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研討會議程

2015 年 11 月 21 日(星期六)		
時 間	議 程	主 持 人
08:30-09:00	報到 (東華大學環境學院演講廳)	
09:00-09:10	貴賓致詞 中國科學院植物學研究所 馬克平 東華大學環境學院 裴家騏	
09:10-09:50	專題演講: An experimental test of the environmental filtering hypothesis 華東師範大學生態與環境科學學院 沈國春	東華大學自然資源與環境學系 孫義方
09:50-10:30	專題演講: 自動照相機在野生動物研究上之應用 東華大學環境學院 裴家騏	
10:30-10:50	茶 敘	
10:50-11:10	Rarefaction and extrapolation of phylogenetic diversity 清華大學統計學研究所 邱春火	中國科學院植物學研究所 馬克平
11:10-11:30	Spatial variation of soil respiration linked to forest structure and soil parameters in an old-growth mixed broadleaved-Korean pine forest in northeastern China 東北林業大學 金光澤	
11:30-11:50	Multiple dimensions of diversity have different effects on temperate forest functioning over succession 中國科學院瀋陽應用生態研究所 原作強	
11:50-12:10	Scaling of occupancy in forest plots worldwide: role of environment and species traits 中國科學院植物學研究所 任海保	
12:10-13:20	午餐與海報展示	

13:20-13:40	Effects of density-dependence and topography on tree mortality in a subtropical mountain forest in central China 中國科學院武漢植物園 盧志軍	東華大學自然資源與環境學系 陳毓昀
13:40-14:00	Effect of environmental filtering on intraspecific variation in leaf functional traits along an elevation gradient in Fushan Forest Dynamics Plot, Taiwan 東華大學自然資源與環境學系 Kanokporn Kaewsong	
14:00-14:20	福山亞熱帶闊葉林樹木功能性狀種內變異來源之初探 東華大學自然資源與環境學系 饒益品	
14:20-14:40	Spatial heterogeneity of soil C and their prediction using hyperspectrum in a subtropical mixed forest in Badagongshan 中國科學院武漢植物園 劉峰	
14:40-15:00	Beta diversity determinants in Badagongshan, a subtropical forest in central China 中國科學院武漢植物園 喬秀娟	
15:00-15:20	茶 敘	
15:20-15:40	Spatial-temporal variability of main tree species in a mixed needle-broad leaved forest in the Baotianman Nature Reserve 河南農業大學 王婷	中國科學院西雙版納熱帶植物園 林露湘
15:40-16:00	Partitioning phylogenetic and species composition in soil fungal community of a 20 ha tropical rainforest 中國科學院西雙版納熱帶植物園 胡躍華	
16:00-16:20	Soil fauna diversity and distribution in the tropical and subtropical forests - a case study of 20-ha CTFS plot in Yunnan province, SW China 中國科學院西雙版納熱帶植物園 楊效東	
16:20-16:40	影響蓮華池動態樣區地被植物分布之環境因子與各地被植物及上層喬木相互關係之研究 林業試驗所 張勵婉	
16:40-17:00	The research of ant communities in the vertical structure of Lienhuachih Forest Dynamics Plot 臺灣大學生態暨演化研究所 許峰銓	
17:00-18:00	海 報 展 示	
18:00-21:00	歡 迎 晚 宴 地點：東華大學 綠色廚房	

2015 年 11 月 22 日(星期日)		
時 間	議 程	主 持 人
09:00-09:40	專題演講: Carbon and water fluxes in a subtropical montane cloud forest in Taiwan 東華大學自然資源與環境學系 張世杰	東華大學自然資源與環境學系 夏禹九
09:40-10:20	專題演講: 由構樹的親緣地理學追蹤樹皮布文化的傳播 臺灣史前文化博物館 張至善	
10:20-10:40	茶 敘	
10:40-11:00	Dimensions US-China collaborative research: how historical constraints, local adaptation, and species interactions shape biodiversity across an ancient floristic disjunction 浙江大學生命科學學院 傅承新	林業試驗所 王相華
11:00-11:20	Why permanent plots in the fragmented landscapes are important? 浙江大學生命科學學院 劉佳佳	
11:20-11:40	Estimating seasonal variations of leaf area index using litterfall collection and optical methods in four mixed evergreen-deciduous forests 東北林業大學 劉志理	
11:40-12:00	大興安嶺興安落葉松林 25-ha 樣地研究進展 黑龍江省科學院自然與生態研究所 朱道光	
12:00-13:30	午餐與海報展示	

13:30-13:50	Structure and species composition of wood plant communities on lands-bridge islands: research of habitat fragmentation effect based on forest dynamic plots 浙江大學生命科學學院 劉金亮	中國科學院亞熱帶農業生態研究所 曾馥平
13:50-14:10	Pollen and seed flow under different predominant winds in wind-pollinated and wind-dispersed species <i>Engelhardia roxburghiana</i> 中國科學院華南植物園 王崢峰	
14:10-14:30	The effects of seed dispersal and predation on resource allocation in fruit parts 東華大學自然資源與環境學系 林好芬	
14:30-14:50	台灣南仁山低地雨林地區非生物及生物因子對於小苗存活的影響 中興大學國際農業學程 林詠喬	
14:50-15:10	梅花鹿啃食對木本植物更新之影響 – 墾丁森林動態樣區圍籬實驗結果初探 東海大學生命科學系 呂俊緯	
15:10-15:30	茶 敘	
15:30-16:30	分 組 討 論	各組主持人
16:30-17:30	兩岸論壇：海峽兩岸森林動態研究展望	中國科學院植物學研究所 馬克平 東華大學自然資源與環境學系 孫義方
17:30-18:00	自 由 活 動	
18:00-21:00	晚 宴	

專題演講摘要

An experimental test of the environmental filtering hypothesis

Guochun Shen (沈國春)
East China Normal University

The environmental filtering hypothesis is one of the most pervasive and enduring concepts in community ecology. However, the established evidence on the hypothesis has been challenged by recent studies and is commonly confounded by dispersal limitation and biotic interaction. To minimize or explicitly examine these confounders, 48 plots containing understory grass communities naturally generated from the same soil seed bank were exposed to illumination with a clear and stable intensity gradient for 6 months. The results revealed that species compositional dissimilarity increased among communities with different illumination intensities, and decreased among communities with the same strong abiotic filter. These trends were absent or even reversed among communities with strong biotic interaction. This experimental evidence clearly and consistently supports the environmental filtering hypothesis and simultaneously provides the first experimental evidence of the necessity of separating biotic interaction from abiotic filtering in future studies.

Keywords: illumination gradient, abiotic filtering, biotic interaction, grass community, species composition, Bray-Curtis distance, Heishiding Nature Reserve

Email: gcshen@des.ecnu.edu.cn

自動照相機在野生動物研究上之應用

裴家騏
東華大學環境學院

自動照像設備可長時間在野外，於無人干擾的狀況下收集野生動物的資訊，不但所需人力較少，且資料品質較統一；綜合而言，至少具備：可有效的偵測到稀有或不易見到之物種、可同時收集多種物種之資料、可確認動物棲息或活動之位置及環境等功效。本文整理了在台灣應用自動照相機的經驗，內容涵蓋：(1) 區域性物種名錄的普查、(2) 動物活動模式的研究、(3) 野生動物棲地空間分布模式的建立、(4) 野生動物分布現況的建立，和(5) 野生動物族群密度的估計等。

Email: kcjpei@mail.ndhu.edu.tw

Carbon and water fluxes in a subtropical montane cloud forest in Taiwan

張世杰
東華大學自然資源與環境學系

Chi-Lan Mountain (CLM) long-term ecosystem research site is one of the few flux tower sites in Taiwan. This mid-altitude forest site is characterized by prevalent foggy conditions throughout the year which leads to a permanently humid aerial and soil environment. Our studies at this specific site and for the montane cloud forests in general deal with questions of how ecosystem carbon and water budgets are controlled by fog.

Fog contributes around 300 mm y⁻¹ atmospheric water deposition to the *Chamaecyparis obtusa* var. *formosana* ecosystem. Although this represents only a small part of the total water input (precipitation + fog ca. 4500 mm y⁻¹), fog deposition provides an avenue for nutrient input because of the high nutrient concentrations in the fog droplets compared to that in rain water. Forest canopy is the place where most fog droplets are intercepted, which, together with the precipitation generates a prolonged wet leaf surface (52% of the time) in this cloud forest. To demonstrate the effect of leaf wetness on the pattern of water vapor fluxes, a two-year dataset of evapotranspiration (from eddy covariance method) and transpiration (from sap flow measurement via heat dissipation probes) was analyzed. The morning net radiation first drives the evaporation of the leaf surface wetness that was intercepted in the previous fog/rain event, leaves behind the initiation of transpiration, as indicated by a 1 to 3 hour-delay of sap flow. The mid-day canopy conductance was thus higher in the foggy/rainy days compared with the clear days. The cloud forest trees species that have adapted to the moist conditions might be vulnerable to the increasing fog-free period under warming climate.

