Chinese Forest Biodiversity Monitoring Network (CForBio) 2017

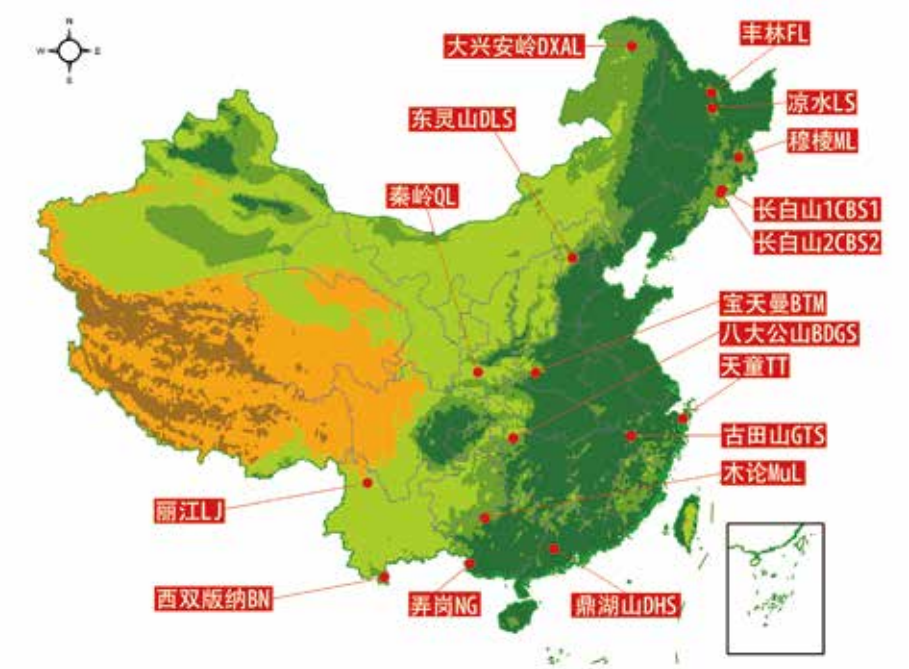
CForBio

CNC-DIVERSITAS

Chinese Forest Biodiversity Monitoring Network (CForBio)2017

Chinese Forest Biodiversity Monitoring Network,CForBio

http://www.cfbiodiv.org



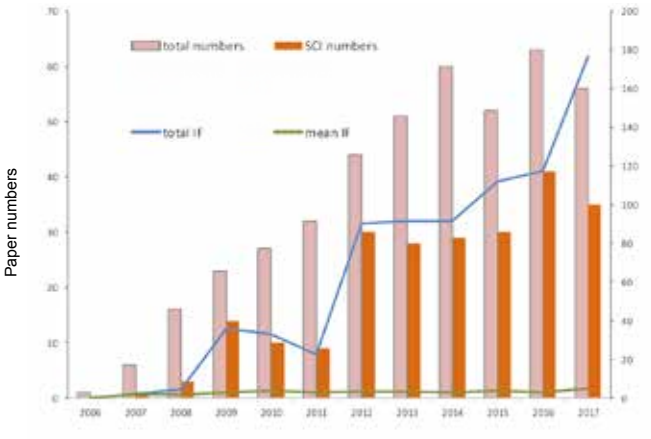
I. A Brief Introduction of Chinese Forest Biodiversity Monitoring Network (CForBio)

Organized by Biodiversity Committee, Chinese Academy of Sciences, collaborated with institutes and universities, the Chinese Forest Biodiversity Monitoring Network (CForBio, http://www.cfbiodiv.cn) was established in 2004, aiming to monitor the long-term changes of the biodiversity of main forests in China, study the changes and maintenance mechanism of forest biodiversity, such as community assembly and species co-existence mechanism. CForBio is the most active part of Chinese Biodiversity Observation and Research Network (Sino BON) and global forest biodiversity monitoring network (CTFS-Forest GEO). It covers zonal forest types in major climate zones in China, including cold temperate boreal forests, temperate coniferous and broadleaved mixed forests, warm temperate deciduous broadleaved forests, subtropical evergreen broadleaved forests and tropical rain forests.

Distinct progress of research on mechanisms of species co-existence and community assembly has been made in recent years, becoming a symbolic achievement in community ecology. Approaches of large permenant forest dynamics plots provide unique platform for mechanism studies. By the end of 2017, 17 permanent forest dynamics plots and more than 50 associated plots with the size 1 ha or larger have been set up for CForBio. The total plot area is 513.6 ha. 2,209,400 individuals belonging to 1,614 species (DBH≥1 cm) were recorded. Among these 17 plots, 12 plots were established by institutes of CAS, and the rest by East China Normal University (Tiantong plot), Northeast Forestry University (Fenglin Plot and Liangshui Plot), Institute of Natrual Resources and Ecology, Heilongjiang Academy of Sciences (Daxing'anling plot) and Heilongjiang Forest Engineering and Environmental Research Institute (Muling plot).

1) 25-ha dahurian larch forest plot in Daxing'an Mountain in Heilongjiang Province
2) 30-ha broadleaved-Korean pine mixed forest plot at Fenglin in Xiaoxing'an Mountain in Heilongjiang Province
3) 9-ha broadleaved-Korean pine mixed forest plot and 9 ha spruce-fir valley forest plot at Liangshui in Xiaoxing'an Mountain in Heilongjiang Province
4) 25-ha *Taxus cuspidata forest* plot at Muling in Heilongjiang Province
5) 25-ha deciduous broadleaved-Korean pine mixed forest plot at Changbai Mountain in Jilin Province
6) 24-ha poplar-birch forest plot at Changbai Mountain in Jilin Province
7) 20-ha warm temperate deciduous broadleaved forest plot at Dongling Mountain in Beijing
8) 25-ha deciduous broadleaved forest plot in a temperate-subtropical ecological transition zone at Qinling in Shannxi Province
9) 25-ha warm temperate deciduous broadleaved forest plot at Baotianman in Henan Province
10) 25-ha mid-subtropical mountain evergreen and deciduous broadleaved mixed forest plot at Badagong Mountain in Hunan Province
11) 20-ha subtropical evergreen broadleaved forest plot at Tiantong Mountain in Zhejiang Province
12) 24-ha subtropical evergreen broadleaved forest plot at Gutian Mountain in Zhejiang Province
13) 20-ha lower subtropical evergreen broadleaved forest plot at Dinghu Mountain in Guangdong Province
14) 25-ha cold-temperate spruce-fir forest plot at Yulong Snow Mountain in Yunan Province
15) 25-ha karst evergreen and deciduous broadleaved mixed forest plot at Mulun in Guangxi Zhuang Autonomous Region
16) 15-ha karst seasonal rain forest plot at Nonggang in Guangxi Zhuang Autonomous Region
17) 20-ha tropical rain forest plot at Xishuangbanna in Yunnan Province

The same methods followed CTFS procedures were used to collect data across all of the forest plots in the CForBio. Each plot was divided into 20 m×20 m quadrats with total station. All free-standing trees at least 1 cm in diameter at breast height were tagged, measured and identified to species, and their geographical coordinates were recorded for long term monitoring. Besides the recensus every 5 years, monitoring on seed rains, seedlings, litterfalls, functional traits, breast diameters with dendrometers, herbs, soil, logs and wildlife have been carried out. Recently, researches on near-surface remote sensing and canopy biodiversity monitoring have been embarked on some CForBio plots.



Annual trends of paper publishing

In the past ten years, studies on the monitoring of population structure, dynamics of plants, animals and microbes, their interactions, and the exploration of their internal mechanism continued, CForBio has become the most influential and fastest-growing regional research platform. Based on data cross climatic spectrum in CForBio, 431 scientific articles have been published, including 231 papers in SCI journals, such as Ecology Letters, Ecology and so on, for which more than 750 authors from over 260 worldwide institutions have been involved. The research results on the mechanism of species coexistence were given positive evaluations in Nature and other journals by colleagues worldwide. Meanwhile, the rapid development of CForBio has also stimulated the ministries for forestry, environmental protection and education of China to carry on biodiversity monitoring projects.

II. Important Progress

1. Plot Maintenance

Routine monitoring:

The annual monitoring of seedlings, seeds and litters were completed by all plots.

Plot re-census and construction

Six asscociate plots belonging to 25-ha deciduous broadleaved-Korean pine mixed forest plot at Changbai Mountain finished the first re-census; 20-ha tropical rain forest plot at Xishuangbanna completed its second re-census of field work. Associate plots around tower crane were estabished in Changbai Mountain deciduous broadleaved-Korean pine mixed forest plot, Dinghu Mountain plot and Lijiang Yulong Mountain plot.

Monitoring of tree diameter growth

The tree breast diameters monitoring with dendrometers were also carried out in Changbai Mountain deciduous broadleaved-Korean pine mixed forest plot, Badagong Mountain plot, Gutian Mountain plot, and Xishuangbanna plot, which recorded 1,637, 5,588, 4,003, 3,800, and 2,175 tree individuals, respectively, 17,203 individuals in total. 747 tree-ring samples were taken from Changbai Mountain deciduous broadleaved-Korean pine mixed forest plot.

Functional traits measurement

To further explain the mechanisms of species co-existence and community assembly, besides Changbai Mountain deciduous broadleaved-Korean pine mixed forest plot, Dongling Mountain plot, Gutian Mountain plot, Nonggang plot and Xishuangbanna plot, the functional traits were also measured in Liangshui broadleaved-Korean pine mixed forest plot, Badagong Mountain plot and Dinghu Mountain plot this year.

