' actual distribution point and prediction of reintroduction area in SAS 9.2.

**Table1. The variance analysis between actual distribution and prediction of reintroduction area in wild plant species with extremely small populations.**

A. Altitude; AMT, Annual Mean Temperature; TS, Temperature Seasonality; MTW, Max Temperature of Warmest Month; MTC, Min Temperature of Coldest Month; AP, Annual Precipitation; PS, Precipitation Seasonality; PWQ, Precipitation of Wettest Quarter; PDQ, Precipitation of Driest Quarter.

| Species | The mean data | A | AMT | TS | MTW | MTC | AP | PS | PWQ | PDQ | P values |
|---|---|---|---|---|---|---|---|---|---|---|---|
| (a) *Hopea hainanensis* | actual | 713 | 22 | 3192 | 29 | 12 | 1668 | 79 | 864 | 56 | 0.4189 |
| | prediction | 860 | 20.8 | 3093 | 27.9 | 11.3 | 1754 | 79 | 904 | 59 | |
| (b) *Chieniodendron hainanense* | actual | 574 | 22 | 3227 | 29 | 13 | 1637 | 78 | 845 | 57 | 0.9278 |
| | prediction | 594 | 22.1 | 3232 | 29.5 | 12.5 | 1618 | 79 | 837 | 55 | |
| (c) *Horsfieldia kingii* | actual | 828 | 20.7 | 3231 | 28 | 11.1 | 1672 | 80 | 878 | 56 | 0.6779 |
| | prediction | 927 | 20.4 | 3099 | 27.5 | 10.9 | 1756 | 79 | 911 | 59 | |
| (d) *Oxystophyllum changjiangense* | actual | 710 | 21.4 | 3123 | 28.6 | 11.9 | 1720 | 79 | 884 | 58 | 0.4741 |
| | prediction | 775 | 21.2 | 3108 | 28.4 | 11.7 | 1721 | 79 | 886 | 57 | |
| (e) *Dendrobium hainanense* | actual | 626 | 22 | 3153 | 29 | 12 | 1699 | 78 | 869 | 57 | 0.5209 |
| | prediction | 721 | 21.5 | 3107 | 28.7 | 12 | 1714 | 78 | 879 | 58 | |
| (f) *Dendrobium sinense* | actual | 1137 | 19.7 | 3027 | 26.7 | 10.3 | 1869 | 78 | 963 | 63 | 0.2406 |
| | prediction | 869 | 20.7 | 3094 | 27.8 | 11.2 | 1754 | 79 | 905 | 59 | |
| (g) *Dendrobium tomentosum* | actual | 622 | 22 | 3185 | 29.3 | 12.4 | 1687 | 78 | 862 | 57 | 0.4498 |
| | prediction | 786 | 21.2 | 3092 | 28.3 | 11.7 | 1746 | 78 | 895 | 59 | |

The reintroduction area from SVM model prediction was drawn by ArcGIS. According to vegetation data, the reintroduction areas were divided into easy, general and hard reintroduction areas.

## Results and Discussion

WPESP all had few populations and individuals, were also submitted to human disturbance and threats, and often found in fragmental habitats. The reintroduction area of Hopea hainanensis was 1,823 km2, with a vertical distribution ranging from 384 to 1,867 meters (AUC=0.96, Fig.2-a); the reintroduction area of Chieniodendron hainanense was 1,022 km2, with altitude ranging from 246 to 996 meters (AUC=0.99, Fig.2-b); the reintroduction area of Horsfieldia kingii was 1,396 km2, and its altitude ranged from 657 to 1,867 meters (AUC=0.97, Fig.2-c); for Oxystophyllum changjiangense, the reintroduction area was 3,003 km2 (altitude' 527-1,867 meters) (AUC=0.99, Fig.2-d); the reintroduction area of Dendrobium hainanense was 3,472 km2, with altitude ranging from 389- 1353 meters (AUC=0.96, Fig.2-e); the reintroduction area of Dendrobium sinense was 1,916 km2 (altitude, 613- 1,867 meters) (AUC=0.99, Fig.2-f); the reintroduction area of Dendrolirium tomentosum was 2,478 km2, at 516 - 1299 meters altitude (AUC=0.95, Fig.2-g).

The results of difference analysis between the mean environmental data of species' actual distribution point and prediction of reintroduction area showed that all P values of wild extremely small population plants were more than 0.05 (Table1); The mean environmental data of reintroduction area prediction were also similar to mean environmental data of actual distribution points, indicating that the reintroduction areas predicted by the SVM model have a suitable climate and terrain for extremely wild small population plant growth.

According to prediction results of population reconstruction and vegetation data of Hainan Island, reintroduction areas in Hainan were divided into three levels (Figure .3). The level Ⅰ area was primeval forest, with no human disturbance, which is easy for reintroduction. However, it should not be used as the main population reconstruction area because of its small size. The level Ⅱ area comprised secondary forest, shrub and sparse forest. Despite the light human disturbance, this area was the largest and thus suitable for reintroduction; it should be used as a major area for reintroduction. The level Ⅲ area was composed of plantations and other areas, often subjected to serious human disturbance; therefore it is hard to use level III area for reintroduction. In this case, special attention should be paid to management and recovery of plant habitat before its use as reintroduction area.

Conclusion

The SVM model has a good performance in predicting reintroduction areas, and could be used to predict reconstruction areas of other endangered plants as well. The reintroduction areas were divided into three levels: the level Ⅰ area is primeval forest, easy for reintroduction but should not be used as the main population reconstruction area (small size); the level Ⅱ area, composed of secondary forest, shrub and sparse forest, is suitable for reintroduction; the level Ⅲ area comprises plantations and other areas, often subjected to human disturbance; it is hard to use level III for reintroduction.

Overall, our findings provided a comprehensive technical route for reintroduction, and help in predicting and planning reintroduction areas of other endangered plants.

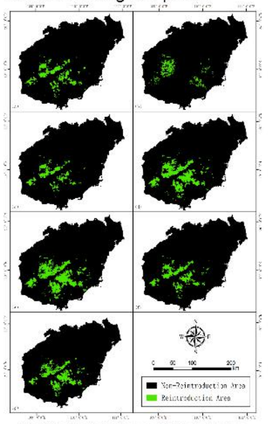



**Fig.2 The Reintroduction area of wild plant species with extremely small populations in Hainan island(a-g).**
a. Hopea hainanensis; b. Chieniodendron hainanense; c. Horsfieldia kingii; d. Oxystophyllum changjiangense; e. Dendrobium hainanense; f. Dendrobium sinense; g. Dendrolirium tomentosum.