High precipitation and frequent cloud/fog cover has led to another significant character of the montane cloud forests, i.e. the constantly humid soil. A consequence of the high soil water content is the retarded gas diffusion and decreased soil respiration rate. At the CLM site, an annual soil respiration rate of 176 g C m⁻² y⁻¹ was determined, which is among the lowest values ever published in forest ecosystems. To understand the mechanisms underlying the soil CO₂ efflux process of cloud forests, a field manipulation experiment was conducted in which soil water content was lowered gradually beneath a roof system. The volumetric soil water content of 0.30 was found to be the optimum value for soil respiration. The BIOME-BGC ecosystem model was used to further study the soil carbon budget of the CLM site. Based on the results from the previous field experiment, the equations in the model were modified such that the model could better simulate soil respiration. Through adding an extra module of leaching of dissolved organic carbon, the simulated carbon fluxes could greatly be improved when comparing them with the eddy covariance measurements.

We believe that in tropical/subtropical montane cloud forests, the unique patterns and controlling mechanisms of water and carbon fluxes deserve more studies.

Email: scchang@mail.ndhu.edu.tw

由構樹的親緣地理學追蹤樹皮布文化的傳播

張至善^{*1}、鍾國芳²、劉筱蕾²

¹臺灣史前文化博物館 ²臺灣大學森林環境暨資源學系

近 200 年以來，南島語族的遷移與擴散一直是語言學、考古學和文化人類學討論與爭辯的重要課題。由於研究工具的提升和考古發現的進展，讓科學家可以利用分子遺傳的方法，研究各類生物遷徙歷史中所呈現出的遺傳多樣性變動與可能的機制。其中有許多例子都以人類共生生物為媒介，例如緬甸小鼠、豬、香蕉等。環太平洋地區樹皮布製作主要原料的構樹，也成為研究的對象，看看能否作為人類在太平洋拓殖問題的參考資訊。親緣地理與生物遺傳科學的進步，提供了新的工具，得以檢驗並挑戰此一學術領域的各種假說。本研究之主題為構樹，是樹皮布的主要製作材料之一。利用拍打、槌氈構樹樹皮內層製作而成的樹皮布，是南島語族極具特色的物質文化之一。構樹屬於雌雄異株的桑科植物，原生於東亞，由於文獻記載在島嶼東南亞與大洋洲的構樹均不結果實，該地區構樹的族群應非天然分布，較可能是隨著樹皮布文化的傳播自東亞被南島語族人攜帶到大洋洲地區，因此研究構樹傳播的歷史，可提供南島語族自東亞播遷至大洋洲的重要線索。本研究以採集自臺灣、中國、中南半島、日本、菲律賓、印尼蘇拉威西、新幾內亞及大洋洲島嶼等地共 604 個構樹樣本（含 19 個取自近大洋洲和遠大洋洲之植物標本），分析其葉綠體基因組 *ndhF* 與 *rpl32* 兩個基因間的 DNA 序列，偵測出 48 個基因單型 (haplotype)。結果顯示：中國南方及臺灣為構樹遺傳多樣性最高的地區，是構樹的物種起源中心。另其中分布在蘇拉威西、新幾內亞及遠大洋洲島嶼上絕大多數的構樹均攜帶基因單型 *cp-17*，而除了大洋洲外，*cp-17* 僅分布在臺灣南部。*cp-17* 在臺灣與大洋洲間的不連續分布證明了臺灣是「太平洋構樹」的原鄉，本研究為第一個由民族植物學的角度以共生物種親緣地理學檢測「出臺灣說」的研究，反映了南島語族的遷徙全貌，並見證了臺灣在南島研究上的重要性。

Email: woods@nmp.gov.tw

口頭報告摘要

Rarefaction and extrapolation of phylogenetic diversity

Chun-Huo Chiu (邱春火)
Tsing Hua University

Traditional species diversity measures do not make distinctions among species. Faith's phylogenetic diversity (PD), which is defined as the sum of the branch lengths of a phylogenetic tree connecting all species, takes into account phylogenetic differences among species and has found many applications in various research fields. Like species richness, Faith's PD tends to be an increasing function of sampling effort and thus tends to increase with sample completeness. We develop in this paper the 'PD accumulation curve' (an extension of the species accumulation curve) to depict how PD increases with sampling size and sample completeness. To make fair comparisons of Faith's PD among several assemblages based on sampling data from each assemblage, we derive both theoretical formulae and analytic estimators for seamless rarefaction (interpolation) and extrapolation (prediction). The PD estimator for an extrapolated sample is generally reliable up to twice the size of the empirical sample. We propose an integrated curve that smoothly links rarefaction and extrapolation to standardize samples on the basis of sample size or sample completeness. A bootstrap method is used to obtain the unconditional variances of PD estimators and to construct the confidence interval of the expected PD for a fixed sample size or fixed degree of sample completeness. This facilitates comparison of multiple assemblages of both rarefied and extrapolated samples.

Key words: diversity, extrapolation, phylogenetic diversity, rarefaction, sample coverage, species richness, undetected phylogenetic diversity

Email: entropy4337@gmail.com

Spatial variation of soil respiration linked to forest structure and soil parameters in an old-growth mixed broadleaved-Korean pine forest in northeastern China

Baoku Shi, Weifeng Gao, Huiying Cai, Guangze Jin (金光澤)*
Northeast Forestry University

The aim of this study was to quantify and to understand driving factors of spatial variation of soil respiration (RS) in an old-growth mixed broadleaved-Korean pine forest in northeastern China. All woody stems ≥ 1 cm diameter at breast height (DBH) were measured in the 9 ha plot. Simultaneous measurements of RS, soil temperature and soil water content were carried out for 256 sampling points on a regular 20-m grid refined with 512 additional sampling points randomly placed within each of the 20-m blocks in spring (May), summer (July) and autumn (September) of 2014. Variogram analyses revealed 87–91% of sample variance was explained by autocorrelation over a range of 15–23 m during the observation periods. RS were highly correlated among the measurements made in May, July and September. The model indicated that soil water content, bulk density and maximum DBH for trees within 3 m (radius) of the measurement collars explained 46% of the spatial variation in RS seasonally averaged across three observations. The spatial patterns of RS remained constant across three measurement campaigns. The spatial variation in RS was primarily controlled by soil water content and forest stand structure.

Keywords: old-growth temperate forest, soil respiration, spatial variation, soil water content, forest stand structure

Email: taxus@126.com

Multiple dimensions of diversity have different effects on temperate forest functioning over succession

Zuoqiang Yuan (原作強)^{*1}, Shaopeng Wang², Antonio Gazol³, Fei Lin¹, Xugao Wang¹, Ji Ye¹, Zhanqing Hao¹, Michel Loreau²

¹State Key Laboratory of Forest and Soil Ecology, Institute of Applied Ecology, Chinese Academy of Sciences, ²Centre for Biodiversity Theory and Modelling, Station d'Écologie Expérimentale du CNRS, France, ³Instituto Pirenaico de Ecología, Spain

1. Although species richness, phylogenetic diversity and functional diversity jointly influence ecosystem functioning, it remains unclear whether these different measures of biodiversity have similar predictive power on forest ecosystem functions, and how these relationships change across succession.
2. Here, we measured species richness, phylogenetic and functional diversity, and examine the relationships between biodiversity and tree aboveground biomass stock (AGB) and coarse woody productivity (CWP) in two succession stages of the broad-leaved Korean pine forest in northeastern China. In particular, functional diversity is calculated from six functional traits, singly or in combination.
3. Our results demonstrate that nine of the 12 combinations of diversity-biomass (AGB and CWP) correlation showed significantly positive relationship, especially in terms of functional trait diversity. The mean diversity-biomass correlation increased from 0.094 in secondary forest to 0.293 in old growth forest, suggesting stronger biodiversity effect in mature forest.
4. Furthermore, multi-model selection results showed that species richness, phylogenetic diversity and single functional traits were required simultaneously to explain more variation in forest biomass, with different traits included in the two forest plots. The models including single trait, i.e. leaf area in secondary forest and wood density in mature forest, provided better explanations of forest biomass than multivariate-trait models. This finding may reflect tree functional trade-offs in resources acquisition and resource conservation strategies in secondary and old growth forests.
5. *Synthesis*. This work demonstrate that diversity effect on ecosystem functioning is increased over forest succession, and also shed light on the idea that multiple dimensions of diversity have different effects on temperate forest functioning over succession.

Keywords: biodiversity and ecosystem functioning, functional diversity, phylogenetic diversity, natural secondary forest, old growth forests, biomass, leaf area, wood specific gravity

Email: yuanzq825@126.com

Scaling of occupancy in forest plots worldwide: role of environment and species traits

任海保

中國科學院植物學研究所

Fine-grained distributions of species are vital for the study and management of biodiversity. The scale-area relationship (ScAR) enables predicting fine-grained occupancy of individual species from coarse-grained occurrence. Using 3574 woody species in 17 forest plots of 20 ha across the globe, we assessed if environments and species traits influencing species' abundance and aggregation modeled ScAR slopes, and tested if the predicted ScARs improved occupancy downscaling. We showed that environments and species traits well modeled the variations in ScAR slopes among plots and species. The explanatory power orderly increased from coarse-grained occupancy (CO), species traits to environments, whereas the downscaling performance increased conversely. Environments improved the downscaling greatly than the empirically fitted ScARs over coarse scales. And excluding the spatially restricted species made the improvement more evident. These are because CO itself correlates with species abundance, and environments more affect spatial aggregation. We suggest that the factors associated with species' spatial aggregation highly improve occupancy downscaling through applying the ScAR predicted by them in downscaling. Beyond the factors we used, other factors associated with species' spatial distribution are required to model ScARs and apply them in downscaling.