Overseas expansion

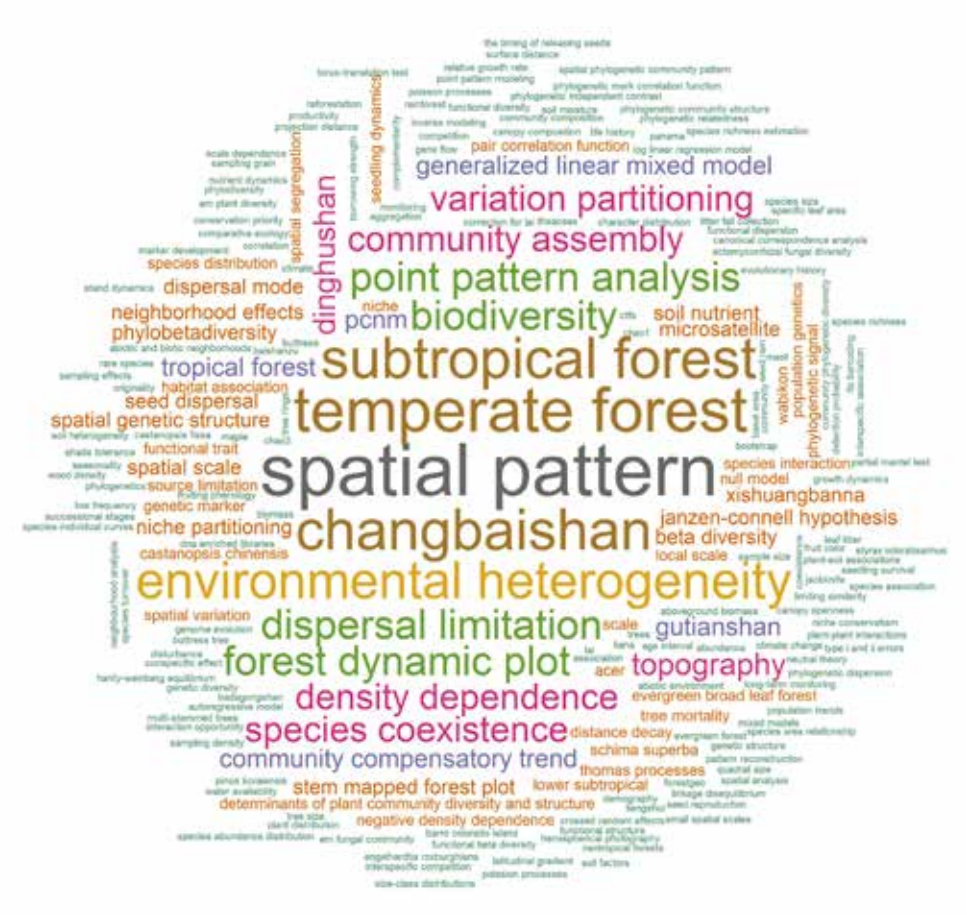
The collaboration with Thailand was promoted by Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences. Southwest China-Central South Peninsula forest dynamics plot network including 10 large permenant forest plots have been preliminarily formed, which expanded CForBio to Central South Peninsula. About 3000 species and 1 million individuals were recorded. This regional network is a complement to CForBio for the tropical rain forest.

2. Important Research Progress

Based on the monitoring data in CForBio, research on functional traits, community phylogenetics, community structure, spatial pattern, forest dynamics and community genomics were carried out. The understanding of species diversity and mechanisms of coexistence have been promoted, and important findings and progress have also been obtained. With the platform, research on camera traps for wildlife and fungal diversity were also conducted. The statistics of keywords in published studies focuses on subtropical and temperate forest types, the locally internal factors affecting community dynamics, habitat heterogeneity, density dependence, dispersal limitation and so on, which reflected the current research hotspot in the field of biodiversity science.

Density dependence:

Using 6 years of data on seedling recruitment and seed rain of 13 species from 130 stations, our results reveal that conspecific seed and seedling densities play a more important role than the density or relatedness of heterospecific seeds and seedlings during the seed to seedling stage, suggesting that species-specific seed predators, along with habitat preferences, may contribute to diversity maintenance in this forest (Du et al., Oecologia, 2017. 184, 193–203).



Summary graph of keywords of SCI papers published (Provided by Feng Gang of Inner Mongolia University)

Community functional phylogenomics

Quantizing different ecological strategies among species is important for community ecology study. In this study, we take advantage of community functional phylogenomics to explore the influence of light to survival of seedlings. The result indicates the importance of abiotic filtering and performance hierarchies. The present work takes a novel approach by sequencing the transcriptomes of naturally co-occurring tree species in a sub-tropical forest in China (Han et al., Journal of Ecology, 2017. 105, 592–601).

Regeneration niche partitioning

We investigated the seedling dynamics of evergreen and deciduous broad-leaved plants among light (due to forest gap disturbance) and topographic habitats in the subtropical evergreen broad-leaved forest of Gutianshan. We found that forest gap disturbance played a larger role in promoting coexistence of evergreen and deciduous broad-leaved plants than topography, suggesting that heterogeneous light environment importantly contribute to the coexistence of these two plant groups in subrtropical evergreen broad-leaved forests (Jin et al., Journal of Ecology,106, 1634-1645,doi: 10.1111/1365-2745.12911).

Microorganism biodiversity

In Gutianshan 24-ha plot, we examined fungal community structure and linked them with biotic and abiotic variables. Ridge and valley habitats with different fungal communities were delineated. The fungi belong to to mycorrhizal, pathogenic and saprotrophic guilds. Total, saprotrophic and pathogenic fungal richness were significantly correlated with plant species richness and/or soil nutrients and moisture in the ridge habitat, but with habitat convexity or basal area of Castanopsis eyrei in the valley habitat. The variables influencing soil fungal diversity and community composition differ between ridge and valley habitats, and relationships between fungal and woody plant assemblages depend on habitat types in the subtropical forest ecosystem (Gao et al., New Phytologist, 2017. 213(4), 1874–1885).

Forest canopy Study

Canopy is a key ecological interface between forest and atmosphere. With the development of equipment and technology, it has become possible to carry out large-scale cross-regional forest canopy research. Progress and prospective in the canopy science were reviewed and a number of research directions were proposed in this paper. How do human disturbances affect forest canopy biodiversity globally? What are the impacts of changes in atmospheric circulation on forest canopy biodiversity? The study of forest canopy is about to unveil a new chapter (Akihiro et al., Trends in Ecology & Evolution, 2017. 32, 438-451).

Biogeochemical cycling of forest soil

A manipulated nitrogen (N) deposition study was done in the field to explore the effects of N deposition on soil N dynamics and greenhouse gas emissions. The concentrations of total N, NO_3− and dissolved organic N in soil solution increased significantly with N deposition ($P<0.05$). N deposition did not affect soil CO_2 emissions, while N_2O and CH_4 emissions were sensitive to N deposition, and the emission rate of N_2O and CH_4 increased from 0.02 mg m^{-2} h^{-1} and −0.74 μg m^{-2} h^{-1} to 0.05 mg m^{-2} h^{-1} and 1.41 μg m^{-2} h^{-1} with N addition, respectively (Song et al., Science of the Total Environment, 2017. 609: 1303-1311).

Both carbon and net nitrogen mineralization rates in topsoil was significantly higher than in subsoil. The net nitrogen mineralization in subsoil was limited by the low content of labile C source and degradable organic N. The decoupled relationships between soil C and net N mineralization highlighted the need for soil carbon models to capture this effect (Tian et al., Soil Biology & Biochemistry, 2017. 109, 135-144).

This paper especially explored the possibility of using spiking with extra-weighting to improve model applicability. The results highlighted the potential application of VNIR spectroscopy as a reliable tool to quantify SOC and TN concentrations in highly heterogeneous forest soils. This approach is potentially useful in rapidly quantifying and monitoring soil carbon and nitrogen pools in

heterogeneous landscapes (Jiang et al., Geoderma, 2017. 293:54–63).

Tree mortality and growth trade-off among species

There are differences between the responses of tree mortality and growth to local neighborhood variables in this temperate forest. Tree growth and mortality are tightly correlated both within (negatively) and among species (positively), and their relationships are both size dependent in this temperate forest. Tree mortality and growth trade-off can contribute to species coexistence and diversity maintaining in forests (Zhu et al., Forest Ecology and Management, 2017. 404: 354-360).

Measurements of plant traits at a leaf scale

Based on linear mixed-effect model, we proposed empirical models for estimating leaf area, leaf mass and specific leaf area at a leaf scale in different seasons and canopy positions within non-destructive for five dominant broadleaved tree species in the Xiaoxing' an Mountain. The accuracies for estimating leaf traits were all higher than 86%, and the optimum number of sample leaves necessary for good accuracy and reasonable error for estimating specific leaf area is 40–60 (Liu et al., Ecological Indicators, 2017. 78: 340-350).

III. Program Management

Routine monitoring on seedling, seed and litterfall, and infrared camera trappings were carried out by plots in CForBio, and related projects set in 8 plots were mainly established by institutes of CAS. The associated progress was reviewed by experts organized by Biodiversity Committee of CAS.

IV. Paper Publication

Fifty-six research papers were published in 2017. Among them, 35 were in SCI-indexed journals. 19 papers were published in international journals with IF >3.0, such as *Journal of Ecology*, *Oecologia* and so on.

V. Funds-raising

The research teams received seven regular projects, one National Natural Science Foundation of China (NSFC) Key Program and one NSFC excellent young scholars project, which is the first time for CForBio to win a grant from NSFC for key projects and excellent young scholars. Meanwhile, the research teams also received five NSFC General Programs, three NSFC Young Investigator Programs, two projects from National Regional Science Foundation of China. One project and one sub-project of the National Key R&D Program. One project and two sub-projects of the Strategic Priority Research Program B of Chinese Academy of Sciences. One Fundamental Research Funds for the central affiliated universities. Two research projects of CAS key laboratory of forest ecology and management, Institute of Applied Ecology. Two Sub-projects of "One-Three-Five" major project of Thirteenth Five-year Plan of XTBG, CAS.

VI. Data sharing

1. Routine Monitoring Data Sharing

After years of continuous monitoring, plot census data was fully shared among Changbai Mountain plot, Donglin Mountain plot, Gutian Mountain plot, Dinghu Mountain plot and Xishuangbanna plot. The shared data includes six categories: datasets on woody species in the first census, seedlings and seed rain, topography and soil, woody species re-census data after two years since collected.

Up to the end of 2017, 170.49 M, 2.16 million records of original monitoring data have been shared. Offline application is supported and the shared data will be provided after approval (The paper proposal must be submitted by the plot which is among the data sharing group).

2. Camera Trapping Data Sharing

To establish an effective camera trapping data sharing mechanism, “the agreement on camera trapping data sharing in Chinese Forest Biodiversity Monitoring Network (CForBio)” was signed by eight plots belonging to insitutes of Chinese Academy Sciences. Almost 2380 GB of photos (420 thousand) and videos were shared in 2017. The monitored data will provide information on species composition and distribution, population demography, behavior and environment for terrestrial vertebrates (mammals and birds).