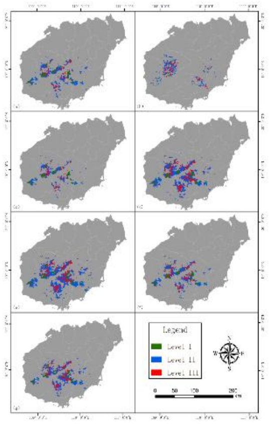



**Fig.3 The grading of reintroduction areas (a-g).**
a, Hopea hainanensis; b, Chieniodendron hainanense; c, Horsfieldia kingii; d, Oxystophyllum changjiangense; e, Dendrobium hainanense; f, Dendrobium sinense; g, Dendrolirium tomentosum.

# ISOLATION AND IDENTIFICATION OF INDOLE-DEGRADING BACTERIA

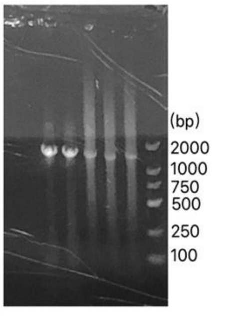
HE QI-FANG

## Introduction

Indole is a typical aromatic heterocyclic compound containing nitrogen. It is widely used as raw material for drug, food, pesticide, feed additive and spice production.However, if the indole is discharged directly without treatment, it will have an impact on the environment and even pose a threat to human life. Therefore, it has become one of the major problems that must be solved in time.Due to the rapid development of industry and some non-standard use of pesticides, the pollution caused by those substances that cannot be easily degraded in the soil will become more and more serious.In this study, a strain with indoles as the only carbon source was screened out from soil samples collected from the silt near the repair shop of guilin university of technology, and the indoles degradation ability of the strain was investigated under different environmental conditions to obtain the optimal growth condition of indoles degradation by strain QF1.The aim is to provide efficient resources for degradation of indoles and provide basis for treatment of indoles contaminated microorganisms by QF1 in the environment.

## Material and Methods

Effects of different environmental factors on degradation of indole by QF1 strain:By single factor experiment to investigate the influence of different environmental factors on the strain degradation of indole, cultivate the basic conditions for temperature 30 ℃, table speed 150 r/min, indole concentration of 100 mg/L, quantity of 10 mL, pH (pH = 7), nature of its every 24 h sample determination of residual indole concentration in culture medium, 24 h when the bacteria as the best growing season (of which do not meet the fungus as ck, and three parallel experiment in each group).




According to the figure, the results showed that the optimum pH value was 8, and the ability of the strain to degrade indoles was the highest, reaching 92%.When the pH value is 8, the degradation rate is the highest. When the pH value is greater than 8, the medium is too alkaline, which makes the degrading bacteria unsuitable for growth, resulting in a decrease in the degradation rate.

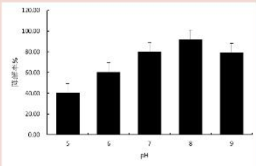


*Fig.1* Effect of initial pH on the degradation rate of indole-degrading bacteria

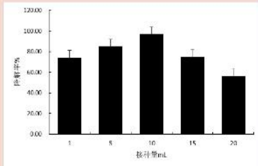


*Fig.2* Effect of inoculum size on the degradation rate of indole-degradable bacteria

As can be seen from the figure, the results showed that the optimal inoculation amount was 10 mL, and the ability of the strain to degrade indoles was the highest, reaching 97.32%.When the inoculation amount was 10mL, the degradation rate was the highest. When the inoculation amount was greater than 10mL, the amount of bacteria inhibited growth, resulting in a decrease in the degradation rate.

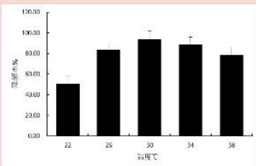


*Fig.3* Effect of temperature on the degradation rate of indole-degradable bacteria

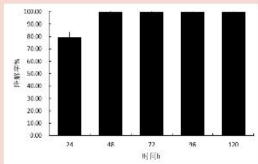


*Fig.4* The effect of time on the degradation rate of indole-degradable bacteria

As can be seen from the figure, the results showed that the degradation rate reached 100% after the most timely time was 48 h.Therefore, the indoles in culture bottles were completely degraded after 48 h.

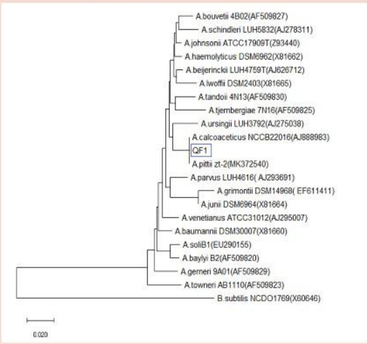


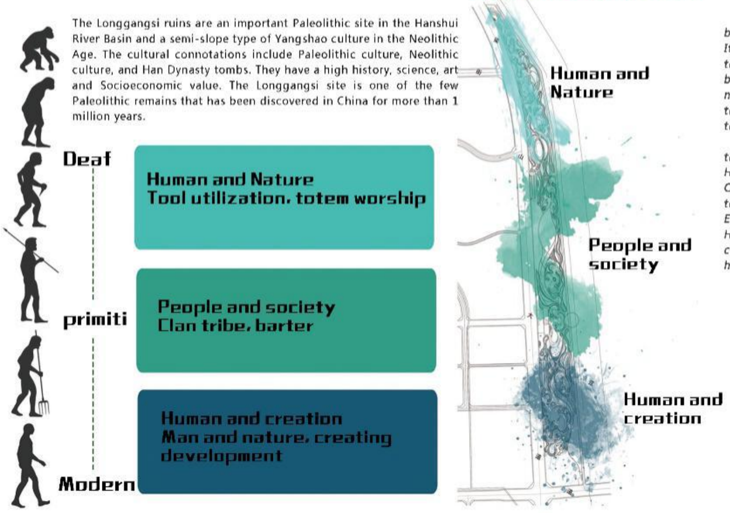

*Fig.5* Phylogenetic tree based on 16S rRNA sequences of strain QF1 and related strains

## Discussion

IN THIS PAPER, A HIGHLY EFFICIENT INDOLE-DEGRADING BACTERIA QF1, WHICH PROVIDED THE BASIS FOR THE TREATMENT OF INDOLE-CONTAMINATED MICROORGANISMS IN THE ENVIRONMENT.