Email: renhb@ibcas.ac.cn

Effects of density-dependence and topography on tree mortality in a subtropical mountain forest in central China

Hao Wu^{1,2}, Zhijun Lu (盧志軍)^{*1}, Mingxi Jiang¹

¹ Key Laboratory of Aquatic Botany and Watershed Ecology, Wuhan Botanical Garden, Chinese Academy of Sciences, ² Department of Life Science, University of Chinese Academy of Sciences

Detecting spatial pattern of snags and driving factors of tree mortality is critical to understand the mechanisms of species coexistence. In 2014 and 2015, we conducted a census of the snags (dbh \geq 10 cm) of the adult woody plants in the 25-ha Badagongshan (BDGS) forest dynamics plot. We used the univariate, bivariate pair correlation function $g(r)$ to analyze the spatial distribution pattern of snags and the association between snags and live trees. The relative importance of neighborhood-density and topographical factors on adult tree mortality were examined by generalized linear mixed model (GLMM). The results showed that: 1) At community level, snags showed aggregated distribution in 0-50 m scale; snags and live trees showed significantly negative correlation in 0-3 m scale; At species-level, 12 of the 18 common species with snags \geq 25 demonstrated significantly negative association between live trees and snags at the scale of 0-50 m; 2) Basal area of conspecific neighborhoods showed a significant positive or negative effects on adult tree mortality at different research levels (community, life form and species); However, basal area of heterospecific neighborhoods showed a constant significant positive effect at all levels; Topographic factors (except elevation) showed no significant correlation with tree mortality. In summary, adult trees mortality is nonrandom and mainly driven by interspecific competition and intraspecific negative density dependence in the subtropical mountain evergreen and deciduous broad-leaved mixed forest. Topography conditions have no significant effects on mortality of adult trees. Our study demonstrates that interactions of species tended to be more important in affecting adult tree mortality than habitat variables.

Keywords: BDGS plot, density dependence, snags, topography, tree mortality

Email: luzj@wbpcas.cn

Effect of environmental filtering on intraspecific variation in leaf functional traits along an elevation gradient in Fushan Forest Dynamics Plot, Taiwan

Kanokporn Kaewsong (Ar)*, I-Fang Sun
Department of Natural Resources and Environmental Studies
Dong Hwa University

Many studies try to explain how species coexist. Since plant functional traits influence plant performance, these traits are powerful tools for investigating how species coexist and respond to environment. Most studies use species-averaged trait value to investigate hypotheses concerning the relationship between functional traits and species coexistence. Recent studies, however, have shown that neglect of intraspecific variation in functional traits may lead to incorrect conclusions. Variation within a species can provide more detail for understanding community dynamics. Very few studies have examined the effects of intraspecific variation of functional traits on coexistence. Therefore, I address two questions: 1) do mean trait values differ among populations at different elevations? and 2) does the environmental filtering process play an important role on individuals associated with an elevation gradient? I analyzed five functional traits (specific leaf area, leaf area, leaf dry matter content, leaf thickness, and leaf vein density) from saplings (DBH 2-7 cm) of six tree species in the Fushan Forest Dynamics Plot, Taiwan. I used four elevation classes within a 133-m range as a surrogate for variation in environmental conditions with Bayesian analysis and the null model approach. I show that, within a species, different functional traits varied among elevation classes. In addition, environmental filtering effect is in part, responsible for the intraspecific variation among elevation classes. Therefore, intraspecific variation in functional traits was important for the understanding of species coexistence in this community.

Keywords: functional traits, intraspecific variation, environmental filtering, Bayesian analysis, species coexistence, specific leaf area, leaf dry matter content

Email: kaewsong_k@hotmail.com

福山亞熱帶闊葉林樹木功能性狀種內變異來源之初探

饒益品*、孫義方
東華大學自然資源與環境學系

在群落生態學的研究中，植物功能性狀的測量及分析可提供新的工具以驗證不同假說、釐清群落組成及物種共存的機制。近年來，除了功能性狀的種間差異之外，種內變異之重要性也逐漸獲得重視。為了更清楚了解功能性狀種內變異的來源及其對於群落組成機制的影響，我們於福山森林動態樣區的亞熱帶闊葉林中，分別於 2008 – 2009 及 2013 – 2014 年間重覆採集了二十二個物種相同個體的葉厚度、比葉面積 (SLA) 及葉乾物質含量 (LDMC) 等功能性狀資料，並使用巢狀重複測量變異量分析 (nested repeated measures ANOVA) 以嘗試區分個體間遺傳差異及表型可塑性分別對於種內變異的貢獻度。分析結果顯示，種內變異絕大部分來自於個體間遺傳差異而非表型可塑性，然而不同物種的表型可塑性對於種內變異的貢獻度仍有差異。

關鍵字：森林動態、群落組成、物種共存、功能性狀、種內變異、表型可塑性

Email: epingchris@gmail.com

Spatial heterogeneity of soil C and their prediction using hyperspectrum in a subtropical mixed forest in Badagongshan

Feng Liu (劉峰)*, Qianxi Li, Qinghu Jiang
Wuhan Botanical Garden

Spatial heterogeneity of soil carbon (C) in a forest is affected by many factors. To quantify the relative contributions of these factors is essential to understand the underlying ecological processes and to better design sampling regimes to accurately estimate soil C pool in forest ecosystems. In this study, we examined the spatial variation of soil C in a subtropical mixed forest, quantified the relative contributions of abiotic and biotic factors, and tried to use hyperspectral techniques to build prediction model to estimate soil C. We found a moderate spatial autocorrelation in both surface soil (0-10 cm) and subsurface soil (10-30 cm) with structural spatial autocorrelation ranged from 0.31 to 0.47. The highest contribution to SOC came from soil variables, followed by geographic space and vegetation. Topography showed weak but significant contributions. However, a large portion of variance in SOC were unexplained (46.6%). Micro-environmental variables should deserve enough attention, and a smaller-scale experimental design is needed to reveal the mechanism of SOC and STN patterns in this area in future studies. Prediction models based on Visible-near infrared (VNIR) hyperspectra of soil samples were highly accurate in estimating soil C content ($R^2 = 0.88$). However, models based on surface soils were less accurate in estimating surface soil samples ($R^2 = 0.71$), and vice versa. The accuracy can be improved by spiking and put extra weight on the spiking subset ($R^2 \sim 0.85$). Overall, soil C is highly variable in the subtropical mixed forest and a large portion of this variability is likely to be caused by micro-environmental factors. Thus, we need pay more attention for them in addressing spatial heterogeneity of soil C in forest ecosystems. VNIR spectroscopy was shown to be effective in estimating soil C content for different horizons.

Keywords: spatial heterogeneity, soil carbon, hyperspectral technique, variation partitioning

Email: liufeng@wbcas.cn

Beta diversity determinants in Badagonshan, a subtropical forest in central China

Xiujuan Qiao (喬秀娟)
Wuhan Botanical Garden

Niche and neutral theories emphasize different processes in contributing to the maintenance of species diversity. In this study, we calculated the local contribution to beta diversity (LCBD) of every cell, and used variation partitioning in combination with spatial distance and environmental variables in the 25-ha Badagongshan plot (BDGS), to determine the contribution of environmentally-related variation versus pure spatial variation. We used topography and soil characters as the environmental variables, distance-based Moran's eigenvectors maps (dbMEM) to describe spatial relationships among cells and redundancy analysis (RDA) to apportion the variation in beta diversity into four components: pure environmental, spatially structured environmental, and the pure spatial. The results showed the LCBD values were negatively related to number of common species, and positively related to number of rare species. Environments and space jointly explained ~60 % of the variation in species composition; soil variables alone explained 21.6%, which is a little bit more than the topographic variables of 15.7%; both topography and soil explained 27%, slightly inferior to spatial variables of 34%. BDGS forest was controlled both by the spatial and environmental variables, and the results were consistent across the different life forms and life stages.

Email: xjqiao@wbgcas.cn

Spatial-temporal variability of main tree species in a mixed needle-broad leaved forest in the Baotianman Nature Reserve

Ting Wang (王婷)*, Siyuan Ren, Luxin Li, Zhiliang Yuan, Yongzhong Ye
河南農業大學

Mixed-species forests sometimes give key viewpoint for understanding ecosystem functions and species coexistence mechanism. Based on two census data of a 1-hm² mixed forest plot in 2009 and 2014, spatial distribution pattern of main tree species were studied in Baotianman National Nature Reserve. Results show that (1) *Quercus aliena*, *Sorbus alnifolia*, *Acer davidii*, *Lindera obtusiloba* trees showed an aggregated distribution pattern at $r > 10$ m scale. (2) *Quercus aliena* showed density-dependent responses by using random labeling null model with a case-control design. (3) *Q. aliena* showed positive correlation with other broad species, but it also represented less correlation with larger scales. *Pinus tabulaeformis* showed negative correlation with *Q. aliena* sapling and other broad-leaf trees. It was concluded that there is density-dependent effect in this mixed needle-broad leaved forest. Intense competitions from other broad species are likely to lead to decreased spatial distribution and less future recruitment of *P. tabulaeformis*. More study and assistant restoration strategies must be employed to improve the regeneration dynamics of the forest in the future time.