VII. Academic Training and Exchange

Data	Important Activities	Lecturers	Summary
Jun. 14-16	Workshop on advances in species distribution and species trait modelling	Severn experts from the Biodiversity and Climate Change Virtual Laboratory (BCCVL), Australia and Dr. Huijie Qiao from Institute of Zoology, Chinese Academy of Sciences (CAS), Dr. Li Zhu from Institute of Botany, CAS and Dr. Minggang Zhang from Shanxi University	The BCCVL team, Dr. Zhu Li and Dr. Zhang Minggang shared their research progress on biodiversity modeling in Australia and China, including patterns of endemism in the Australian flora, identifying refugia from climate change for threatened species, major declines of woody plant species ranges under climate change in Yunnan, China, and niche breadth and geographic properties rather than plant traits can explain niche shifts during invasion etc. Online research facility for biodiversity and spatial database were introduced by BCCVL team. Dr. Qiao explained ecological niche model, data preparation, analysis procedure and evaluation, and results interpretation, and lastly its application.
Jul. 6-7	Visiting ForestPlots office in University of Leeds, UK		Dr. Maofang Luo from Biodiversity Committee, CAS visited ForestPlots office in University of Leeds, UK. Progress and achievements of CForBio, the progress and database management mode of ForestPlots were communicated. The future collaboration was disscussed and an agreement for the Chinese version of ForestPlots website was reached. It will be the beginning of future cooperations.
Jul. 17-30	CTFS and CForBio analytical workshop VII	Experts from CTFS	There were 5 groups in the workshop: dynamics of seeds and seedlings/ phenology, functional traits/diversity, population statistics, biomass and spatial distribution. For each group, there were at least two outstanding scientists offering guidance in data analysis and paper writing, coordinating cooperation among group members. During the workshop, frontier research and future research directions were reported by experts from CTFS. On the last day of the training, 26 participants briefly shared their training outcomes.
Aug.25-26	Workshop on dead-wood researches	Prof. Marc W. Cadotte from University of Toronto, Canada and Dr. Sebastian Seibold from Technical University of Munich, Germany	The core content and major research methods were introduced in the workshop, including the evaluation of saproxylic insects, fungi and bacteria biodiversity, and estimation of wood decomposition rates. The possibly outline and methodology on biodiversity, wood decomposition rates and local gradients with regard to microclimate, anthropogenic gradients,, and size of the sample plot （$10\times10m^2$）of the project were discussed during the workshop. The intended start of the experiment is spring 2019, and part of CForBio plots will join the project.

Data	Important Activities	Lecturers	Summary
Sept. 3	Workshop on plot future cooperation	Prof. Alan Grainger from University Leeds, UK	After a brief introductory on RAINFOR and ForestPlots, Prof. Alan Grainger focused on the prospect of global environmental relativities after Anthropocene tipping point and using the niche hole concept to model future biodiversity impacts of climate change. Progress and achievements of CForBio was communicated by Dr. Xiangcheng Mi. Free talk on ecological processes changing at rates relative to the rate of climate change, the relativity of global environmental uncertainties, forest areas, biodiversity and carbon was carried on during the workshop.
Oct. 27-31	Workshop on analysis of National biodiversity and ecosystem monitoring data	Young scientists of CForBio, and Prof. Chengjin Chu from Sun Yat-sen University, Prof. Jian Zhang from East China Normal University	The workshop focused on the courses as follows: introduction of R statistics, spatial point pattern and modelling, the analysis on species-area relationship and diversity distribution pattern, biodiversity with spatial scale driving, the analysis on species abundance and distribution and the relativities of community and environment, analytical techniques on seed rain and effects of negative density dependence, functional community ecology and phylogenetic diversity, including theory and R software applications. Meanwhile, characteristics and requirements of the Writing of a data paper for Biodiversity Data Journal and Biodiversity Sciences was lectured during the workshop. After the workshop, participants visited the Gutian Mountain station and the 24-ha subtropical evergreen broadleaved forest plot of Gutian Mountain in Zhejiang.
Nov. 9-12	Workshop on spatial statistics	Prof. Aaron Ellison from Harvard University, USA	The codispersion and its application was introduced by Prof. Aaron Ellison and the geostatistics methods were used to raster the point data from 3 plots of Panama, to study the relativities of point pattern and soil and species during the workshop. The participants from CForBio practiced the analysis by using Chinese forest dynamics plot data, a 5-10 minutes report was presented by the participants.

Workshop on deadwood researches

Workshop on plot future cooperation

CTFS and CForBio analytical workshop VII

Workshop on advances in species distribution and species trait modenlling

Workshop on Spatial Statistics II

Workshop on analysis of National biodiversity and ecosystem monitoring data

VIII. International Cooperation

1. Academic Visit

- From September 2016 to September 2017, Dr. Zhu Yan visited Drs Liza Comita and Simon Queenborough's Lab in Yale University and conducted collaborative research.
- From October 2016 to October 2017, Ph.D student Li Meng prepared her PhD work at the Kazimierz Wielki University in Bydgoszcz in Poland. She is studying at the Institute of Experimental Biology, guided by Professors Jarosław Burczyk and Igor Chybicki, working on genetic structure and mating system of plant populations.
- From October 2016 to October 2017, Ph.D student Chen Jie joined Prof. Yakov Kuzyakov's group in the University of Goettingen, Germany, working on soil microbial phosphorus transformations.
- From December 2016 to December 2017, Ph.D. student Wang Yunquan from Gutian Mountain plot visited Marc Cadotte Lab, University of Toronto. During his visit, Yunquan conducted a study on how environmental fluctuations affect species interactions via traits in a subtropical forest.
- From December 2016 to December 2017, Ph.D student Cao Ke from Gutian Mountain plot went to Department of Bioscience-Ecoinformatics and Biodiversity, Aarhus University, Denmark, and collaborated with Prof. Jens-Chriatian Svenning for the research about "Beta diversity pattern at large scale and the ecological mechanisms".
- From January 16 to February 8, Dr. Sun Zhenghua from Xishuangbanna plot visited Calum Lab. of The University of Edinburgh, UK, working on data conjoint analysis.
- On February 20-26 and on May 28-June4, researchers from Xishuangbanna plot visited Suranaree University of Technology, Thailand, and had a discussion on future cooperation plan on forest plots.
- From May to present, Dr. Peng Wanxia from Mulun plot has been visiting EcoLab of Dr. Yiqi Luo, Northern Arizona University (i.e., Formerly EcoLab of Dr. Yiqi Luo, University of Oklahoma), and carried out collaborative studies on dynamics of plant communities in Karst forest ecosystems and its response to global climate changes.
- From July to August, Dr. Yuan Zuoqiang from Changbai Mountain plot, visited Georgia Institute of Technology, conducting research on temporal stability of temperate mixed forest.
- From October to December, Dr. Wang Xugao, from Changbai mountain plot, visited Helmholtz Centre for Environmental Research-UFZ, and worked on mechanisms of biodiversity maintenance.
- On April 4-7, Simon Milne, Director of the Royal Botanic Gardens Edinburgh, UK, and Peter Hollingsworth, Head of Research Department visited the Lijiang Alpine Botanical Garden, Kunming Institute of Botany, Chinese Academy of Sciences and Yulongxueshan 25-ha FDP.
- In May, Ms. Ditte Arp Jensen from Aarhus University in Denmark and Dr. Mi Xiangcheng from Institute of Botany, Chinese Academy of Sciences visited the Muling plot, and had a discussion on the regeneration of *Taxus cuspidata*.
- On August 7-9, Dr. Jun Wen from Smithsonian National Museum of Natural History visited Mulun plot.
- From December 22, 2017 to January 2, 2018, Dr. Richard Condit visit Institute of Botany, CAS, and discussed the studies in Gutianshan forest dynamics plot.

2. International Conferences and Exchanges

- On Mar. 19-23, Du Yanjun from Gutian Mountain plot attended the GLOBIS B Workshop organized by Amsterdam University.
- From Apr. 26 to May 1, Prof. Hao Zhanqing from Changbai Mountain plot, attended the 6th International Conference on Biodiversity and Conservation in Dubai, UAE.
- On June 19-21, Prof. Jin Guangze from Liangshui plot participated in the 9th China·Heihe China-Russia Symposium on Forestry Ecological Construction organized by China Heihe Municipal Government and Russian Armur State Government, undertaken by Heihe Forestry Bureau and the Russian Far East National Agricultural University.
- From July 14 to August 22, Jia Shihong, Mao Zikun and Ren Jing from Changbai Mountain plot, Diao Yunfei from Muling plot, Liu Heming from Tiantong plot, Mei Qiming from Dinghu Mountain plot, Hu Yuehua, Yang Jie, Zhang Caicai and Shao Xiaona from Xishuangbanna plot attended CTFS-CForBio Workshop VII in Puerto Rico on data analysis and paper writing.
- On Aug. 1-3, Dr. Liu ZhiLi, from Liangshui plot participated in the International Symposium on Sustainable Forest Management in the Context of Global Change, organized by Northeast Forestry University and International Union of Forest Research Organizations (IUFRO), undertaken by Northeast Forestry University.
- On Aug. 6-11, Wang Yunquan from Gutian Mountain plot took part in ESA 2017 annual meeting in Portland, Oregon, USA.
- On Aug. 6-19, Deng XiaoBao, Akihiro Nakamura and Deng Yun from Xishuangbanna plot visited Universität Leipzig and Technische Universität München, Germany, Universität Basel, Switzerland focused on their 3 forest canopy cranes, UMR AMAP labs and field equipments.
- From August 29 to September 1, Wang Xugao from Changbai Mountain plot attended 2017 international workshop on lessons learnt and challenges from forest long-term ecological research (LTER) in the Northeast Asian region.

IX. Online Communication Platform

The website for CForBio (www.cfbiodiv.cn) was updated with the latest news and progress, which promoted academic exchange among researchers.

Ⅹ. Plot Introduction and Annual Progress

25-ha Dahurian Larch Forest Plot at Daxing'anl Mountain in Heilongjiang Province

Principal Investigator

Ni Hongwei, professor of Institute of Natural Resources and Ecology, Heilongjiang Academy of Sciences. His research interests focus on wetland ecology, biodiversity, restoration ecology, population ecology, vegetation ecology, global change, nature conservation.