## CULTURAL INTERPRETATION

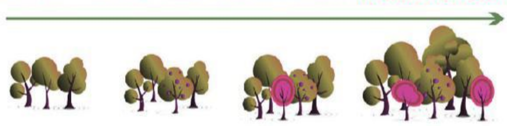
The Longgangsi ruins are an important Paleolithic site in the Hanshui River Basin and a semi-slope type of Yangshao culture in the Neolithic Age. The cultural connotations include Paleolithic culture, Neolithic culture, and Han Dynasty tombs. They have a high history, science, art and Socioeconomic value. The Longgangsi site is one of the few Paleolithic remains that has been discovered in China for more than 1 million years.

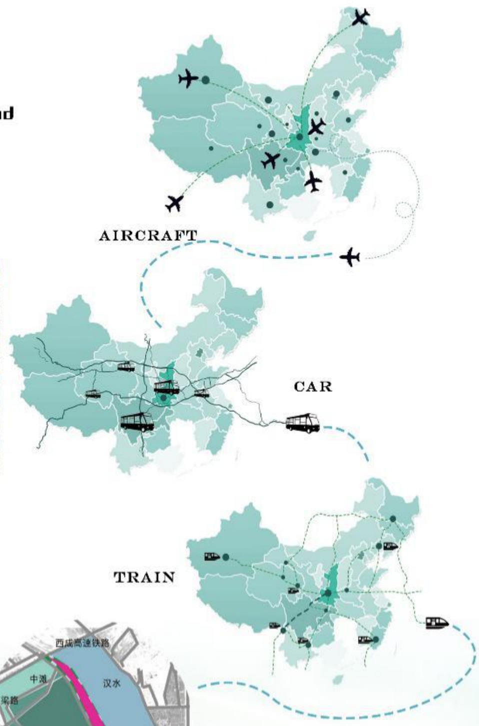



## PROJECT BACKGROUND

*Hanzhong, located in the southwestern part of Shaanxi Province, is bordered by the Qinling Mountains and Nanpingba Mountain in the north. It is known as the "Jiangnan" and "Jinyuyu Basin" in the northwest. It is the best ecological environment on the same latitude on the earth. This basin, surrounded by the Qinling Mountains and the Cangwu Mountain, is nourished by the Han River and the Jialing River. It is a feng shui treasure that benefits from the north and the south and the beauty of the north and the south.*

*The proposed "Longgang Ecological Leisure Sports Park" is located in the Hanzhong Longgang Ecological Tourism Park on the right bank of the Han River. Together with the Hanjiang Wetland Park and the Tianhan Culture Chang Street on the left bank, it forms the central city eco-cultural tourism center, which is an important external display window of the city. Enhancing the influence of Hanzhong cities, promoting the development of Hanzhong cultural tourism industry, and realizing the goals of "regional central cities, famous tourist cities, and most beautiful cities in Shaanxi" have positive driving significance.*




# Effects of monsoon on distribution patterns of tropical plants in Asia

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## Abstract

In summer, there are three types of monsoon in Asia, i.e. East Asia Monsoon, South Asia Monsoon, North-west Pacific Ocean Monsoon. The summer monsoon climate in Asia originated at about 40 Ma, when the early angiosperm evolved and started its diversification in Southeast Asia and South China. It suggested that the monsoon may facilitate the quick speciation and spread of early angiosperm. Monsoon climate facilitates the northward spread of Asia's tropical plants and some tropical plants can be found even at Yarlung Zangbo River and the boundaries of Guizhou-Guangxi-Yunnan. Such effetcs largely change distribution patterns of zonal vegetation and even causes local vegetation types in some places with unusual topography such as tropical seasonal rainforests, monsoon rainforests, savanna and grassland along dry-hot valley in Southwest China, coastal savanna in West Hainan Island. The three summer monsoons interact at Southwest China and Indo-China Peninsula and these regions are dominated by limestone landscapes and high mountains with big rivers. Some Asia-endemic tropical taxa even formed a diversification and endemism center at this region, which may be a reason for the formation and maintenance of Indo-Burma biodiversity hotspots with global warming, the monsoon may further promote the northward spread of tropical plants and may have fundamental effects on biodiversity and flora evolution in South China.

## Introduction

Comparing with other regions, Asia is mostly dominated by the monsoon climate and tropical plants can be found at the furthest places away from the equator. Understanding the role of monsoon in the dispersal and evolution of tropical plants is helpful for exploring the distribution patterns of vegetation and mechanisms underlying the origin and maintenance of biodiversity in Asia.

## Methods

This study analyzed the role of monsoon on the migration and speciation of tropical plants, combined with the monsoon history and early angiosperm evolution history, and selected Cyrtandroideae, *Begonia*, *Hiptage* and *Aspiropterys* to reveal the influence of monsoon climate on the distribution pattern of tropical plants, species diversity and the formation of endemic species distribution center in Asia.

Table 1 Main characteristics of monsoons in Asia

| Monsoon type | | Occurrence month | Affected area | Age (Ma) | Reference |
|---|---|---|---|---|---|
| Summer monsoon | East Asia monsoon; (Southeast monsoon) | June to August. | Center and South China, South Japan, Korea Peninsula | 25–22 | Sun & Wang, 2005 |
| | | | | 9–8 | An *et al.*, 2001 |
| | | | | Unknown | Li *et al.*, 2014 |
| | Northwest Pacific monsoon | May to Sept. | South China Sea and its coastal areas, Southeast Asia including Indo-China Peninsula | 20 | Wu *et al.*, 2013 |
| | South Asia monsoon (Southwest monsoon) | May to July | Hainan Island, Southern Yunnan and Guangxi; India and Indo-China Peninsula | 9–8 | An *et al.*, 2001 |
| Winter monsoon | | Oct. to next Feb. | North and Center China, Mongolia | 2.6 | An *et al.*, 2001 |