Email: tingwang01@126.com

Partitioning phylogenetic and species composition in soil fungal community of a 20 ha tropical rainforest

Yue-Hua Hu (胡躍華)*, Zhen-Hua Sun, Min Cao
Key Laboratory of Tropical Forest Ecology, Xishuangbanna Tropical Botanical Garden,
Chinese Academy of Sciences

Soil fungal communities are essential to global biomass, nutrient cycling, and biodiversity, but so far the driving forces of fungal diversity patterns remain poorly unknown in most terrestrial ecosystems. We investigate the effect of biotic factors (tree community characteristics), abiotic (habitat: topographical and edaphic variables) and neutral factors (space) on species and phylogenetic beta diversity in soil fungal communities using DNA metabarcoding data from 198 soil samples in a 20-ha tropical forest plot. For species beta diversity, we found that the contribution of space and habitat were similar, the contribution of tree community were all embedded in habitat; as species moving from common to rare, the total explained variation in species beta diversity went down. For phylogenetic beta diversity of all the fungal species, the total explained variation (8.25%) were lower that of species dimension (20.24%). As a result, neutral space, biotic and abiotic factors just played a minor role in driving the soil fungal beta diversity, the pure stochastic processes maybe the major force shaping soil fungal distribution in the context of soil fungal biogeography.

Keywords: fungal diversity, species and phylogenetic beta diversity, variation partitioning

Email: huyuehua@xtbg.org.cn

Soil fauna diversity and distribution in the tropical and subtropical forests - a case study of 20-ha CTFS plot in Yunnan province, SW China

Xiaodong Yang (楊效東)*, Haifen Xiao, Zhipeng Li, Douglas Schaefer
Key Laboratory of Tropical Forest Ecology, Xishuangbanna Tropical Botanical Garden,
Chinese Academy of Sciences

Understanding biological distributional patterns at different spatial scales is a crucial issue in ecology. While nematode communities among ecosystems have been compared, little is known of relationships between environmental factors and nematode distributions at different spatial scales. Here, we employed high-throughput sequencing to compare nematode communities in tropical (Xishuangbanna) and subtropical (Ailaoshan) forest ecosystems with identical spatial sampling. Relationships between nematode communities and several environmental factors were analyzed with redundancy analysis (RDA) to find significant factors affecting nematode distributions. Our results showed that soil nematode individuals but not diversity was significantly higher in subtropical evergreen broad-leaved forest (Ailaoshan, 20-ha plot) than in tropical rain forest (Xishuangbanna, 20-ha plot) and traditional microscopic taxonomy was strongly correlated with DNA sequences obtained. Proportions of bacterial- and plant-feeding nematodes were dominant and similar in Xishuangbanna, while bacterial feeders were overwhelmingly dominant in Ailaoshan. Our results also confirmed that at regional scales, climate factors appear to dominate nematode distributions. However, terrain and soil characteristics including pH may mostly drive nematode distributions at local scales. Our sample-based nematode-family accumulation curves provide a reference for sampling strategies in future soil-nematode diversity studies in forest ecosystems. Overall, this study suggests that factors dominating nematode communities vary across spatial scales. These patterns should improve predictions of climate change and soil-property changes (such as land use) on nematode communities and soil ecological functions.

Keywords: nematode distribution, high-throughput sequencing, spatial scales, tropical and subtropical, forest ecosystems

Email: yangxd@xtbg.ac.cn

影響蓮華池動態樣區地被植物分布之環境因子與各地被植物及上層喬木相互關係之研究

張勵婉*、李沛軒、黃正良、羅士福
林業試驗所

地被植物的生物量雖僅佔整個森林植群的一小部分，但對於森林能量的循環和整個森林的營養狀況卻極為重要，了解森林中地被層植物組成、其與環境因子的相互關係，及更有助於森林動態的瞭解。本研究探討台灣中部低海拔蓮華池森林動態樣區內地被植物與環境因子之關係，提出以下幾個問題，地被植物物種的組成是否與環境因子有關？地被植物之間是否相互影響？地被層木本小苗的物種組成與上層植被物種組成相同？研究結果得出以上答案均是。將所有地被分成蕨類、草藤類(草本與藤本)、與木本小苗等 3 類。蓮華池樣區地被組成共有 247 種，其中有 65 種屬於蕨類植物，草藤類植物 77 種、木本小苗 103 種。檢測地被植物與環境因子的關係，以土壤含水率與樹冠開闊度為影響地被植物組成與分布最重要的環境因子；以全部物種數、覆蓋度、與重要值指數而言，與環境因子之土壤水分呈現顯著正相關。不同類群之間相互呈現顯著負相關。在環境因子與上層植被的綜合效應下，影響地被物種之分布。

關鍵字：蓮華池動態樣區、地被層植物、環境因子、台灣

Email: liwanc@tfri.gov.tw

The research of ant communities in the vertical structure of Lienhuachih Forest Dynamics Plot

Feng-Chuan Hsu (許峰銓)^{*1}, Chung-Chi Lin²
¹Taiwan University, ²Changhua University of Education

This research is about ant communities in the vertical structure of natural forest in Lienhuachih, Taiwan. The study area is a 0.36-ha (60×60m) sample plot at the Lienhuachih 25-ha Forest Dynamics Plot in Yuchi Township, Nantou County. We collected by Winkler bag, ground pitfall trap, and circle trunk pitfall traps set at different heights of the main trunk including 1m, 4m and the canopy on 40 trees belonging to 8 tree species. The sampling was carried out once every two months continuing for a year. A total of 72 species, 36 genera belonging to 10 subfamilies of ants were identified. There were 26 species recorded in ground pitfall trap and 31 species in Winkler bag. Two methods compensate for each other because of the low species similarity when investigating terrestrial ants. The circle trunk pitfall trap recorded 46 species, and 29 species among them were only collected on the trees taking up around 40% of the total ant species. The arboreal ant species distribution is mainly affected by food resource, physical structures and heights of trees. These factors shape arboreal ant assemblages at different layers of the forest vertical structure. We also discover that the arboreal ant, *Dolichoderus thoracicus*, which formerly distributed in disturbed places now invades natural forests by human-made facilities. This forms a competitive pressure for native arboreal ants and has strongly changed the arboreal ant assemblages. This influence to the whole forest ecosystem needs further estimation and more attention in the future.

Keywords: canopy, litter, arboreal, microhabitat, community structure

Email: d04b44002@ntu.edu.tw

Dimensions US-China Collaborative Research: how historical constraints, local adaptation, and species interactions shape biodiversity across an ancient floristic disjunction

Chengxin Fu (傅承新)^{*1}, Yunpeng Zhao¹, Pan Li¹, Zhiduan Chen², Haiyan Chu³, Soltis Pamela⁴, Jenny Xiang⁵, Gilbert Jack⁶

¹Zhejiang University, ²Institute of Botany, Chinese Academy of Sciences, ³Institute of Soil Sciences, Chinese Academy of Sciences, ⁴University of Florida, ⁵NC State University, ⁶University of Chicago

Molecular phylogenetic data, together with comparative phylogenetics, genetics and function traits can provide novel insights into biodiversity and evolution at local, regional, and global scales. However, few if any such studies have attempted to integrate plant and associated microbial diversity, as well as function, in a phylogenetic context across a major intercontinental disjunction. In this project, we propose to investigate the relationships between plant and microbial diversity and functions at multiple scales ranging from individual to community and to ecosystem via comparative analyses of selected disjunct lineages and also at 10 appropriate ecological sites. We will leverage the unique opportunities afforded by the ENA-EA floristic disjunction to establish an historical context and address integrative questions at the interface of function, phylogenetics and both microbial and plant diversity, and answer fundamental evolutionary questions regarding the maintenance and future of biodiversity at these scales. We will also investigate climate change projections to assess the possible future distributions of microbial and plant diversity in these relict forests. We will integrate these analyses across two continents that share a once continuous forest community to understand how microbial diversity varies geographically within a single forest type, how the microbial community co-diversifies with plant species, and moreover, if there are similar patterns of diversity, function, and relationships, including co-diversification, observed across the mixed mesophytic forests of ENA and EA. The results will enable the elucidation of the relative importance of historical constraints, local adaptation and species interactions in shaping diversity and function of co-distributed plant and microbial communities across EA-ENA disjunction .

Keywords: disjunction between East Asia & East North America, community phylogeny, plant and microbial species interaction, local adaptation, formation mechanism of species diversity

Email: cxfu@zju.edu.cn

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Why permanent plots in the fragmented landscapes are important?