Research Team

Zhu Daoguang
Yang Libin
Cui Fuxing
Chai Chunrong
Li Jinbo

Plot Introduction

The 25-ha dahurian larch forest plot is a typical cold temperate zonal vegetation of Daxing'an Mountain region, which was established in 2011, located in the north slope of Yilehuli Mountain, with the geographical coordinates 51.82°N, 122.98°E. The mean elevation is 897 m, with a gentle difference of altitude of 16.6 m. The mean annual temperature is -4°C, mean annual precipitation 458.3 mm, mean annual relative humidity 71%, and mean annual evaporation 911 mm.

The plot has a relatively simple community composition, *Larix gmelinii* is the dominant species. There are four main community types represented common vegetation landscape characteristics, including: moss - *Larix gmelinii* forest, herbage - *Larix gmelinii* forest, *Ledum palustre* - *Larix gmelinii* forest, and *Rhododendron dauricum*- *Larix gmelinii* forest.

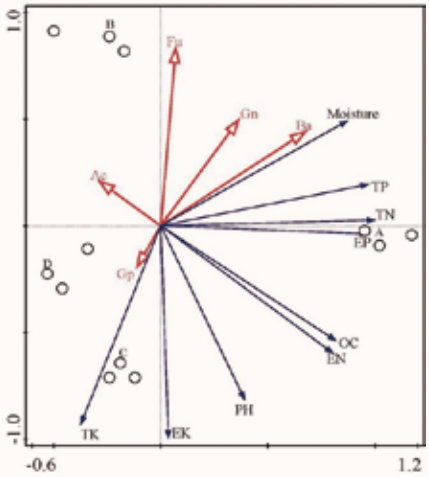
Total number of individuals with DBH≥1 cm was 209,785 recorded in the plot, belonging to 18 woody species (4 tree species, 14 shrub species), 12 genera and 6 families. The maximum DBH in the plot was 52 cm, the mean DBH and basal area were 3.87 cm and 20.93 m^2/ha, respectively.

Soil Microbial Community Characteristics of the Different Forest Types of *Larix gmelini* Forest in Cold Temperate Zone

Yang Libin, Zhu Daoguang, Cui Fuxing, Li Jinbo, Song Ruiqing, Ni Hongwei

Journal of Northeast Forestry University. 2017. 45(9): 66-72.

To clarify the characteristics of soil microbial biomass and community structure and their distribution patterns and influencing factors of different Larix gmelinii forest types, we analyzed the soil microbial biomass and community structures under four typical plots (mosses-, *Ledum palustre*-, grass-and *Rhododendron dauricum*-larch forest) by using the phospholipid fatty acids (PLFA) method. Ten types, 51 species of incomplete distribution of PLFAs biomarkers were found in four plots, in which the total number of soil microbes was in descending order of bacteria, fungi and actinomycetes. The total amount of PLFAs and bacteria in the mosses-larch forest was the highest, and lowest in the grass-larch forest. The total amount of fungi was the highest in the *Ledum palustre*-larch forest and lowest in the grass-larch forest. The amount of rhododendron was highest in the *Rhododendron dauricum*-larch forest and the lowest in the grass-larch forest. The redundancy analysis showed that soil moisture content had the greatest impact on bacteria, total potassium and available potassium had the greatest impact on fungi, and soil organic carbon and alkali hydrolyzable nitrogen had the greatest impact on actinomycetes. There were differences in soil microbial biomass and community among different *L. gmelinii* forests in the cold temperate zone, and there was a correlation between soil microbial community and soil properties.



RDA sequencing results of soil physical and chemical properties and soil microbial community structure in different forest types

Important Outputs

1. Yang LB, Sui X, Zhu DG, Cui FX, Li JB, Song RQ, Ni HW (2017) Study on fungal community's characteristics of different *Larix gmelini* forest types in cold temperate zone. Journal of Central South University of Forestry & Technology, 37(12), 76–84. (in Chinese with English abstract)

2. Yang LB, Zhu DG, Cui FX, Li JB, Song RQ, Ni HW (2017) Soil microbial community characteristics of the different forest types of *Larix gmelini* forest in cold temperate zone. Journal of Northeast Forestry University, 45(9), 66–72. (in Chinese with English abstract)

30-ha Broadleaved-Korean Pine Mixed Forest Plot at Fenglin in Xiaoxing'an Mountain in Heilongjiang Province

Principal Investigator

Jin Guangze, Professor of Northeast Forestry University. His research is focused on forest ecology, biodiversity and conservation.

Research Team

Song Guohua
Wang Quanbo

Plot Introduction

A 30-ha Fenglin broadleaved-Korean pine mixed forest dynamics plot was established in 2009, located in south Xiaoxing'an Mountain (48.08°N, 129.12°E). The flora belongs to Xiaoxing'an Mountain subregion of Changbai Mountain flora. The mean elevation is 419 m with a maximum altitude difference of 66 m. Mean annual temperature is -0.5°C, and mean annual precipitation is 688 mm.

This plot has a complex community composition and high species diversity, which is dominated by *Pinus koraiensis*, with some subtropical vegetation landscape characteristics. The forest remains some tertiary relic species such as *Fraxinus mandshurica*, *Juglans mandshurica*, *Acer mono*, *Tilia amurensis*, *Phellodendron amurense* etc, and some liana species such as *Vitis amurensis*, *Schisandra chinensis* and *Actinidia kolomikta*.

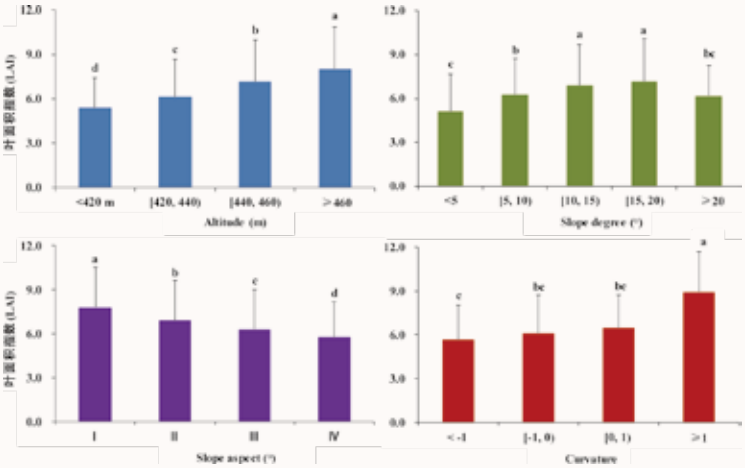
94,920 individuals with DBH ≥ 1 cm were recorded in the plot, belonging to 46 woody species (24 tree species, 19 shrub species and 3 liana species), 39 genera and 21 families. The maximum DBH in the plot was 111.6 cm, the mean DBH and basal area were 3.87 cm and 34.93 m^2/ha, respectively.

Influence of topography on leaf area index in a typical mixed broadleaved-Korean pine forest in Xiaoxing'an Mountain, China

Liu Zhili, Bi Lianzhu, Song Guohua, Wang Quanbo, Liu Qi, Jin Guangze

Chinese Journal of Applied Ecology. 2017. 28, 2856–2862

Based on a 30 hm^2 mixed broadleaved-Korean pine forest monitoring plot at Fenglin National Nature Reserve in Xiaoxing'an Mountain, China, we estimated leaf area index (LAI) for major tree species and total LAI for all species using empirical models between LAI and basal area. We explored the influence of four kinds of terrain factors (including altitude, slope degree, slope aspect and curvature) and the combination influence on the spatial distribution of LAI. Results showed that the four terrain factors all had a significant effect on spatial distribution of LAI for five major tree species, including *P. koraiensis*, *Abies nephrolepis*, *Tilia amurensis*, *Ulmus laciniata* and *Acer mono*. But the slope aspect had a significant effect on the spatial distribution of LAI for *Betula costata*. The four kinds of terrain factors all significantly affected the spatial distribution of total LAI for all species. The plot could be divided into five habitat types, including the ridge, sunny, valley sunny side, shady and valley shady side. The habitat types had significant effects on the spatial distribution of total LAI, and the LAI in the ridge with a mean value of 8.85 was significantly higher than that in other habitat types, followed by LAI in sunny with a mean value of 7.62. The LAI in the valley sunny and shady sides did not differ significantly, and the valley shady side had the lowest LAI, with a mean value of 4.42.



Influence of four kinds of terrain factors on LAI distribution of mixed broadleaved-Korean pine forest plot

Important Outputs

1. Gao MX, Cheng SS, Ni JP, Lin L, Lu TY, Wu DH (2017) Negative spatial and coexistence patterns and species associations are uncommon for carrion beetles (Coleoptera: Silphidae) at a small scale. European Journal of Soil Biology, 83, 52–57.

2. Liu ZL, Bi LZ, Song GH, Wang QB, Liu Q, Jin GZ (2017) Influence of topography on leaf area index in a typical mixed broadleaved-Korean pine forest in Xiaoxing'an Mountain, China. Chinese Journal of Applied Ecology, 28, 2856–2862. (in Chinese with English abstract)

9-ha Broadleaved-Korean Pine Mixed Forest Plot and 9-ha Spruce-fir Valley Forest Plot at Liangshui in Xiaoxing'an Mountain in Heilongjiang Province

Principal Investigator

Jin Guangze, Professor of Northeast Forestry University. His research is focused on forest ecology, biodiversity and conservation.

Research Team

Liu Zhili
Cai Huiying
Zhu Yu
Dina Oktavia

Plot Introduction

The Liangshui 9-ha broadleaved-Korean pine mixed forest plot (47.18°N,128.88°E) and 9-ha spruce-fir valley forest plot (47.20°N,128.85°E) are located on the south slope of Xiaoxing'an Mountain. The mean annual temperature is -0.3°C and mean annual precipitation is 676 mm.

The 9-ha broadleaved-Korean pine forest plot was established in 2005. *Pinus koraiensis* is dominant species, and major associated tree species include *Tilia amurensis*, *T. mandshurica*, *Betula costata*, *Fraxinus mandshurica* etc. 21,382 independent individuals with DBH≥1 cm were recorded, belonging to 48 species, 34 genera and 20 families. The maximum DBH in the plot was 133 cm, the mean DBH and basal area were 7.41 cm and 42.30 m^2/ha, respectively.