## Results

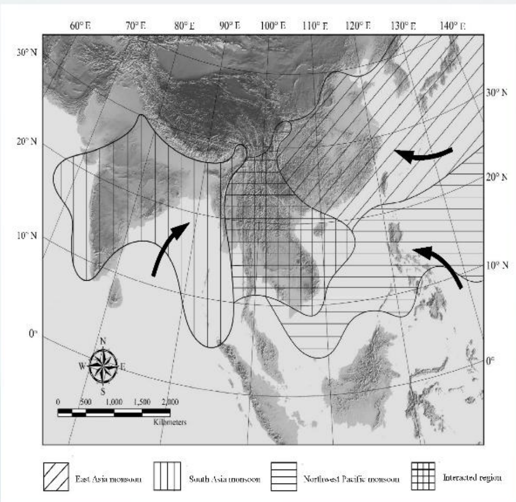


**Fig. 1** Asia summer monsoons and their affected areas (arrow indicates the main wind direction).

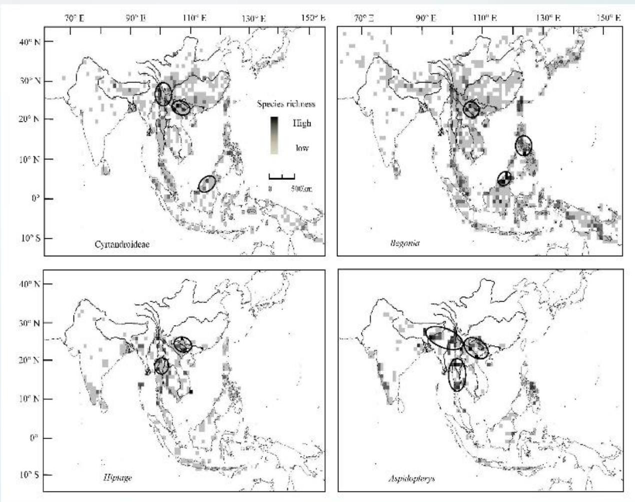


**Fig. 2** The distribution pattern of species richness and endemism of four typical tropical plant taxa in Asia. Black circles indicate regions with highest species richness and endemism. The species distribution information is obtained from http://www.gbif.org and the map was drawn using DIVA-GIS7.5.

## Conclusion

East Asia and Southeast Asia are considered to be the origin and differentiation center of modern angiosperms, in which the tropical monsoon may play an important role through power, precipitation and dynamic. Under the background of global warming, the monsoon may promote the further northward migration of tropical plants and increase the tropical plant composition of flora in southern China.

# Research Group Session
# GR1

# SCS Curve Number Procedure Revisited for Experimental Forests of Different Climate Zones

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**Abstract**

The Natural Resources Conservation Service (NRCS, formerly the Soil Conservation Service) developed the SCS curve number procedure for estimating direct runoff on ungauged small watersheds. This procedure requires the appropriate CN values, which are usually defined from the NRCS tables using land use, soil type, and antecedent moisture condition. But, CNs for forest cover were poorly implemented because the tabulated curve numbers for "forest" are missing, or not valid with the observations. In this study, revised CNs were determined by using rainfall and runoff data that were collected from the experimental forests of the universities in Japan, Korea, Taiwan, and Thailand. CN values for forest cover were defined from the mean, median, and probabilities of a series of maximum retention storage. The reliability of the methods employed was verified by comparing the estimated and measured runoff volumes. Estimated CNs varied with the methods and watershed characteristics, ranging from 47 to 82 for the average condition (AMC II). By comparing estimated runoff to the observations, the probabilistic approach was found to be the most practical method to define CNs for forest cover. This study will help engineers to adopt a reliable and practical approach for determining CN values from the measurements. Overall, the SCS method is a useful tool in for estimating the runoff volume from forested watersheds, though the estimated CN is questionable.

# Hydro-Meteorological Monitoring in Crocker Range Park, Sabah, Malaysia

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**Abstract**

Crocker Range Park with area of 139,000 hectare is an important watershed area for West Coast of Sabah that provides water supply for household, industrial and agricultural purposes. Monitoring of the watershed area is crucial, thus meteorological and hydrological monitoring stations were installed by the cooperation between Sabah Parks, Japan International Cooperation Agency (JICA) and Universiti Malaysia Sabah under the Bornean Biodiversity and Ecosystems Conservation (BBEC) Phase 2 Programme (2007-2012). Automatic weather stations and streamflow gauging stations were installed in 2010 and 2013, respectively. The stations are collecting information of atmospheric pressure, solar radiation, temperature, relative humidity, wind speed, wind direction, rainfall, stream flow, pressure and water temperature. We demonstrated the meteorological and hydrological properties of two experimental watershed catchment areas; lower montane tropical forest (Mt. Alab) and secondary lowland tropical forest (Inobong). We also attempted to evaluate the correlation between field data and spatial data for rainfall and temperature.

# Long Term Data for Flash Flood Forecasting using Antecident Precipitation Index in Upper Nan Watershed, Nan Province, Thailand

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Recently, the high land of northern Thailand became to be disturbed forest area and cash crop like a maize or para rubber tree. It generates imbalance in head watershed that alter hydrological services. Nan province had experienced extreme flash flood and landslide during July to August, 2019 recently. The critical antecedent precipitation index (CAPI) is Maximum wetness soil condition. The CAPI was calculated and mapped using GIS technique. For existing API ($API_t$) was used to consider flood event and compared with extreme rainfall and flood events in 2000–2019. The results were noticed that the CAPI and $API_t$ can apply to forecasting flood event in upper Nan watershed. When compare $API_t$ with CAPI during 2000–2019, also 3 days accumulate rainfall at 6 climatic stations, it was found that flash flood were occurred when the 3 days accumulate rainfall increase and $API_t$ were more than or quite near CAPI.

***Keywords—Antecedent Precipitation Index; Soil water condition; Flash Flood forecasting; Upper Nan watershed***

# Rainfall redistribution by Yagirala Forest Reserves; a secondary lowland tropical wet evergreen forest in Sri Lanka

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**Abstract**

Gross rainfall (GR) partitioning into throughfall (TF), stemflow (SF) and interception loss (I) was studied in the Yagirala Forest Reserves; a secondary lowland tropical wet evergreen forest in Sri Lanka. Measurements were performed on a rainfall event basis in a 400 $m^2$ plot during July 2018 to January 2019. GR was measured with automatic weather station located on the ground in an open area approximately 150 m apart from the study plot. Five manual gauges were used to collect the TF and were placed randomly underneath the canopy. SF was collected with rubber type SF collection collars from 25 trees in the canopy and the sub-canopy layers. Interception losses were calculated as the difference between GR and the sum of TF and SF. For the data analysis 10 GR events started with dry canopy condition was selected. The average of TF/GR, SF/GR, and I/GR ratios for were 66.2%, 1.2% and 32.6%, respectively. TF, SF, and I were found to be closely related to GR amounts. Strong positive correlation between GR and TF, SF and I were observed. Sub canopy trees reported significantly higher (70.8%) SF value compared with the canopy trees (29.2%). Results of the study demonstrate how I represents a remarkable percentage of the incident GR and how TF and SF are both strongly affected by GR itself.