Liu Jiajia (劉佳佳)*, Yu Mingjian
School of Life Sciences, Zhejiang University

Permanent plots have made substantial success in exploring the mechanisms of community assembly process, however, most of these plots were located in primary forest with few disturbances and may shed little light on the management of forests that we have in the real world. To date, most of our forests were deforested and fragmented, but few specific questions related to ecological process have been applied into these systems within the framework of permanent plots. To have a long term observation and better management of the forests that we have, e.g. secondary/disturbed forests, rather than only primary forests, permanent plots are required to build on addressing certain questions in the real world, such as long term effect of habitat fragmentation. Here, we take Biodiversity-Ecosystem Function research as an example, and critically review the current evidence and mechanism in BEF studies, and answer how ecological processes caused by habitat fragmentation will have direct or indirect effect on BEF relationships, to explore the future directions of BEF relationships in the fragmented landscapes. At last, we underscore the importance of building permanent plots in fragmented landscapes, such as in Thousand Island Lake.

Email: liujiajia.ecology@gmail.com

Estimating seasonal variations of leaf area index using litterfall collection and optical methods in four mixed evergreen–deciduous forests

Zhili Liu (劉志理)^{*1}, Jing M. Chen², Guangze Jin¹, Yujiao Qi¹

¹Northeast Forestry University, ²University of Toronto

Leaf area index (LAI), a critical parameter used in process models for estimating vegetation growth, can be measured through litterfall collection, which is usually referred to as a direct method. This method has been demonstrated to be applicable to deciduous forests, but few studies have used this method for estimating seasonal variations of LAI in mixed evergreen–deciduous forests. In this study, we proposed a practical method to estimate the seasonal variation of LAI directly by combining leaf emergent seasonality and litterfall collection (defined as LAI_{dir}) in a mixed broadleaved-Korean pine forest (BK), a Korean pine plantation (KP), a spruce-fir valley forest (SV), and a secondary birch forest (SB). Using the LAI_{dir} as a reference, we validated optical LAI (effective LAI, L_e) measurements through a digital hemispherical photography (DHP) and the LAI-2000 instrument. We also explored the contribution of major sources of errors to optical LAI, including woody-to-total area ratio (α), clumping index (Ω_E), needle-to-shoot area ratio (γ_E) and automatic exposure (E). We determined that DHP L_e underestimated LAI_{dir} from May to November by 48–64% in BK, KP and SV but overestimated LAI_{dir} by 7% on average in SB. Similarly, LAI-2000 L_e also underestimated LAI_{dir} by an average of 27–35% in BK, KP and SV but overestimated LAI_{dir} by 22% on average in SB. The relative contribution of E to the error in DHP L_e is larger than other factors, and the E was the largest relative contributor to the underestimation of LAI by LAI-2000. These results demonstrate that seasonal variations of LAI in mixed evergreen-deciduous forests can be optically estimated with high accuracy (85% for DHP and 91% for LAI-2000), as long as accurate corrections are made to the various factors mentioned above. These close agreements between direct and optical LAI results also suggest that the direct method developed in this study is useful for tracking the seasonal variation of LAI in mixed forests.

Keywords: leaf area index, leaf phenology, seasonal variation, litterfall collection, digital hemispherical photography (DHP), LAI-2000

Email: liuzl2093@126.com

大興安嶺興安落葉松林 25-ha 樣地研究進展

倪紅偉、朱道光*、崔福星、柴春榮、李金博
黑龍江省科學院自然與生態研究所

大興安嶺興安落葉松 (*Larix gmelinii*) 林 25-ha 樣地建於 2011-2014 年，位於大興安嶺北部伊勒呼裡山北坡，具有中國東北大興安嶺植物區系寒溫帶地帶性典型植被，地理位置 51°49'N, 122°59'E。樣地地形平緩，海拔為 847~974 m，最大高差 16.6 m，年均氣溫 -4 °C，年均降水量 458.3 mm，年相對濕度平均為 71%，年蒸發量平均為 911 毫米。樣地初次普查結果表明，樣地群落結構比較簡單，樣地群落以興安落葉松為主要優勢種的寒溫帶針葉林，呈現出的寒溫帶針葉林植被的景觀特點；並形成蘚類—興安落葉松林、草類—興安落葉松林、杜香 (*Ledum palustre*)—興安落葉松林和興安杜鵑 (*Rhododendron dauricum*)—興安落葉松林 4 種主要群落類型。樣地內共有 DBH > 1 cm 的木本植物 41 種，其中喬木 4 種，灌木 37 種，草本 127 種，隸屬於 21 科 39 屬。獨立個體數為 209785 株。樣地內最大胸徑為 52 cm，平均胸徑 3.87 cm，胸高斷面積 20.93 m²/ha。2014-2015 年開展的監測項目包括：

- 1) 設置 150 個 0.5 m² 的種子接收器和 450 個 1 m × 1 m 幼苗樣方，進行種子、凋落物和幼苗的動態；
- 2) 設置 32 部遠紅外相機，進行動物活動監測；
- 3) 寒溫帶森林生物多樣性維持機制；
- 4) 寒溫帶森林溫室氣體 (CO₂; CH₄; N₂O) 排放及其環境效應；
- 5) 寒溫帶森林雪生態學部分內容研究。

關鍵字：興安落葉松林、物種組成、土壤溫室氣體、雪被

Email: zhudg01@163.com

Structure and species composition of wood plant communities on lands-bridge islands: research of habitat fragmentation effect based on forest dynamic plots

Jinliang Liu (劉金亮)¹, Jinfeng Yuan¹, Guang Hu², Mingjian Yu^{*1}

¹Zhejiang University, ²Zhejiang Sci-Tech University

Habitat destruction and fragmentation are widely recognized as leading threats to biodiversity, especially with the intensification of land use. Understanding how long-term habitat fragmentation influences community structure, species composition and their dynamics, and the underlying drivers is very necessary. Habitat area and isolation are regarded as two main factors affecting biodiversity and ecosystem functioning in fragmented landscapes. Thousand Islands Lake (TIL), a man-made lake with more than 1000 land-bridge islands, was formed by construction of the Xin'anjiang dam on the Xin'anjiang River in 1959. TIL is regarded as a model system for studying habitat fragmentation, with homogeneous and inhospitable matrix (water), distinct habitat boundaries, and simultaneous forming islands. Forests in the TIL region were clear-cut during dam construction and the current dominant pine forests on islands are predominantly the result of approximately 50 years of natural succession. During 2009 and 2010, 20 small islands (< 1 ha), 6 intermediate islands (1 to 10 ha) and 3 large islands (> 10 ha) were selected to monitor the relationship of forest community structure, species composition with island spatial attributes. We selected the entire island of small islands and established 0.5-1 ha forest dynamics plots of intermediate and large islands, and total area of the plots was around 13 ha. All woody plants with diameter at breast height (DBH) \geq 1 cm on the study islands/plots were tagged, measured, identified and stem-mapped. We also established one 1 ha forest dynamics plot as a control on the mainland in 2012. In total, we recorded 78 species with 186842 individuals and 57 species with 10867 individuals of woody plant on the study islands and in the mainland plot, respectively. Both species richness and stem density were positively increasing with the increase of islands area. Large islands owned more saplings and adult trees and shade-tolerant species than small islands. Besides, *Pinus massoniana*, *Loropetalum chinense*, *Vaccinium carlesii* and *Rhododendron simsii* were the most abundant species on all islands, suggesting the species composition on the TIL islands apparently differed from nearby secondary and primary broad-leaved forests. These preliminary results indicated that island area as an indicator of fragmentation effect obviously affected the structure and species composition of woody plants. In addition, the forest succession may also be impacted by fragmentation.

Keywords: species composition, abundance, forest fragmentation, succession, Thousand Island Lake

Email: fishmj202@hotmail.com

Pollen and seed flow under different predominant winds in wind-pollinated and wind-dispersed species *Engelhardia roxburghiana*

Zheng-Feng Wang (王崢峰)*, Ju-Yu Lian, Wan-Hui Ye, Hong-Lin Cao, Qian-Mei Zhang,
Zhang-Ming Wang

Key Laboratory of Vegetation Restoration and Management of Degraded Ecosystems &
Guangdong Provincial Key Laboratory of Applied Botany, South China Botanical Garden,
Chinese Academy of Sciences

In most plants, the contributions of pollen and seed flows to their genetic structures are generally hard to disentangle. For a typical wind-pollinated and wind-dispersed species *Engelhardia roxburghiana* in a 20-ha natural forest plot in lower subtropic China, because the prevailing wind directions change during its pollen release and seed dispersal seasons, we could compare its genetic structures in different directions which might have been resulted primarily from pollen or seed flow. Furthermore, because the plot underwent from an open to a close canopy stage historically, we also examined forest canopy effects on gene flow in different generations and different directions. Using 522 *E. roxburghiana* individuals mapped in the plot, our results revealed greater pollen flow created biased gene flow in pollen dispersal predominated direction (pollen direction), while greater seed flow generated lessened spatial genetic structure in seed dispersal predominated direction (seed direction). The results predicted from generalised additive models indicated canopy closure enhanced resistance to gene flow from old generation to new generation. Analyses by landscape genetic models for the new generation revealed that gene flow associated with pollen direction was more strongly affected by canopy than that with seed direction. Our study is new by proposing an alternative way to separate effects of the pollen and seed flow on spatial variation patterns in *E. roxburghiana*. To our knowledge, our study is also the first attempt to use landscape genetic models to represent canopy effects for different dispersal vectors in spatial scales only up to a few hundred meters.