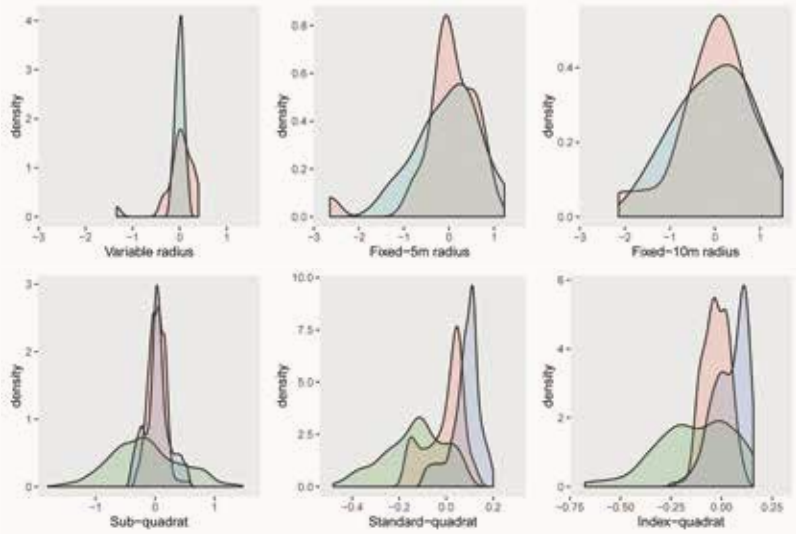
The 9-ha spruce-fir valley forest plot was established in 2006. The dominant species are *Abies nephrolepis*, *Picea koraiensis*, *Acer ukurunduense* etc. 37,873 independent individuals with DBH ≥ 1 cm were recorded, belonging to 44 species, 30 genera and 15 families. The maximum DBH in the plot was 110 cm, the mean DBH and basal area were 5.3 cm and 30.01 m^2/ha, respectively.

Variation of the biotic neighbourhood and topographic effects on tree survival in an old-growth temperate forest

Zhu Yu, Cai Huiying, Jiang Feng, Jin Guangze

Journal of Vegetation Science. 2017. 28(6): 1166-1177

We used generalized linear mixed model and geographically weighted generalized linear model as well as their corresponding test approaches and incorporated tree survival data from a 10-yr interval census to determine whether there is significant interspecies variation in the effects of biotic neighbourhood variables and whether there is significant spatial variation in the effects of topographic variables on tree survival in the Liangshui typical broadleaved-Korean pine temperate forest in China. Our results showed that the effects of neighbourhood variables on tree survival varied among species and effects of topography varied over space. However, the results depended on the neighbourhood radius and spatial scale. The neighbourhood radius affected detection of variation in neighbourhood effects among species, and the spatial scale similarly affected detection of spatial variation in the effects of topography.



Smooth density plot showing estimates of effects of the conspecific neighbour density index (red) and average phylogenetic dissimilarity index (blue) on survival at different neighbourhood radii (top figure). Smooth density plot showing estimates of effects of elevation (green), convexity (red) and hillshade (blue) on survival at different quadrat scales (bottom figure).

Important Outputs

1. Zhu Y, J. Aaron Hogan, Cai HY, Xun YH, Jiang F, Jin GZ (2017) Biotic and abiotic drivers of the tree growth and mortality trade-off in an old-growth temperate forest. Forest Ecology and Management, 404, 354–360.

2. Zhu Y, Cai HY, Jiang F, Jin GZ (2017) Variation of the biotic neighbourhood and topographic effects on tree survival in an old-growth temperate forest. Journal of Vegetation Science, 28, 1166–1177.

25-ha *Taxus cuspidata* Forest Plot at Muling in Heilongjiang Province

Principal Investigator

Tian Songyan, professor of Heilongjiang Forest Engineering and Environment Institute. His research is focused on forest ecology, biodiversity and conservation.

Research Team

Liu Yankun
Diao Yunfei
Liu Yulong
Li Yunhong
Shao Yingnan
Chen Yao
Han Lidong
Wo Xiaotang
Li Lin

Plot Introduction

A 25-ha *Taxus cuspidata* forest plot was established in Muling Nature Reserve in 2014, with the geographical coordinate 43.95 °N, 130.07 °N. The altitude varies from 658 m to 781 m, with a maximum altitude difference of 123 m. The mean annual temperature is -2°C, and mean annual precipitation is 530 mm.

The *Taxus cuspidata* forest plot is a typical middle-aged multi-storied uneven aged forest with obvious dominant species. The main constructive species include *Tilia amurensis*, *Pinus koraiensis*, *Acer mono*, *Abies nephrolepis* and *Betula costata* etc. 63,877 individuals (126,573 individuals if including branches at ground surface) with DBH ≥ 1 cm were recorded, belonging to 22 families, 38 genera and 57 woody species. The mean DBH and basal area were 7.83 cm and 26.4 m^2/hm^2 respectively.

The importance value of Taxus cuspidata (Category I national protected species) is 1.49% and ranked 21. The DBH distribution of all individuals showed a reversed “J” type, and the peak of DBH was between 35 cm and 38 cm. The mean DBH was 39.42 cm, and the maximum DBH is 89.0 cm. The percentage of the basal area (0.93 m^2/hm^2) was 3.6% of total basal area (26.4 m^2/hm^2) by less numbers.

25-ha Deciduous Broadleaved-Korean Pine Mixed Forest Plot at Changbai Mountain in Jilin province

Principal Investigator

Hao Zhanqing, professor of Shenyang Institute of Applied Ecology, CAS. He mainly conducts studies on forest ecology and biodiversity.

Research Team

Wang Xugao
Ye Ji
Lin Fei
Yuan Zuoqiang

Plot Introduction

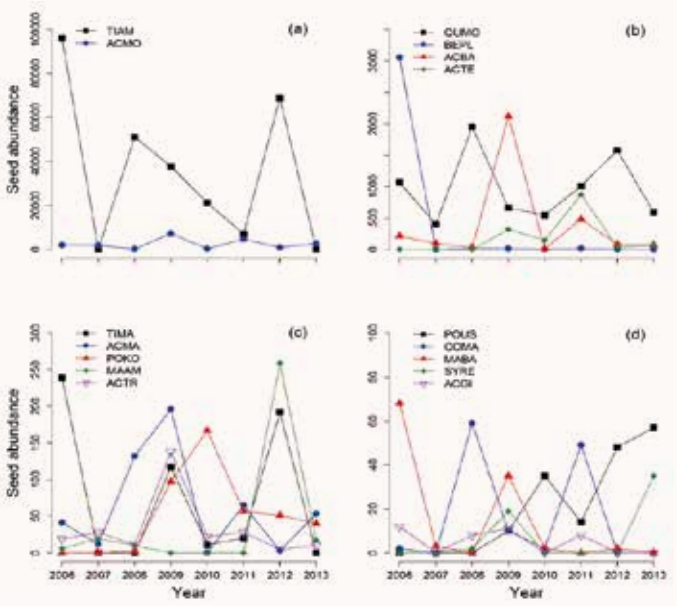
A 25 ha broadleaved-Korean pine mixed forest plot was established in Changbai Mountain in 2004. The plot is not only the first temperate forest dynamics plot in China but also worldwide, with the geographical coordinate 42.38°N, 128.08°E. The mean elevation of the plot is 801.5m, and the terrain is relatively gentle with very little elevation change (17.7 m). Seasonal changes are distinctly recognizable here. Mean annual

temperature is 3.6°C, and mean annual precipitation is approximately 700mm.
The main constructive species of the Changbai Mountain plot include *Pinus koraiensis*, *Tilia amurensis*, *Quercus mongolica* and *Fraxinus mandshurica* etc. 38,902 individuals with DBH ≥ 1cm were recorded, belonging to 18 families, 32 genera and 52 species. It is a typical old-growth multi-storied uneven aged forest with obvious dominant species. The height of main canopy species is nearly 30m, and the oldest trees are about 300 years old. The mean DBH and basal area are 10.52 cm and 43.23 m^2/ha, respectively.

Variation and synchrony of tree species mast seeding in an old□growth temperate forest

Wang Yunyun, Zhang Jian, Jalene M. LaMontagne, Lin Fei, Li Buhang, Ye Ji, Yuan Zuoqiang, Wang Xugao, Hao Zhanqing
Journal of Vegetation Science. 2017. 28(2), 413–423

Spatio-temporal variations and the mechanisms underlying seed production regulate population dynamics, community assemblages and biodiversity maintenance in forest ecosystems. The lack of long-term monitoring of seed production in diverse forest communities hampers our understanding and prediction of plant communities in response to species-specific reproductive pressure and changing climates over time.
Based on continuous seed rain data in the last 8 years at 25 ha Changbai mountain plot, we employed generalized linear mixed-effects model to analyze the inter-annual variability and synchrony of mast seeding in 20 plant species. Our findings suggest that pollination efficiency hypothesis had a much stronger effect than predation satiation hypothesis on mast seeding, and weather conditions demonstrated the proximate role of weather drivers in producing the community-wide mast-seeding pattern. This result emphasized the need to simultaneously assess drivers of mast seeding for multiple species within a plant community.



Annual seed production for 16 tree species between the years of 2006 and 2014

Important Outputs

1. Wang YY, Zhang J, LaMontagne JM, Lin F, Li BH, Ye J, Yuan ZQ, Wang XG, Hao ZQ (2017) Variation and synchrony of tree species mast seeding in an old-growth temperate forest. Journal of Vegetation Science, 28(2), 413–423.
2. Kuang X, Zhu K, Yuan ZQ, Lin F, Ye J, Wang XG, Wang YY, Hao ZQ (2017) Conspecific density dependence and community structure: Insights from 11 years of monitoring in an old-growth temperate forest in Northeast China. Ecology and Evolution, 7(14), 5191–5200.

24-ha Poplar-Birch Forest Plot at Changbai Mountain in Jilin Province

Principal Investigator

Hao Zhanqing, professor of Shenyang Institute of Applied Ecology, CAS. He mainly conducts studies on forest ecology and biodiversity.