**Keywords**: Gross precipitation, Stemflow, Throughfall, Canopy interception, Yagirala forest reserve

# Dynamic changes of runoff and sediment yield in the small headwater catchments under intensive tropical forest management system, central Kalimantan, Indonesia

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**Abstract**

Tropical rainforests in Indonesia is currently managed by Intensive Forest Management System (IFMS), characterized by selective timber harvesting and intensive line planting to enrich standing stock. This study conducted on catchment scale impacts of IFMS during each selective logging (SL) and intensive line planting (ILP) stage. While no forestry operation was conducted in catchment A, operations based on IFMS were conducted in catchments B and C. During the post-SL period, total runoff of catchments B and C increased by 68.8% and 47.3%, respectively. During the post-SL period, SS yields for catchments B and C dramatically increased to 34.0, and 14.5 t $ha^{-1}$ y-$^{1}$, respectively, , in comparison with a SS yield for catchment A of  0.6 t $ha^{-1}$ $y^{-1}$. This study indicated that ILP of IFMS was not effective to decrease total runoff and SS discharge in the initial stage of the post operation period.

# The key roles of fog on tropical cloud forest, Hainan island

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**Abstract**
Community-scale (weighted by species abundance) plant hydraulic responses to soil water, fog and precipitation in dry and wet season can help reveal how tropical cloud forest ecosystem response to future drought and climate change. However nearly no research touch this topic. Here we utilized isotopic $\delta^2H$, $\delta^{18}O$ and $\delta^{13}C$, leaf anatomical traits related to plant transpiration and species abundance to determine community-scale plant hydraulic responses to fog in dry and wet season in a tropical cloud forest in Hainan island, China. We observed community-scale foliar water uptake from fog and precipitation and reduced transpiration kept sufficient water supply in dry season. Thus, future climate change induced drought and fog reduction can threaten this tropical cloud forest ecosystem.

# Exploring Spatiotemporal Patterns of PM2.5 in the Xitou Region, Central Taiwan

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**Abstract**
Xitou region, as the epitome of the mid-elevation forest ecosystem in Taiwan, possesses a rich diversity of flora and fauna and is a famous Taiwan forest recreation area. Most tourists visit Xitou for health. However, air pollution is a big issue in Taiwan and is still a question in the Xitou region. This study cooperated with "Maker" to develop an atmospheric particulate matter observation system suitable for the high-humidity forest environment and set up this system at different altitudes for exploring the spatiotemporal patterns of PM2.5. The results showed that the PM2.5 value of the Xitou area (montane area) was lower than that of Zhushan (lowland area) from November to February, and the PM2.5 values of both areas were similar during the rest of months. According to this result, we encourage the public to visit the Xitou forest recreation frequently during the worse air quality season in the lowland area.

# Possible hydrological benefits from cypress plantation forests

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**Abstract**

Although conifer trees use less water at the plant scale, studies at the watershed scale have shown varying results due to the differences in climate and forestry practices. In this study, streams in two adjacent headwater catchments (cypress, 2.42 ha; mixed-broadleaf, 2.08 ha) in Inuyama city, Aichi prefecture, central Japan were gauged over five years and compared. Overall discharge in the cypress catchment was 6.4% lower than in mixed-broadleaf catchment due to lower streamflow on high-flow days. On low-flow days, discharge was higher in the cypress catchment, which may be advantageous for increasing water availability. Storm runoff in the cypress catchment is more buffered during large storm events thus suggesting possible flood attenuation benefits. By understanding the flow frequencies and storm event runoff characteristics between the different forest type, accurate forestry decisions can be made based on water demand and existing storm drainage infrastructures.

# Effect of litter removal and logging trees on surface runoff in Ananomiya Experimental Watershed, Ecohydrology Research Institute, The University of Tokyo Forests

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**Abstract**

To identify impact of litter removal and logging trees on surface runoff, a paired experimental surface runoff plot was established in the Ananomiya Experimental Watershed, Ecohydrology Research Institute, The University of Tokyo Forests. The water catchment area of treatment and control plots are 7.4 and 8.1 $m^2$ respectively. Surface runoff observation was started in May 2015. The first (litter removal) and second (logging trees) treatment was conducted on February 2017 and June 2018 in the treatment plot. The surface runoff in the treatment plot increased after litter removal and increased again after logging trees. The ratio of the control plot surface runoff to the treatment plot surface runoff tend to increase for events with no or little rainfall during 5 days before the event. After litter removal, the start time of surface runoff in the treatment plot was earlier than that in the control plot, suggesting the water repellent effect of the surface soil after litter removal. On the contrary, the start time of surface runoff in the treatment plot was later than that in the control plot after logging trees. This result suggest that the decrease of canopy interception may be one of the important mechanism to explain the increase in surface runoff in the treatment plot after logging trees.

# GR2

# Acoustic monitoring of bats as a forest indicator

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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 the University of Tokyo Hokkaido Forest, bat activity was monitored to assess the effect of forest habitat types (primary forest, selectively logged natural forest, secondary forest and conifer plantation). The result shows that 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.

# Temporal Dynamics in Bird Altitudinal Distribution in the Experimental Forest of National Taiwan University

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**Abstract**

I investigated temporal dynamics in bird altitudinal distribution and population abundance in the Experimental Forest of National Taiwan University by using biodiversity monitoring data. I repeated bird censuses at same 50 sampling stations along an altitudinal gradient from 1400 m to 3700 m in 1992 and 2014, respectively. During this time span of 22 years, average ambient temperature in breeding season increased 0.92°C (equivalent to 168 m upwards), 21 bird species had their altitudinal distribution significantly shifted upwards, 6 shifted downwards, and 3 expanded their distribution ranges, while all bird species shifted upwards 60 m in average. Historical trends of citizen science data (Chinese Wild Bird Federation Bird Database) from 1972 to 2010 were similar with the trends revealed by the repeated field investigations. We suggest that, large datasets of citizen science data have full potentials to detect biodiversity trends revealed by structured census data.