Email: wzf@scib.ac.cn

The effects of seed dispersal and predation on resource allocation in fruit parts

Yu-Fen Lin (林妤芬)*, Yu-Yun Chen
Dong Hwa University

To increase reproductive success, plants have to maximize dispersal efficiency and minimize predation through allocating fruit parts. However, there are trade-offs between resource allocation in dispersal trait, defense trait and true seed in fruits. How much resource should plant invest on seed within a single fruit depend not only on the physiological constrain but also the interaction between dispersal and predation selective pressure. Here, we hypothesized that the selective forces of seed dispersal and predation influence fruit evolution, determining resource allocation in different fruit parts via enhancement seed/seedling survivorship. We investigated the relationships of the ratios of dispersal trait-to-seed and defense trait-to-seed to seed dispersal distances and seed predation rates. We predict that species with higher dispersal trait-to-seed ratio could spread far; species with higher defense trait-to-seed ratio should exhibit lower seed predation rate in average. The preliminary results showed that both the ratios of dispersal trait-to-seed and defense trait-to-seed were significantly different among species; the dispersal trait correlated seed mass positively.

Keywords: fruit trait, seed dispersal distance, seed predation rate

Email: elviefen@gmail.com

台灣南仁山低地雨林地區非生物及生物因子對於小苗存活之影響

林詠喬*¹、趙國容¹、宋國彰²

¹中興大學國際農業學程、²中興大學水土保持學系

在森林動態中，小苗在植群更新佔據重要地位。木本植物從種子至成熟個體的各階段，都受到許多環境及生物因子限制其存活，而小苗在植物成長階段是最為敏弱的時期，因此植物植群動態多在此時期決定。本研究 2009 年十月至 2012 年一月間，於台灣南仁山森林動態樣區系統取樣 38 個樣方，每個樣方取樣 1 至 2 個小苗樣方，進行小苗存活的限制因子調查(n = 75)，包含季節變異、年間變異、空間微環境、以及生物互動等。結果顯示，每月落葉輸入量愈高，小苗存活率愈低，且小苗遭到動物咬食與落葉覆蓋時，存活的機率也降低，然而，值得注意的是，地被植被遮光度愈高與初生高度愈高則小苗存活的機率愈大。此結果可能與高地被植物覆蓋度會攔截上方凋落物，或因而減少了中型野生動物的干擾有關。在了解小苗存活因子的限制後，期待未來可透過改變限制因子來改變森林的結構與組成，提供森林經營及復育上的參考價值。

關鍵字：南仁山、森林動態、木本小苗、存活限制因子

Email: chiau8526g@gmail.com

梅花鹿啃食對木本植物更新之影響 - 墾丁森林動態樣區圍籬實驗結果初探

呂俊緯*、蕭逸柔、陳淮實、張楊家豪、傅詠豪、林宜靜
東海大學生命科學系

瞭解草食動物對於植物群聚的影響，是群聚生態學的重要議題。尤其，鹿科動物在許多生態系中，扮演關鍵物種的角色，對於植物群聚的多樣性，具有決定性的影響。近年來，墾丁森林動態樣區內，梅花鹿 (*Cervus nippon taiouanus*) 的族群數量日漸增加，可能影響該樣區之植物群聚的組成與動態。本研究透過操作型實驗，評估梅花鹿對木本植物小苗更新與存活之影響。我們於 2014 年 12 月，在墾丁森林動態樣區周邊，架設 15 個圍籬，並在圍籬內設立 6 x 6 公尺的樣方。除此之外，我們在圍籬附近，設立等面積與等數量的控制組樣方。自 2015 年 1 月起，每隔三個月，記錄樣方內，高於 10 公分木本植物小苗之物種、位置與高度。首次調查總計發現 1191 棵小苗，並鑑定出 31 物種，數量前三名依序為：紅柴、大葉楠、毛柿。在三個月之間，圍籬內小苗之存活率顯著較控制組小苗高，且圍籬內的新增小苗數量，顯著較高。初步結果顯示，梅花鹿對森林更新具有顯著影響。未來將持續監測，希望藉此能掌握鹿科動物對森林造成的危害或效益。

關鍵字：喀斯特森林、動植物交互關係、梅花鹿復育計畫

Email: s1012524@thu.edu.tw

海報展示摘要

A brief introduction of 25 ha dynamics plot in the karst mixed evergreen and deciduous broad leaf forest in Mulun, Guangxi

Fu-Ping Zeng (曾馥平)*, Tong-Qing Song, Wan-Xia Peng, Hu Du
Institute of Subtropical Agriculture, Chinese Academy of Sciences

Southwest China is one of the largest karst regions in the world and is considered fragile because of its special geological background with a small environmental carrying capacity and anti-interference capacity. Vegetation in this region has a unique adaptation to drought conditions, establishment on rocky surfaces, and excessive soil calcium. The climax community is azonal limestone mixed evergreen and deciduous broadleaf forest. The 25-ha Dynamic Plot (25°8'N, 108°0'E) of Mulun Karst Mixed Evergreen and Deciduous Broad Leaf Forest was established by the Institute of Subtropical Agriculture, CAS, in 2014, located in Mulun National Nature Reserve of Huanjiang County, Guangxi Province. The goal is to provide basic information to further our understanding of biodiversity mechanism in the subtropics of China. The altitude of the plot ranged from 442.6 to 651.4 m, and the average soil thickness is 28.6 cm. Based on the standard of CTFS, all individuals with DBH (diameter at breast height) ≥ 1 cm were tagged, mapped and identified to species in this plot. A total of 101 598 individual trees (133 796 individual with branch) were recorded in the plot. *Cryptocarya austroweichouensis*, *Itoa orientalis*, *Eurycorymbus cavaleriei*, *Platycarya longipes*, *Radermachera sinica*, *Boniodendron minius*, *Cladrastis platycarpa*, *Bridelia tomentosa* are the most dominant species. The soil pH is high with small variation, while the SOC, TN, TP, and TK showed moderate variation. Exponential model fitted best for these soil indexes. Soil pH and SOC showed moderate spatial correlation, while other soil variables show strong spatial correlation. Soil pH, SOC, and TN had distribution pattern of low in lower slope and high in upper slope, TP and TK presented fragmented patch distribution. RDA showed that soil SOC, TN had an opposite association with soil thickness, TP and TK showed negative correlations with altitude, and pH showed positive correlation with slope.

Keywords: brief introduction, Mulun dynamic forest plot, subtropical monsoon climate zone, karst mixed evergreen and deciduous broad leaf forest

Email: fpzeng@isa.ac.cn

Studying species diversity and its linkage to ecosystem functions in the Fushan Experimental Forest, Taiwan – a long-term ecological study via a forest dynamics plot

Yi-ching Lin (林宜靜)^{*1}, Jyh-Min Chiang¹, Sheng-Hsin Su², I-Fang Sun³
¹Tunghai University, ²Taiwan Forestry Research Institute, ³Dong Hwa University