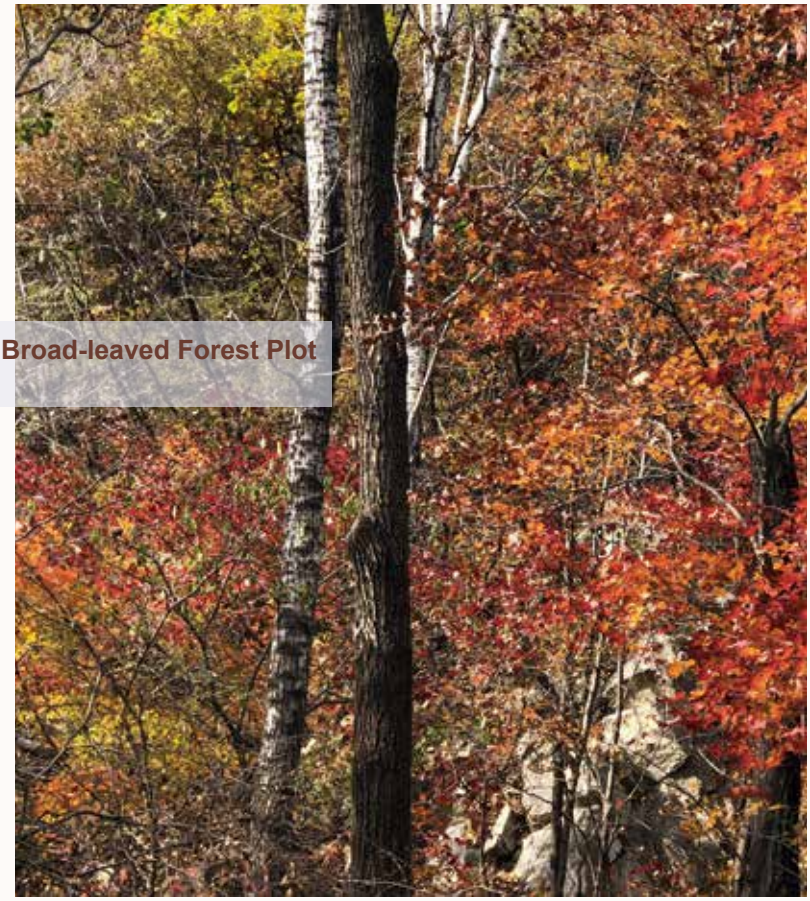
Research Team

Wang Xugao
Ye Ji
Lin Fei
Yuan Zuoqiang

Plot Introduction

The 24-ha poplar-birch forest monitoring plot in Changbai Mountain was extended in 2016 with the geographical coordinate 42.22°N , 128.00°E (Initial 5 ha forest plot was established in 2005). The mean elevation of the plot is 793.4 m, and the largest elevation change is 17.7 m.

Poplar-birch forest in Changbai Mountain is a secondary forest, which is mainly composed of white birch and poplar after being deforested or burnt in a broadleaved-Korean pine mixed forest about eighty years ago. 65749 individuals with DBH ≥ 1cm were recorded, belonging to 21 families, 38 genera and 65 species. Among them, 36 species are trees, 25 species are shrubs and 4 species are lianas. The structure of understory is complex and the mean DBH and basal area are 7.79 cm and 32.15m^2/ha, respectively.



20-ha Warm Temperate Deciduous Broad-leaved Forest Plot at Dongling Mountain in Beijing

Principal Investigator

Sang Weiguo, professor of Minzu University of China. His research interests are in forest ecology, invasion ecology, and ecological modelling.

Zhu Li, assistant professor of Institute of Botany, CAS. Her research interests are in plant population ecology and invasion ecology

Research Team

Su Hongxin

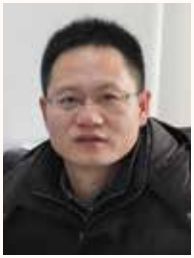
Wang Shunzhong

Ma Fang

Plot Introduction

The 20-ha Dongling Mountain warm temperate deciduous broadleaved forest plot was established in 2010, with the geographical coordinate 39.96°N, 115.43°E. The mean elevation of the plot is 1395 m, and the terrain is relatively steep with the elevation change of 219.3 m, ranging from 20° to 60°. The plot belongs to a warm temperate continental monsoon climate. The mean annual rain fall is 500-650 mm and annual average temperature is 4.8°C.

The 20-ha Dongling Mountain plot is a typical warm temperate secondary forest, which has obvious dominant species all belonging to deciduous broadleaved trees (e.g. *Quercus wutaishanica*, *Acer mono* and *Betula dahurica*). Vertical structure was composed of an overstory layer, midstory layer and a shrub layer, the first five species comprised 61% of all individuals, and the first 20 species comprised 92% of all individuals, and there were 52,136 individuals with DBH ≥ 1cm, belonging to 58 species, 33 genera and 18 families.



25-ha Deciduous Broadleaved Forest Plot at Qinling in Shannxi Province

Principal Investigator

Zhang Quanfa, Dang Haishan, professors of Wuhan Botanical Garden, CAS. Their interests focus on temporal and spatial pattern of watershed ecosystem services, community dynamics of mountain forests, and functional adaptability of population in key ecologically vulnerable regions.

Research Team

Zhang Kerong
Shu Xiao
Zhou Quan
Shang Hang
Xie Fenglin

Plot Introduction

The 25-ha Qinling deciduous broad-leaved forest plot was established in 2015 at 33.69°N, 107.82°E, located in the Foping National Nature Reserve, Shaanxi Province. Average altitude of the plot is 1550 m with a maximum vertical drop of near 120m. The annual mean temperature is 11.5°C and the annual mean precipitation is 924 mm.

There are 73,932 individuals with DBH≥1cm, belonging to 119 species, 66 genera and 35 families. Dominant species in the plot mainly belong to Fagaceae, Aceraceae and Betulaceae. Deciduous broad-leaved species are largely dominant, which account for 86.3% of the total importance values of all the species in the plot. The first tree most important species are *Quercus aliena*, *Sorbus alnifolia* and *Quercus spinose*. 39 rare species (less than 1 individual per hectare) accounting for 32.8% of all the species in the plot were recorded.

Vertical structure of the forest community in the plot is distinguishable, classified into three layers from canopy storey to sub-canopy storey and shrub storey. The structure of the forest community is stable and DBH distribution of all trees followed a reverse “J” shape. Mean DBH of all individuals is 8.56 cm, and the largest DBH recorded in the plot is 142 cm.

25-ha Warm Temperate Deciduous Broadleaved Forest Plot at Baotianman in Henan Province

Principal Investigator

Du Xiaojun, assistant professor, Institute of Botany, CAS. His research interests focus on forest ecology, biodiversity and restoration ecology.

Research Team

Qi Guang
Liu Yonggang
Ye Yongzhong
Liu Zongcai
Yuan Zhiliang
Wang Ting

Plot Introduction

The 25-ha Baotianman warm temperate deciduous broadleaved forest plot was established in 2009, located in the transition zone between warm temperate and subtropical zone in Central China (33.49º N, 111.94 ºE). The mean annual temperature is 15.1 °C, and mean annual precipitation is 885.6 mm.

The woody species are composed by the family of the Fagaceae, Tiliaceae, Aceraceae, Pinaceae, Cornaceae, Betulaceae, etc. The dominant tree species are *Quercus aliena* var. *acutiserrata*, *Acer grosseri*, *Pinus armandii* etc.; *Cercidiphyllum japonicum* is the Category II national protected species, *Corylus chinensis*, *Meliosma veitchiorum*, *Fagus longipetiolata* and *Tsuga chinensis*, the preferential protected plants of Henan Province, were also recorded in the plot.

25 ha Mid-subtropical Mountain Evergreen and Deciduous Broadleaved Mixed Forest Plot at Badagong Mountain in Hunan Province

Principal Investigator

Jiang Mingxi, professor of Wuhan Botanical Garden, CAS. His research interests focus on vegetation dynamics, conservation ecology of endangered plants, and structure and function of riparian ecosystems.

Research Team

Liu Feng
Qiao Xiujuan
Xu Yaozhan
Huang Handong
Tian Qiuxiang

Plot Introduction

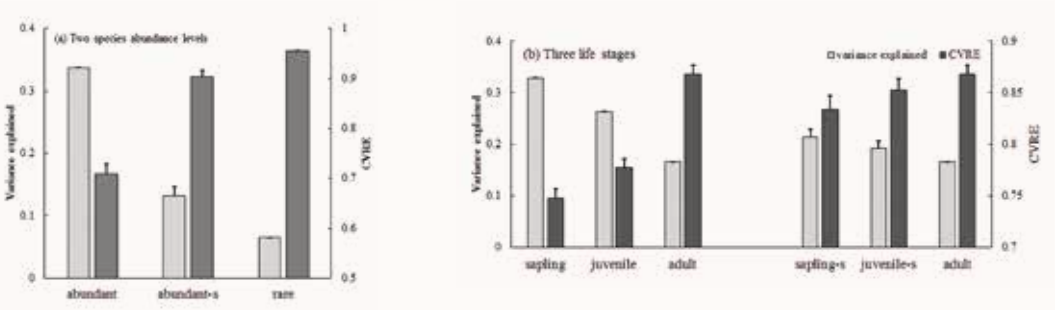
A 25-ha plot of mid-subtropical mountain evergreen and deciduous broadleaved mixed forest was established in 2011, with the geographical coordinate 29.77°N, 110.09°E, belonging to subtropical mountain humid monsoon climate, located at the Eastern Sichuan-Western Hubei endemic plant genus distribution center (relic center) and China endemic plant annular region (eastern Sichuan, southwestern Hubei, northwest Hunan and northeastern Guizhou), the distribution center of the genus Fagus and possible origin center. The annual

mean temperature is 11.5°C and annual rainfall averages 2105.4 mm.
The dominant trees include evergreen species such as *Cyclobalanopsis multinervis*, *C. gracilis* and *Schima parviflora* etc, and *deciduous species*, like *Fagus lucida*, *Carpinus fargesii* and *Sassafras tzumu* etc.