# The Long-term variation of spring temperature and egg-laying dates of nestbox-breeding Varied Tits (Sittiparus various) in South Korea and Japan

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Climate change can alter and disrupt the phenology and phenological interaction between organisms from various trophic levels in forest ecosystems. In temperate forests, the breeding activity phenology of birds is correlated to local microclimatic conditions, especially spring temperature, to match the timing of food availability. We investigated the annual change in the mean egg-laying dates of Varied Tits (Sittiparus various) and pre-breeding temperature indices in three plots located along with the elevational gradient in South Korea (11 years) and a low-elevation plot in Japan (36 years). Evidence of the rise in the pre-breeding temperature was strong in the higher-elevation plots in South Korea but relatively stable in other low-elevation plots in South Korea and Japan over the last decade. Although the mean egg-laying dates advanced more in plots experiencing a greater increase in the pre-breeding temperature, the shift in egg-laying dates was subtle during the study period. On the other hand, the mean egg-laying dates in Japan during the last 36 years have advanced in response to the rising temperature. Our study suggests that local microclimatic conditions, especially the altitude, may alter the effects of climatic shifts on the phenological response of breeding songbirds. As shown in our study, the systematic, continuous, long-term study of songbirds and climatic conditions in forests across various landscapes is necessary to understand the variable effects of climate change on forest birds.

Keywords: experimental forest; temperature rise; long-term monitoring; forest songbirds; breeding phenology

# My long-term researches on forest insects

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Long-term research is important but difficult to continue by one person because lifespans of woody plants, major components of the forest ecosystem, are generally much longer than that of humans. However, generation times of most insects are short and some insects spend more than one generation a year, which is a great advantage of insects as targets of long-term research. Especially, those in tropics have continuous generations for a whole year. In this presentation, I will introduce my studies on long-term research on insects in and outside of Japan. A target species and groups include: a beech caterpillar *Syntypystis punctatella* and insect community on beech seed both in Japan, moths belonging to the genus *Lymantria* in Indonesia, and ambrosia and bark beetle community in Asia. The beech caterpillar is a univoltine species and the population oscillated with approximately 10-yr cycle. *Lymantria* spp. in Indonesia showed generation cycles with 10-15 weeks of cycles. However, bark and ambrosia beetle populations in the tropical seasonal forests did not show generation cycles but the one-year cycles caused by the revolution of the globe.

# MONITORING THE GUMMOSIS SYMPTOM ON INVASIVE *Acacia decurrens* Willd. AFTER MOUNT MERAPI ERUPTION IN YOGYAKARTA, INDONESIA

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**Abstract**

Gummosis on *Acacia decurrens*, an invasive tree species, that established in Gunung Merapi National Park (GMNP) after the eruption of Mount Merapi in 2010 was studied to i) identify the causal organism of the disease, ii) analyze disease symptoms, iii) understand the spatial-temporal distribution of gummosis in the tree population and iv) monitor the development of gummosis symptom. Based on pathological, morphological and molecular studies, *Ceratocystis fimbriata* was proven to be the causal organism of the disease. The disease spread was probably aided by the ambrosia beetle (*Euwallacea* sp.) which bores holes on the stem. The disease is noted to spread from the base of the trees, where the ambrosia beetle bores holes first, to the upper part. Based on the monitored data, the gummosis were developed slowly from year 2015 to 2018. However the invasion of the pathogen poses serious threat to the ecosystem.

Key words: *Ceratocystis fimbriata*, *Acacia decurrens*, gummo

# Ecosystem physiology of tropical forests: findings from monitoring networks

Tan, Zheng Hong (HU)

# Restoration pathways for rain forest in southwest Sri Lanka: a review of concepts and models

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**Abstract**

The Sri Lankan government has changed its policy regarding its remaining rain forest from one that promoted commercial exploitation to one of conservation. The growing importance of uplands as catchments for water production, biodiversity conservation and other downstream services has been recognized. We review research investigating rain forest dynamics with the objective of using this knowledge for forest restoration providing principles for understanding the integrity of rain forest dynamics in southwest Sri Lanka. These principles are applied to determine effects of two rain forest degradation processes that have been characterized as chronic and acute. Restoration pathways are suggested that range from the simple prevention of disturbance to promote release of rain forest succession to establishment and release of successionally compatible mixed-species plantations. We summarize with a synthesis of the restoration techniques proposed for reforestation using native vegetation on cleared conservation areas and parks, and for the stabilization of eroded upland watersheds.

# Long-term Tree Species First Leafing and Flowering Trends at the Tokyo University Hokkaido Forest

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**Abstract**

Advancement of temperate region plant spring phenophases is a direct and an eminent consequence of warming. In this study, we analyzed the long-term (1931-2017) first leafing and flowering records of seven dominant and co-dominant tree species at the University of Tokyo Hokkaido Forest. Based on the homogenized daily and monthly temperature data, models were developed to impute missing observations. Trends were extracted based on ensemble empirical mode decomposition. We derived the trends' velocities and accelerations based on differencing. We also established pointwise confidence envelopes for the above estimates using maximum entropy bootstrap. The results showed that the two spring phenophases of the seven species all significantly advanced since 1931. By analyzing the trends of relevant temperature records and possible climate drivers, the results suggested that the advancing trends of the two phenophases were caused by an increased spring temperature, which in turn was due to a strengthened Arctic Oscillation, a weakening East Asian Winter Monsoon, and recent warming.

# Impacts of Climate Changes on Forest Dynamics at Doi Suthep-Pui National Park, Chiang Mai Province, Northern Thailand

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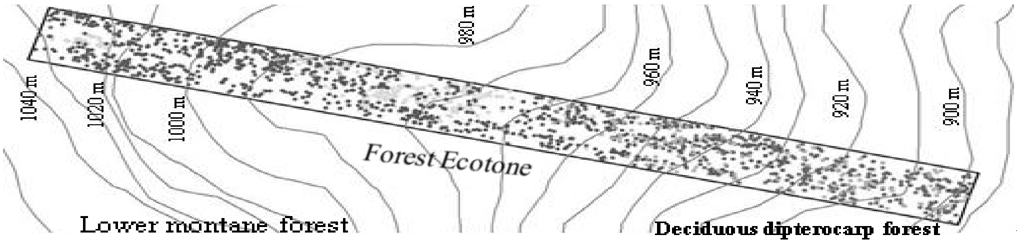
**Abstract**

The impacts of climate changes on forest regeneration are crucial concerned for ecologists. This study aimed to clarify relationship between environmental changes and forest dynamics along altitudinal gradient, 900-1,100 m asl. A 3-ha permanent plot, 50 x 600 m, was established which covered deciduous dipterocarp and lower montane forest. All trees, DBH > 1 cm, were tagged, measured, and identified. Monitoring was done every two year since 2012. The results showed that altitudinal factor strongly influenced on tree spatial distribution and three species groups can be classified, low-altitude (deciduous species), high-altitude (evergreen species) and intermediate altitude group at forest ecotone where coexisted species can be found (Figure 1). El Niño in 2015-16 induced high temperature and less amount of rainfall. Mortality rate of saplings, DBH < 5 cm, particular evergreen species, had significantly correlated with this event (Figure 2). Indicating the environmental changes are very important on plant establishment and coexisting.