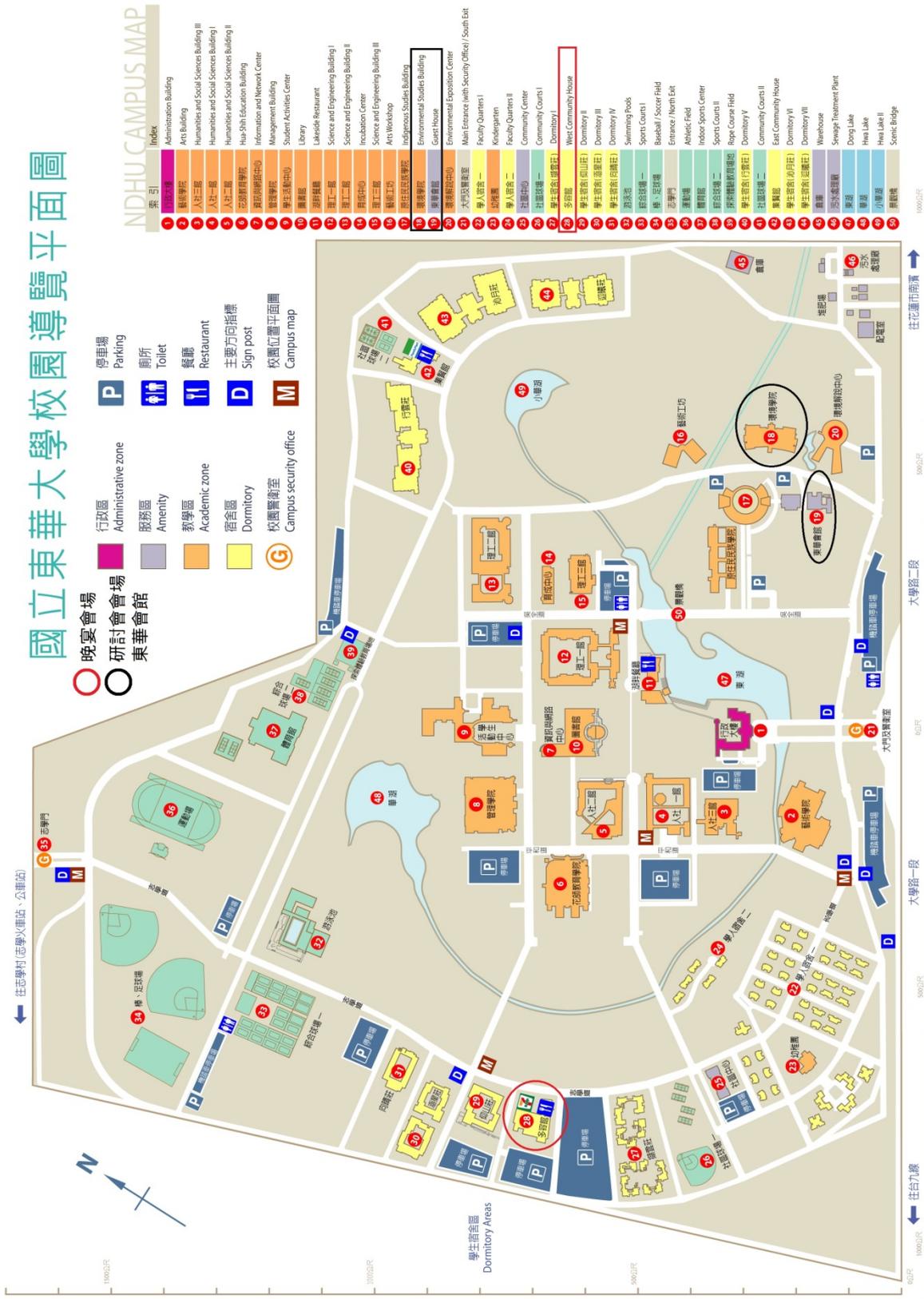
The high diversity of tree species in tropical forests has intrigued ecologists for a long time. Understanding mechanisms of species coexistence and the impact of species diversity on ecosystem functions have been important themes in modern ecology. To appropriately address this question, a large-scale, long-term and spatially-explicit approach is necessary. A series of forest dynamics plots, therefore, have been established worldwide since 1980s, including Taiwan. A 25-ha forest dynamics plot was established in the Fushan LTER site, Taiwan in 2003. In the forest dynamics plot, all woody stems greater than 1 cm in diameter at breast height (DBH) were identified, tagged and mapped and recensus every five years. Three tree censuses were completed since 2003 (2003, 2008 and 2013). Using available census data, we investigated spatial and temporal variability in tree abundance and functional traits to identify potential mechanisms of species coexistence. We also explored relationships between species richness and aboveground biomass. Our analyses suggested that habitat preference and habitat filtering could be critical mechanisms for species coexistence in the Fushan Experimental Forest. Especially, habitat-specific mortality rates were detected in Fushan and suggested strong filtering effects imposed by habitats. In the Fushan Forest, aboveground biomass increased with convexity and stem density. However, there is no significant relationship between species richness and aboveground biomass. The long-term data at the Fushan LTER site revealed that topography is critical in maintaining species diversity in the forest. It may influence ecosystem functions. In this study, we demonstrated a case study in which census data of forest dynamics plots provided a unique opportunity for long-term ecological research.

Keywords: forest dynamics, Fushan, International Long-Term Ecological Research (ILTER), Taiwan Ecological Research Network (TERN)

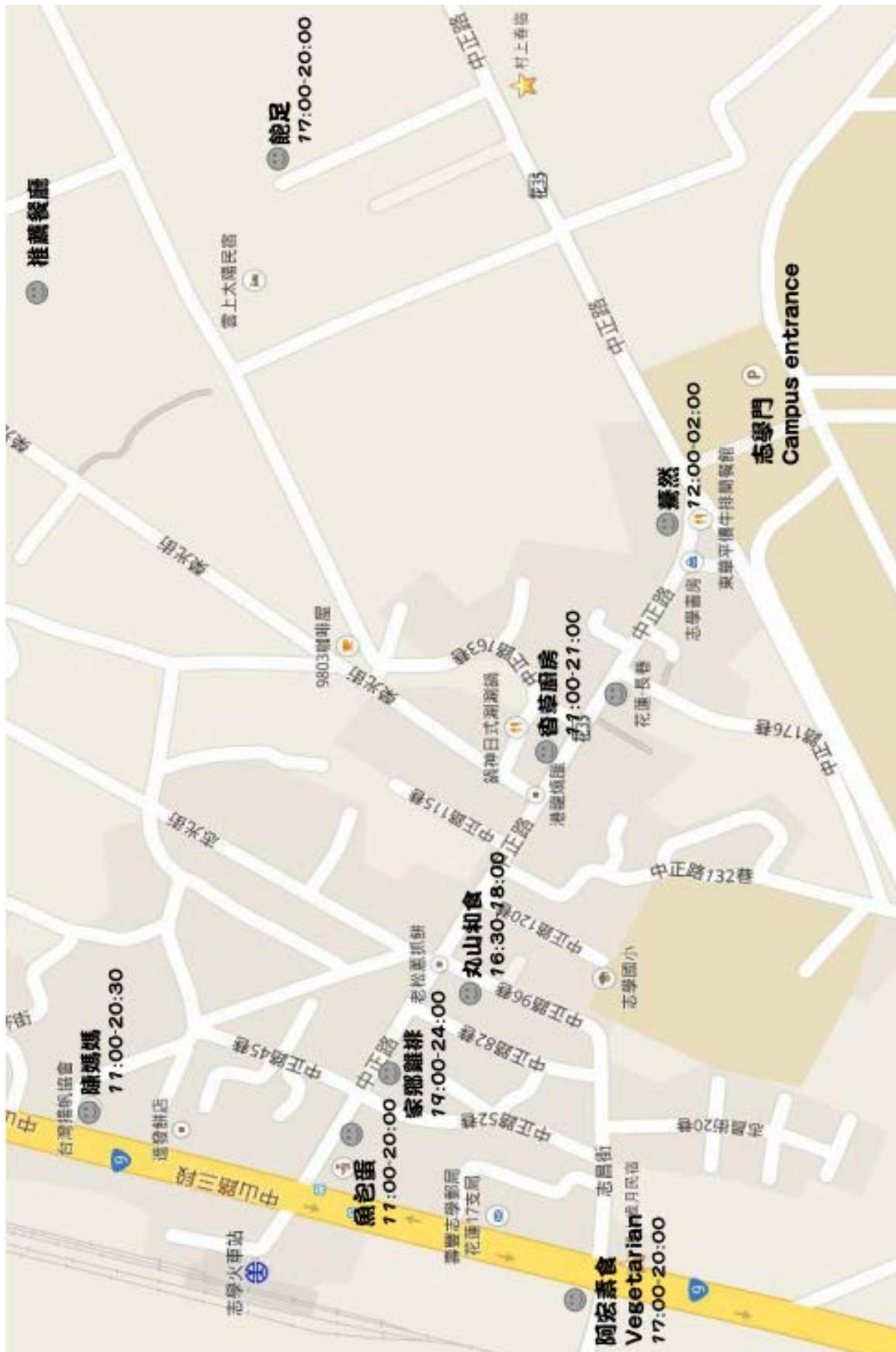
Email: yichingtree@gmail.com

東華大學地圖

國立東華大學校園導覽平面圖



志學街附近用餐地圖



與會者名單

序號	姓名	服務單位	職稱	聯絡資訊
1	馬克平	中國科學院植物研究所	研究員	kpma@ibcas.ac.cn
2	張守仁	中國科學院植物研究所	研究員	zsr@ibcas.ac.cn
3	任海保	中國科學院植物研究所	助理研究員	renhb@ibcas.ac.cn
4	朱麗	中國科學院植物研究所	助理研究員	julie@ibcas.ac.cn
5	蘇宏新	中國科學院植物研究所	工程師	hxsu@ibcas.ac.cn
6	郭靜	中國科學院植物研究所	碩士生	guojing13@mails.ucas.ac.cn
7	倪紅偉	黑龍江省科學院自然與生態研究所 黑龍江省政協委員，民盟省委常委	研究員	Nihongwei2000@163.com
8	朱道光	黑龍江省科學院自然與生態研究所	副研究員	zhudg01@163.com
9	柴春榮	黑龍江省科學院自然與生態研究所	副研究員	chaicr2012@163.com
10	崔福星	黑龍江省科學院自然與生態研究所	助理研究員	39850192@qq.com
11	趙增福	黑龍江呼中國家級自然保護區管理局	局長	zhaozengf@sohu.com
12	劉永志	黑龍江呼中國家級自然保護區管理局	副局長	zrbhj_2000@163.com
13	畢連柱	黑龍江豐林國家級自然保護區管理局	研究員級高級工程師	bilianzhu@126.com
14	宋國華	黑龍江豐林國家級自然保護區管理局	高級工程師	flsgh@126.com
15	金光澤	東北林業大學	教授	taxus@126.com
16	劉志理	東北林業大學	博士生	liuzl2093@126.com