Effects of topography on structuring species assemblages in a subtropical forest

Wang Qinggang, Punchi-Manage Ruwan, Lu Zhijun, Scott B. Franklin, Wang Zhiheng, Li Yaoqi, Chi Xiulian, Bao Dachuan, Guo Yili, Lu Junmeng, Xu Yaozhan, Qiao Xiujuan, Jiang Mingxi
Journal of Plant Ecology. 2017. 10, 440–449

Many studies revealed that species may show species-habitat associations. However, few studies investigate how species assemblages are associated with local habitats, and it still remains unclear how the community-habitat associations vary with species abundance class and life stage. In this study, we analyzed the community-habitat associations in Badagongshan dynamics plot. Indicator species analysis was used to identify the most important species for structuring species assemblages. We also compared the community-habitat associations for two levels of species abundances (i.e. abundant and rare) and three different life stages (i.e. saplings, juveniles, and adults), while accounting for sample size effects. The Badagongshan plot was divided into five distinct habitat types, which explained 34.7% of the variance in tree species composition. Even with sample size taken into account, community-habitat associations for rare species is much weaker than those for abundant species. Similarly, very small differences were found in the variance explained by topography for the three life stages. Indicator species of habitat types were mainly abundant species, and nearly all adult stage indicator species were also indicators in juvenile and sapling stages. Our study manifested that topographical habitat filtering was important in shaping overall local species compositions. However, habitat filtering was not important in shaping rare species' distributions in this forest. The community-habitat association patterns were mainly shaped by abundant species. In addition, during the transitions from saplings to juveniles, and from juveniles to adults, the relative importance of habitat filtering was very weak.



The degree of community -habitat association (species variance explained by habitats), cross-validated relative error (CVRE) and sampling size effects for two species abundance levels and three life stages. (a) two species abundance level, (b) three life stages

Important Outputs

1. Wang QG, Punchi-Manage R, Lu ZJ, Franklin SB, Wang ZH, Li YQ, Chi XL, Bao DC, Guo YL, Lu JM, Xu YZ, Qiao XJ, Jiang MX (2017) Effects of topography on structuring species assemblages in a subtropical forest. Journal of Plant Ecology, 10, 440–449.
2. Wu H, Franklin SB, Liu JM, Lu ZJ (2017) Relative importance of density dependence and topography on tree mortality in a subtropical mountain forest. Forest Ecology and Management, 384, 169–179.

20- ha Subtropical Evergreen Broad-leaved Forest Plot at Tiantong in Zhejiang Province

Principal Investigator

Wang Xihua, professor of East China Normal University. His research is mainly focused on vegetation ecology and restoration ecology.

Research Team

Chen Xiaoyong
Yan Enrong
Zhang Jian
Yang Haibo
Shen Guochun
Yang Qiongsong
Zheng Zemei
Yao Fangfang

Plot Introduction

The 20-ha Tiantong plot was established in 2009 at 29.8°N, 121.8°E, located in the core area of Ningbo Tiantong National Forest Park, Zhejiang Province. Altitude of the plot varies from 304.26 m to 602.89 m. The annual mean temperature is 16.2 °C and the annual mean precipitation 1374.7 mm.
There are 94,603 individuals (DBH≥1cm), belonging to 152 species, 94 genera and 51

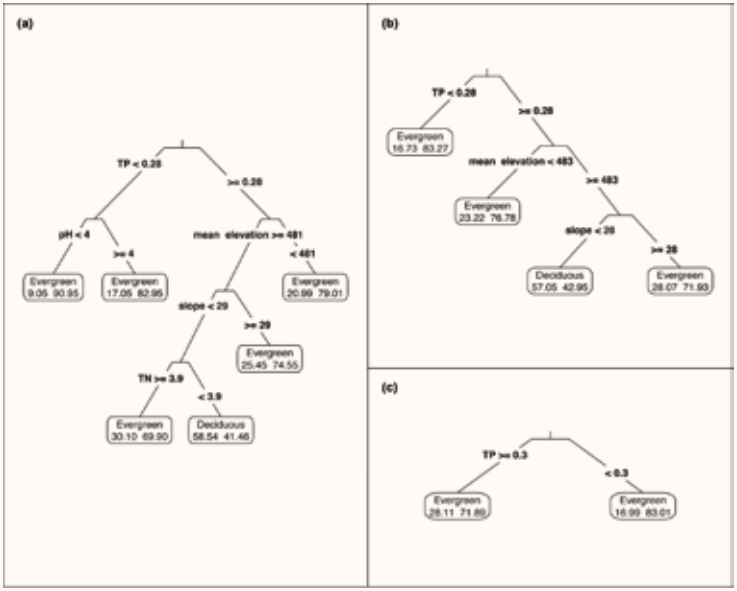
families. Dominant species in the plot mainly belong to Theaceae, Lauraceae and Fagaceae. Evergreen species are largely dominant, which account for 80.3% of total importance values of all species in the plot. The first three most important species are *Eurya loquaiana*, *Litsea elongata* and *Choerospondias axiliaris*. Fifty-five rare species (less than 1 individual per hectare) accounting for 36.2% of all species in the plot were recorded.

Vertical structure of the forest community in the plot is distinguishable, classified into three layers from canopy storey to sub-canopy storey and shrub storey. The structure of the forest community is stable and DBH distribution of all trees followed a reverse "J" shape. Mean DBH of all individuals is 5.66 cm. Proportion of small (DBH<5cm) individuals achieves 70.3%.

Habitat heterogeneity explains mosaics of evergreen and deciduous trees at local-scales in a subtropical evergreen broad-leaved forest

Fang Xiaofeng, Shen Guochun, Yang Qingsong, Liu Heming, Ma Zunping, David C. Deane, Wang Xihua
Journal of Vegetation Science. 2017. 28, 379–388

We sought to explain the mosaic pattern of evergreen and deciduous trees in a 20-ha individual-mapped subtropical evergreen broad-leaved forest through the use of spatial modeling techniques such as pair-correlation functions and null models. We show that environmental heterogeneity, especially soil phosphorus availability, is the main factor regulating their coexistence at multiple spatial scales over our study extent.



Results of multiple regression tree analysis at three spatial scales. (a), (b) and (c) demonstrated the habitat classifications at 10×10 m, 20×20 m and 50×50 m scales. Labels (e.g. Evergreen and/or Deciduous) in the boxes indicate the dominant life form in the classified habitats. Numerals (from left to right) below the labels are the average important value of deciduous and evergreen trees in the habitat groups. Characters and digits on the branches represent the classification thresholds of the environmental factors. Soil total phosphorus concentration (TP), soil total nitrogen concentration (TN) and soil pH value (pH).

Important Outputs

1. Fang XF, Shen GC, Yang QS. Liu HM, Ma ZP, David C. D, Wang XH (2017) Habitat heterogeneity explains mosaics of evergreen and deciduous trees at local-scales in a subtropical evergreen broad-leaved forest. Journal of Vegetation Science, 28, 379–388.
2. Li XP, Scott X. C, Liu JT, Zheng ZM, Wang XH (2017) Topography-soil relationships in a hilly evergreen broadleaf forest in subtropical China. Journal of Soils and Sediments, 17.1101–1115.

24-ha Subtropical Evergreen Broadleaved Forest Plot at Gutian Mountain in Zhejiang Province

Principal Investigator

Mi Xiangcheng, associate professor in Institute of Botany, CAS. His main research interest is the ecology and evolution of forest community.

Yu Mingjian, Professor of Zhejiang University. His research mainly focuses on vegetation ecology, biodiversity and island biogeography.

Research Team

Ren Haibao, Lai Jiangshan, Chen Lei, Du Yanjun, Liu Xiaojuan, Xue Jianhua, Liang Yu, Zhu Yan, Shen Xiaoli, Ding Ping, Chen Jianhua, Bao Yixin, Guo Liangdong, Li Minghong, Liu Jinsong

Plot Introduction

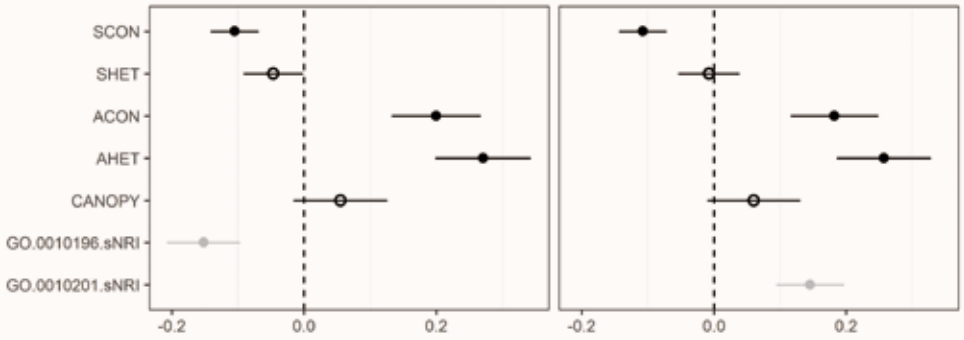
The Gutian Mountain 24-ha plot was established in 2005. It is a typical mid-subtropical evergreen broadleaved forest, with the geographical coordinate 29.25°N, 118.117°E. The altitude varies from 446.3 m to 714.9 m, slope ranges from 12° to 62°. Annual mean temperature is 15.3°C and annual mean precipitation is 1963.7mm. There are 140,700 individuals (DBH ≥ 1 cm) in the plot, belonging to 159 species, 104 genera and 49 families. Trees from Fabaceae, Lauraceae and Theaceae are dominant in the plot, such as *Castanopsis eyrei* and *Schima superba*. Thirty-two species have more than 1000 individuals in the plot, and 59 rare species have less than 1 individual per ha.

The vertical structure of the forest is clear: canopy storey, sub-canopy storey and shrub storey. The maximal DBH is 87.4 cm and the mean value of BDH is 5.21 cm in the plot. The DBH size of individuals in the plot follows the distribution of inverse “J” shape.

The role of transcriptomes linked with responses to light environment on seedling mortality in a subtropical forest

Han Baocai, María Natalia Umana, Mi Xiangcheng, Liu Xiaojuan, Chen Lei, Wang Yunquan, Liang Yu, Wei Wei, Ma Keping
Journal of Ecology. 2017. 105, 592–601.

In tree communities, differences in light use strategies are frequently invoked to explain differences in seedling demographic performance through growth and survival trade-offs. Thus, functional traits related to photosynthesis should be strong predictors of demographic rates, but results in the literature are mixed indicating that additional or alternative information regarding organismal function should be considered. In this study, we provide a community-wide inventory of transcriptomes in a subtropical tree community. This information is utilized to determine the degree to which species share homologous genes related to gene ontologies for light use and harvesting. The results show neighbourhood similarity in three of the 15 gene ontologies evaluated are significantly related to survival rates based on neighbourhood composition. For two of these ontologies, survival rates increase when neighbours are similar in their gene tree composition indicating the importance of abiotic filtering and performance hierarchies. This study demonstrates that exploring the functional genomic similarity of non-model species in nature has the potential to increase the breadth and depth of our understanding of how gene function influences species co-occurrence and population dynamics in communities.