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gure 1 Tree spatial distribution (dots) related to altitudinal gradient.

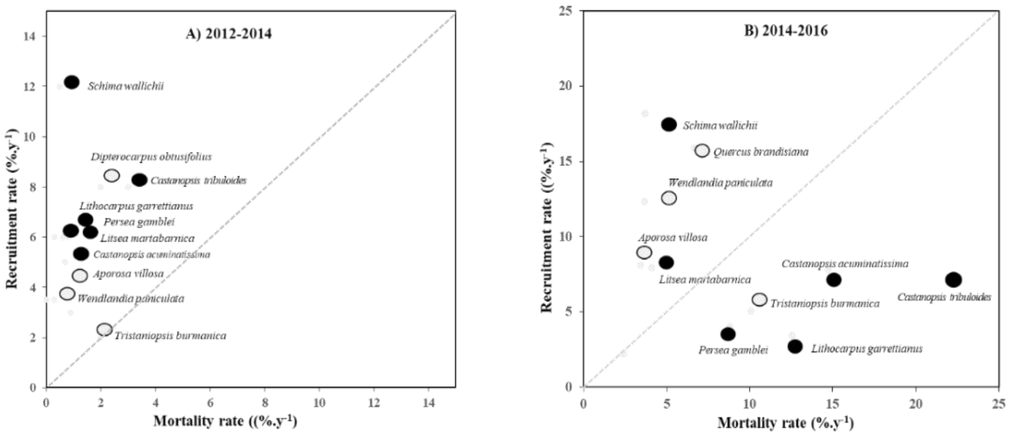


Figure 2 The recruitment and mortality rate for deciduous (○) and evergreen (●) species.

# Ecophysiology of drought-induced Dipterocarps

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**Abstract**

Dipterocarps have been used widely in forest restorations in Sabah, Malaysia. Despite a vast number of species in Dipterocarpaceae family, only a few are utilized in forest restoration because of their economic value to the county. This study aims to evaluate the ecophysiology of nine selected species commonly used in forest restoration in Sabah. A total of 108 one-year-old seedlings were transplanted in 3 blocks of 12 x 12 m under forest canopies of Kawang Forest Reserve. Rainfall exclusion roofs were installed in the forest to initiate a drought event in the field. The growth and survival rate, water relations, gas exchange and leaf traits of seedlings were studied. The non-dipterocarp pioneer species of *Neolamarckhia cadamba* exhibited the largest diameter increment while a local species of KFR, *Dryobalanops lanceolata* displayed the fastest height growth. Midday water potential ($\Psi_{MD}$) showed significant differences ($p$ = 0.025) between control and drought stressed seedlings.

# Why tropical forests has the highest drought-induced tree mortality

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**Abstract**
Recent tree mortality events associated with predicted worldwide frequent extreme drought events have led to recognition of the importance of the physiological mechanisms associated with drought-induced tree mortality in different biomes. Quantifying global patterns in the HSM-TLP relationships can provide insight into the drivers of drought-induced tree mortality globally. Unfortunately, we lack a clear picture of HSM-TLP relationships at the global scale. Here we draw together published data on these two hydraulic traits for 1773 species from 370 sites worldwide to test the global and regional relationships between stem HSM and TLP. We found that TLPs and HSMs are merely coupled in tropical rain forests and tropical seasonal forests. The results suggest that leaves of species in tropical forests cannot act as “safety valves” to prevent low HSM, which does not support the vulnerability segmentation hypothesis. On the other hand, the lowest TLP and srogest HSM-TLP relationships in tropical rain forests may explain why tropical rain forests have the highest drought-induced tree mortality relative to other biomes.

# RG3

# Long-term monitoring sites of Seoul National University Forests

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**Abstract**

Long-term vegetation monitoring sites at Seoul National University Forests were located at Mt. Taehwa, Mt. Jiri and Mt. Baegwoon. Mt. Taehwa sites were established in 2008 to compare species composition and stand structure between plantations and natural forests and have been used for field practice of Forest Ecology class. Three monitoring sites were established on Mt. Jiri in 2005 as a part of National Long-term Ecology Research. Each site represented *Pinus densiflora* stand, *Abies koreana* stand and *Quercus mongolica* stand. Mt. Jiri sites were annually monitored from 2005 to 2013. Only *A. Koreana* stand has been monitored since 2014. Mt. Baewoon sites consist of several old plantations for research and riparian forests for student field practice. Old plantation sites on Mt. Baewoon were established at *Pinus koraiensis, Picea abies, Abies firma, Cryptomeria japonica*, and *Chamaecyparis obtusa* plantations in 2016 to understand species growth characteristics. Riparian sites were established in 2010.

# Academic utilization of various records in the University of Tokyo Chiba Forest

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**Abstract**

The University of Tokyo Forests have long accumulated “fundamental data” organizationally for research, such as meteorological data. The University of Tokyo Chiba Forest (UTCBF), established in 1894, is the oldest university forest in Japan. With its long history, it has collected not only fundamental data and long-term research data such as growth data of planted forest, but also various records. One example of them is a group of old materials mainly for forestry education. Other example is historical records such as management plans, maps and correspondence files. In this presentation, I introduce some researches using such records, and illustrate the importance of such researches for claiming the value of records.

# Growth prediction variability according to observation period of long-term data in old Sugi (Crypromeria japonica) planted stands

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**Abstract**

It is important to predict the growth of Sugi planted stand in old age in the state of long rotation of final cutting in Japan. When growth of Sugi planted stand is predicted, it is possible that the accuracy of growth prediction gets worse without enough growth data in old ages because it is pointed out that growth of Sugi does not get slower in old ages than expected in the past growth predictions based on growth data only in young to middle ages. This study investigated the changes in extrapolation values of DBH in old Sugi planted stands according to the changes in the observation period of long-term data. Study sites were long-term growth observation sites of Sugi planted stands in the University of Tokyo Chichibu Forest. In this study, both DBH of individual trees and mean DBH of stands were analyzed by fitting a Richards growth function. The results showed that the accuracy of growth prediction in old ages got improved by accumulating growth data up to enough old age. From another point of view, growth prediction in old ages tended to underestimate actual growth if growth data was not accumulated up to enough old age.