序號	姓名	服務單位	職稱	聯絡資訊
17	葉 吉	中國科學院瀋陽應用生態研究所	副研究員	yeji1011@163.com
18	原作強	中國科學院瀋陽應用生態研究所	副研究員	yuanzq825@126.com
19	藺 菲	中國科學院瀋陽應用生態研究所	助理研究員	
20	齊 光	平頂山學院	講師	qiguang594@163.com
21	王 婷	河南農業大學	副教授	tingwang01@126.com
22	袁志良	河南農業大學	副教授	18637107347@163.com
23	劉 峰	中國科學院武漢植物園	研究員	liufeng@wbgas.cn
24	盧志軍	中國科學院武漢植物園	副研究員	luzj@wbgas.cn
25	喬秀娟	中國科學院武漢植物園	副研究員	xjqiao@wbgas.cn
26	黨海山	中國科學院武漢植物園	副研究員	dangkey@wbgas.cn
27	沈國春	華東師範大學	副教授	gcshen@des.ecnu.edu.cn
28	楊慶松	華東師範大學	講師	
29	黃忠良	中國科學院華南植物園	研究員	Huangzli@scbg.ac.cn
30	王崢峰	中國科學院華南植物園	研究員	wzf@scib.ac.cn
31	劉 衛	中國科學院華南植物園	副研究員	liuwei@scib.ac.cn
32	歐陽學軍	鼎湖山國家級自然保護區	副研究員	ouyxj@scbg.ac.cn
33	楊效東	中國科學院西雙版納熱帶植物園	研究員	yangxd@xtbg.ac.cn

序號	姓名	服務單位	職稱	聯絡資訊
34	林露湘	中國科學院西雙版納熱帶植物園	副研究員	linluxa@xtbg.ac.cn
35	胡躍華	中國科學院西雙版納熱帶植物園	助理研究員	huyuehua@xtbg.org.cn
36	孫振華	中國科學院西雙版納熱帶植物園	助理研究員	
37	張文富	中國科學院西雙版納熱帶植物園	助理工程師	zwf@xtbg.org.cn
38	高連明	中國科學院昆明植物所	研究員	gaolm@mail.kib.ac.cn
39	曾馥平	中國科學院亞熱帶農業生態研究所	科技管理與規劃處處長	fpzeng@isa.ac.cn
40	宋同清	中國科學院亞熱帶農業生態研究所	研究員	songtongq@isa.ac.cn
41	彭晚霞	中國科學院亞熱帶農業生態研究所	副研究員	wxpeng@isa.ac.cn
42	杜 虎	中國科學院亞熱帶農業生態研究所	助理研究員	hudu@isa.ac.cn
43	于秀波	地理科學與資源研究所	研究員	yuxb@igsnr.ac.cn
44	傅承新	浙江大學生命科學學院	教授	cxfu@zju.edu.cn
45	趙雲鵬	浙江大學生命科學學院	副教授	ypzhao@zju.edu.cn
46	劉佳佳	浙江大學生命科學學院	博士後	liujiajia.ecology@gmail.com
47	劉金亮	浙江大學生命科學學院	博士生	jinliang.liu@foxmail.com
48	李 攀	浙江大學生態研究所	講師	68128249@qq.com
49	劉如章	中華紙漿公司農林課	專員	rjliou.chp@yfy.com
50	林宜靜	東海大學	副教授	yichingtree@gmail.com
51	傅永豪	東海大學	研究助理	cicinnurus@hotmail.com

序號	姓名	服務單位	職稱	聯絡資訊
52	呂俊緯	東海大學	學生	s1012524@thu.edu.tw
53	姜介民	東海大學	學生	insbbt@yahoo.com.tw
54	蘇靖雅	東海大學	學生	fairy891@gmail.com
55	姚筑云	東海大學	學生	s1022540@gmail.com
56	陳淮實	東海大學	學生	angusxd@yahoo.com.tw
57	陳利菁	東海大學	學生	s1022541@thu.edu.tw
58	葉騏瑞	東海大學	學生	psna91@gmail.com
59	蕭逸柔	東海大學	學生	s1012541@thu.edu.tw
60	王相華	林業試驗所	研究員	hhwang@tfri.gov.tw
61	王巧萍	林業試驗所	副研究員	cpwang@tfri.gov.tw
62	張勵婉	林業試驗所	助理研究員	liwanc@tfri.gov.tw
63	楊蒼叡	林業試驗所	助理研究員	pkray@tfri.gov.tw
64	伍淑惠	林業試驗所	助理研究員	wsh@tfri.gov.tw
65	葉定宏	林業試驗所	助理研究員	yehdh@tfri.gov.tw
66	陳可芳	林業試驗所	研究助理	ckf@tfri.gov.tw
67	金恒鏞	珍古德教育及保育協會	理事長	henbiau.king@gmail.com
68	范素瑋	特有生物研究保育中心	助理研究員	suweifan@tesri.gov.tw
69	蔣寶慧	特有生物研究保育中心	臨時工	grecy31@gmail.com

序號	姓名	服務單位	職稱	聯絡資訊
70	蔡昀芸	高雄醫學大學	學生	snoopy071716@gmail.com
71	林詠喬	中興大學	碩士生	chiau8526g@gmail.com
72	謝長富	臺灣大學	教授	tnl@ntu.edu.tw
73	許峰銓	臺灣大學	博士生	d04b44002@ntu.edu.tw
74	黃 生	臺灣師範大學	教授	biofv057@ntnu.edu.tw
75	郭奇芊	臺灣師範大學	助理教授	cckuo@ntnu.edu.tw
76	王露翊	臺灣師範大學	碩士生	lu1200120012011@gmail.com
77	唐聖凱	臺灣師範大學	學生	kwz50902@gmail.com
78	洪宗泰	宜蘭大學	研究助理	k465fd4gfd@yahoo.com.tw
79	許 驊	宜蘭大學	研究助理	s810506@gmail.com
80	涂瀚銓	宜蘭大學	學生	fujj89109@gmail.com
81	裴家騏	東華大學	院長	kcjpei@mail.ndhu.edu.tw
82	孫義方	東華大學	教授	ifsun@mail.ndhu.edu.tw
83	夏禹九	東華大學	教授	yjhsia@mail.ndhu.edu.tw
84	張世杰	東華大學	副教授	scchang@mail.ndhu.edu.tw
85	陳毓昀	東華大學	副教授	ychen@mail.ndhu.edu.tw
86	潘郁雯	東華大學	研究助理	gattopan@gmail.com
87	饒益品	東華大學	研究助理	epingchris@gmail.com

序號	姓名	服務單位	職稱	聯絡資訊
88	賴正偉	東華大學	研究助理	david_lai@seed.net.tw
89	張至善	東華大學	博士生	woods@nmp.gov.tw
90	王瓊芯	東華大學	博士生	s24105.wang@gmail.com
91	Kanokporn Kaewsong (Ar)	東華大學	博士生	kaewsong_k@hotmail.com
92	Yanakho Naruemon (Naja)	東華大學	碩士生	coyoty_xl@hotmail.com
93	Ridmontree Nachanok (Bow)	東華大學	碩士生	bownachanok7536@gmail.com
94	林好芬	東華大學	碩士生	elviefen@gmail.com
95	Jennifer	東華大學	學生	shopaholic4--@hotmail.com
96	袁尚謙	東華大學	學生	pk4638453@gmail.com
97	梁雅婷	東華大學	學生	lyting0910@gmail.com
98	邱雅莘	東華大學	學生	410254015@ems.ndhu.edu.tw
99	葉又仁	東華大學	學生	410154075@ems.ndhu.edu.tw
100	徐曼薰	東華大學	學生	410354041@ems.ndhu.edu.tw
101	黃慈惠	東華大學	學生	410354046@ems.ndhu.edu.tw
102	林苡晴	東華大學	學生	410354043@ems.ndhu.edu.tw
103	留裕凱	東華大學	學生	kai140527@gmail.com
104	楊佩縝	東華大學	學生	410154048@ems.ndhu.edu.tw
105	吳沛城	東華大學	學生	410354005@ems.ndhu.edu.tw

序號	姓名	服務單位	職稱	聯絡資訊
106	呂佳燁	東華大學	學生	stnina98@gmail.com
107	廖苡珊	東華大學	學生	613lys@gmail.com
108	劉旻瑜	東華大學	學生	410254030@ems.ndhu.edu.tw
109	程意華	東華大學	學生	mynameistanya831@gmail.com
110	劉俊佑	東華大學	學生	410211238@ems.ndhu.edu.tw
111	秦書群	東華大學	學生	410154022@ems.ndhu.edu.tw
112	甘浩廷	東華大學	學生	opensos36@gmail.com
113	盧鎔邑	東華大學	學生	410154037@ems.ndhu.edu.tw
114	汪品姘	東華大學	學生	410254032@ems.ndhu.edu.tw
115	邱春火	清華大學	助理研究員	entropy4337@gmail.com
116	趙偉村	嘉義大學	助理教授	wcchao@mail.ncyu.edu.tw
117	古鎮嘉	嘉義大學	碩士生	jjakon11@gmail.com
118	廖捷妤	嘉義大學	碩士生	dovikkiself@gmail.com
119	李曜彰	嘉義大學	學生	jcjh30101@gmail.com
120	蔡佩芳	嘉義大學	學生	jjakon11@gmail.com
121	陳雯美	臺北護理健康大學	學生	nicole6366@gmail.com

筆記頁

筆記頁