# Long-term growth trends of *Cryptomeria japonica* plantations at The University of Tokyo Forests and National Taiwan University Experimental Forest

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**Abstract**

*Cryptomeria japonica* D. Don (Japanese cedar; 'sugi' in Japanese) is one of the important plantation species in East Asia including Japan, Taiwan, and South Korea. The University of Tokyo Forests (UTF), National Taiwan University Experimental Forest (NTUEF), and Seoul National University Forest (SNUF) hold old *C. japonica* plantation stands, which were planted between 1890s–1920s. UTF and NTUEF have continuously been monitoring experimental plots in old *C. japonica* plantations. Under the Core-to-Core Program of the Japan Society for the Promotion of Science (JSPS), researchers in three universities have been working together for collaborative research activities on long-term *C. japonica* growth. In this presentation, we synthesize the growth trends of old *C. japonica* plantations between UTF and NTUEF.

# An Experiment of Mixed Deciduous-Coniferous Forests to Rehabilitate *Cryptomeria japonica* Plantations

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## Abstract

At appropriate elevation in the National Taiwan University Experimental Forest, *Cryptomeria japonica* plantations are gradually being rehabilitated to mixed deciduous-coniferous forests. A silvicultural experiment is set up with the motivation to understand stand dynamics and development of mixed forests, and timber and non-timber services provided by this forest. Two sites at Xitou and Heshe are selected for the experiment. Tree species *Michelia compressa* and *Cunninghamia lanceolata* are chosen because they are both classified as Grade 1 timber. The experiment factor is planting ratio of 1:1, 1:3, and 3:1 (*M. compressa* : *C. lanceolata*). The experiment is set up as a Randomized Complete Block Design with each site (block) having 9 experimental units. The three levels of planting ratio are randomly assigned to the 9 experimental units in each site. The experiment is currently being established. Tree seedlings diameter, height, and survival rate will be monitored continuously.

# ENRICHMENT PLANTING INCREASES GENETIC DIVERSITY OF SECONDARY LOWLAND DIPTEROARP FORESTS IN INDONESIA

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An application of selective logging and enrichment planting using native species is one of methods to maintain forest degradation in lowland dipterocarp forests. However, it was little known about the impact of enrichment planting on genetic diversity in secondary forest. The goals of research evaluated the impact of selective logging with multi rotations and enrichment planting on the genetic diversity of Shorea parvifolia.. The result showed that the most genetic diversity was not significantly different between primary forest and the other treatments ($P>0.05$), except for the private allele ($P<0.05$). An second rotation resulted decrease in the numbers of rare and private alleles, suggesting a negative impact on the genetic diversity of the remaining tree population. Enrichment planting improved some genetic parameters, especially for allelic richness (+3.9-22.8%) and rare allele (+8.1-82.1%). It suggested that genetic diversity of logged forests can be maintained by enrichment planting of focal species.

Keywords: genetic diversity, selective logging, enrichment planting

# GENOMIC DIVERSITY OF *Acacia mangium* AND *Acacia auriculiformis* NATURAL GERMPLASMS USING SNP MARKERS

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**Abstract**

The *Acacia mangium* and *A. auriculiformis* are economically important tree plantation species in the humid tropical region. The aim of this paper is to present the genomic diversity and population structure of *A. auriculiformis* and *A. mangium* natural germplasms using single nucleotide polymorphism analysis. A total of 450 *Acacia* samples were genotyped using 230 SNPs on the lllumina Bead Xpress and 132 SNPs on the Sequenom MassARRAY platform. FST outlier analysis revealed 4 (6.7 %) *A. auriculiformis* and 10 (15.6 %) *A. mangium* SNPs were putative outliers respectively. Heterozygosity of *A. mangium* and *A. auriculiformis* natural populations were 0.28 and 0.26 respectively. Cluster analysis revealed two and three distinct clusters within the *A. mangium* and *A. auriculiformis* natural populations respectively consistent with their natural distribution. The *Acacia* species have low genomic diversity but high genetic variation within and among the natural populations.

# Prescribed Fire Behavior and Management in Khuan Khreng Peat Forest, Nakhon Si Thammarat Province, Thailand.

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**Abstract**

Recently, frequent anthropogenic fires in Melaleuca peat forest becomes big issues. Fire behaviors in this peat forest are very important for fire danger evaluation, and management. This study, investigated fuel and prescribed fire behavior in 12 prescribed fires experiments in Khuan Khreng peat forest, Southern Thailand.

The results revealed that aboveground fuel comprised of litter, undergrowth, fresh leaf and bark. Total average aboveground fuel were 17.44 $t.ha^{-1}$.The heat value of Melaleuca fresh bark was very high (5502.95 $cal.g^{-1}$). The average peat depth and its bulk density was 1.4 m, and 0.23 $g.cm^{-3}$, respectively. The deepest of the peat was 3.10 m. Burning experiments in 2014 demonstrated that the rate of fire spread (4.01 $m.min^{-1}$) and flame length (1.3 m) in the peatland dominated by sedge were very high compared to the Melaleuca stands. Burning in the sedge plots was classified as medium intensity (639.32 $kW.m^{-1}$), while low fire intensity was observed in the Melaleuca stands plots. Peat burning in the laboratory demonstrated that rate of spread was very slow (3.24 $cm.hr^{-1}$). Peat temperatures were generally higher than 620 °C. However, fire intensities and severities reported here were obviously lower than those of wildfire recorded in the Khuan Khreng peat forest 2012 fire.

# Ensuring the Sustainability of Sri Lanka's Wood-based Industries for a Circular Bio-economy

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Wood Based Industry (WBI) of Sri Lanka is one of the oldest manufacturing sectors, providing substantial employment. These industries predominantly supply their products to the domestic market while, relatively smaller number of manufacturers target export markets. Sri Lanka's WBIs has potential in producing to the higher end of the market. However, insecure supply of wood, lack of stable policy direction, excessive regulations on transport of wood and finished products, bad image of the quality of the industry, lack of industry information, inadequate management, technology and skills have hindered the development of WBIs. The University of Sri Jayewardenepura established Timber Process Innovation Center (TPIC) for Sri Lankan WBI value enhancement. TPIC proposed sustainability strategy for WBIs is based on process innovation, cleaner production, wood waste utilization and value chain enhancement. With particular focus on novel value chains, this paper provides insights into the role of innovation in facilitating the shift towards sustainable, circular bio-economy in Sri Lanka, and future collaborative research on based on long-term data on wood products manufacturing and trading.