Estimates of fixed effects (±1 SE) for the best models for all seedling species. Filled dots represent significant values ($P < 0.05$) after a Holm correction for multiple tests. Open dots represent non-significant values. SCON is the conspecific seedling density, SHET is the heterospecific seedling density, ACON is the conspecific adult density, AHET is the heterospecific adult density, Canopy is canopy openness, LWR. sNRI is the standardized effect size of the leaf length-width ratio and GO.0010201. sNRI is the standardized effect size of GO:0010201.

Important Outputs

1. Han BC, Umaña MN, Mi XC, Liu XJ, Chen L, Wang YQ, Liang Y, Wei W, Ma KP (2017) The role of transcriptomes linked with responses to light environment on seedling mortality in a subtropical forest. China. Journal of Ecology, 105, 592–601.
2. Du YJ, Queenborough SA, Chen L, Wang YQ, Mi XC, Ma KP, Comita LS (2017) Intraspecific and phylogenetic density-dependent seedling recruitment in a subtropical evergreen forest. Oecologia, 184, 193–203.

20-ha Lower Subtropical Evergreen Broadleaved Forest Plot at Dinghu Mountain in Guangdong Province

Principal Investigator

Ye Wanhui, Professor of South China Botanical Garden, CAS, majors in plant community ecology and population biology, and in recent years his research focus has been the maintenance of community species diversity and ecology of invasive alien species.

Research Team

Cao Honglin, Lian Juyu, Huang Zhongliang, Wang Zhengfeng, Shen Hao, Liu Wei, Bin Yue, Mei Qiming

Plot Introduction

A 20-ha permanent plot was established in lower subtropical evergreen broadleaved forest in Dinghu Mountain of Guangdong Province in 2005, with the geographical coordinate 23.10ºN, 112.32ºE and altitudes ranging from 230 m to 470 m, slope of 30-50 degree. Annual mean temperature in the region is 20.9°C. The average annual precipitation is 1927 mm.

The vegetation in Dinghu Mountain is the typical lower subtropical evergreen broadleaved forest, which can be divided into ravine rain forest, lower subtropical broadleaved forest, montane evergreen broadleaved forest or montane evergreen scrub and grass community along the elevation gradient. There are 71,617 individuals of woody species which are DBH≥1 cm, belonging to 210 species, 119 genera and 56 families in the plot. Vertical structure can be classified into three tree layers (upper, middle and low), one shrub layer and one herb layer and interlayer plants including

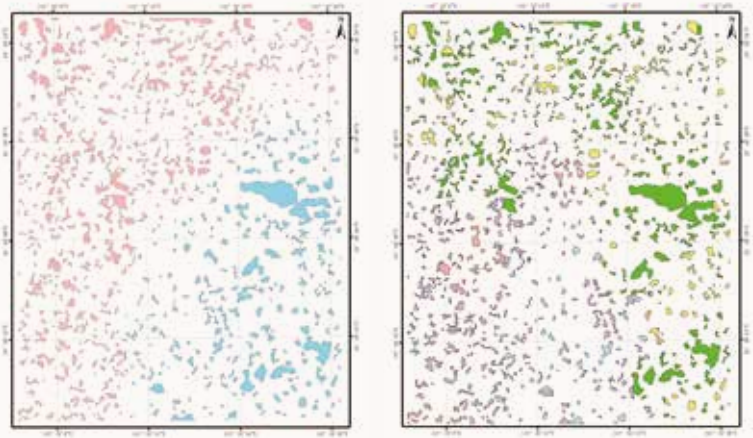
liana and epiphytes. *Castanopsis chinensis*, *Schima superba* and *Engelhardtia roxburghiana* are the three most dominant species in the upper layer. *Syzygium rehderianum*, *Craibiodendron scleranthum* var. *kwangtungense* etc. are dominant species in the middle layer. And *Aquilaria sinensis* is the rare and endangered species in the plot.

The four research priorities in DHS Plot are as follows. (1) Research on the adaptive mechanism and epigenetic diversity pattern of *Castanopsis chinensis* populations in Dinghu mountain; (2) Distribution patterns of tree species in a lower subtropical forest: Linking plant functional traits and hydraulic physiology to community assembly; (3) The local and regional effects on maintenance of eurychoric species and stenochoric species; (4) Measurement of tree species' competition ability and development ability and testing their competition-colonization trade-off.

Gap distribution patterns in the south subtropical evergreen broad-leaved forest of Dinghushan

Sui Dandan, Wang Yue, Lian Juyu, Zhang Jian, Hu Jianbo, Ouyang Xuejun, Fang Zongji, Cao Honglin, Ye Wanhui
Biodiversity Science, 2017, 25, 382-392.

Studying the dynamic characteristics, species coexistence and biodiversity conservation mechanisms of subtropical forest ecosystems is important in the study of the quantitative characteristics and spatial gap distribution patterns. Based on census data from the 20 ha dynamics plot of the subtropical evergreen broad-leaved forest in Dinghushan in 2015, we analyzed the geometric characteristics and spatial distribution pattern of gaps in the plot by combining aerial image processing technology of unmanned aerial vehicles and GIS. Results show that the distribution of gaps in each habitat shows the same pattern as that found in the whole plot. However, the difference in the valley is significant when compared with other habitats, and gap area and gap density in the valley are larger than other habitats. The ridge gap is also distinctive, and its gap density is lower than other habitats. Gap area is significantly correlated with topographic factors. It was significantly negatively correlated with altitude and convexity, and had a significantly positive correlation with aspect and gradient. Based on these comparative analyses, a monitoring system of forest canopy changes and patterns can be established using drones, to dynamically monitor forest gaps and the undergrowth community.



Gap distribution at different maturity levels (A) and in different habitats (B). (A) Pink = Mature forest; Blue = Over-mature forest. (B) Purple = High valley; Blue = High slope; Pink = Ridge; Green = Low valley; Yellow = Low slope.

Important Outputs

1. Shen H, Cai JN, Li MJ, Chen Q, Ye WH, Wang ZF, Lian JY, Song L (2017) On Chinese forest canopy biodiversity monitoring. Biodiversity Science, 25, 229–236. (in Chinese with English abstract)
2. Sui DD, Wang Y, Lian JY, Zhang J, Hu JB, Ouyang XJ, Fang ZJ, Cao HL, Ye WH (2017) Gap distribution patterns in the south subtropical evergreen broad-leaved forest of Dinghushan. Biodiversity Science, 25, 382–392. (in Chinese with English abstract)

25-ha cold-temperate spruce-fir forest plot at Yulong Snow Mountain in Yunan Province

Principal Investigator

Xu Kun, Senior engineer in Kunming Institute of Botany, Chinese Academy of Sciences. His main research interest is plant ecophysiology.

Research Team

Huang Hua, Liu Detuan, Chen Zhifa, Liu Weiwei, Li Jin, Fan Zhongyu, Zhu Wenhao, Meng Qianshun, He Zhixun

Plot Introduction

25–ha Cold–temperate Spruce–fir Forest Plot was established in 2014 at 27.14°N, 100.22°E, located in cold–temperate coniferous forest belt of Yulong snow mountain, which is located in northwest Yunnan and in one of the three plant diversity centers of plant species in China. The altitude of the plot varies from 3220 m to 3344 m. The annual mean temperature is 5.5°C and the annual mean precipitation 1587.5 mm.

There are 47,751 individuals (DBH≥1cm) of woody plants, belonging to 62 species, 41genera and 26 families. The forest communities are dominanted by *Berberis fallax* (28416 individuals) and *Abies forrestii* (5207 individuals), and 6 other species that have over 1000 individuals (totally accounting for 80.18% of the trees). Rare species, i.e. less than 1 individual per ha, account for 35.48% of the total species pool (22 out of 62 species).

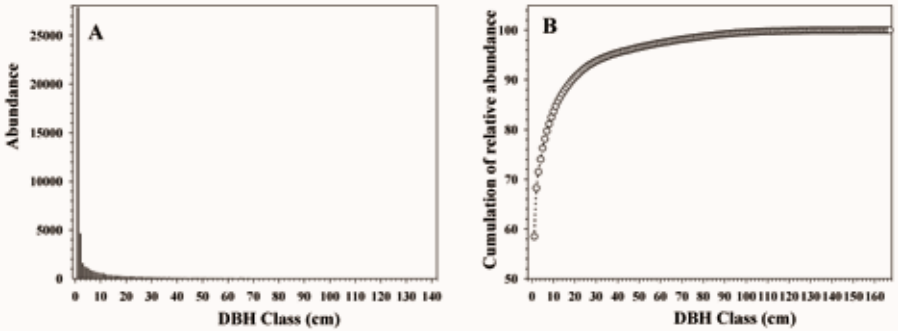
The vertical structure of the forest is divided into four storeys; top canopy, middle canopy, below canopy and shrub storey, which contain 4, 10, 20 and 25 species, respectively. The top canopy storey is dominated by *Abies forrestii*, *Picea likiangensis*, and *Quercus guyavifolia*, middle canopy by *Gamblea ciliata*, *Acer pectinatum* and *Padus brachypoda*, below canopy by *Sorbus prattii*, *Viburnum betulifolium*, and *Rhododendron yunnanense*, and the shrub storey by *Berberis fallax*, *Lonicera tangutica* and *Ilex delavayi*. The structure of the forest community is stable and DBH distribution of all trees follow a reverse "J" shape. Mean DBH of all individuals is 7.50 cm and the maximum is 167.52 cm. The proportion of small (DBH<5cm) individuals achieves 76.24%.

Species composition and community structure of the Yulongxueshan (Jade Dragon Snow Mountain) forest dynamics plot in the cold temperate spruce-fir forest, Southwest China

Huang Hua, Chen Zhifa, Liu Detuan, He Guoxing, Li Dezhu, Xu Kun

Biodiversity Science, 2017. 25(3):255–264

According to the results, a total of 47,751 free-standing individuals with DBH≥1cm were recorded, there were 62 species belonging to 41 genera and 26 families, the north temperate distribution plants were the most important part of floristic character. There were 19 species about IV (importance value) ≥ 1, contributed IV for 91.23. Based on the vertical structure of plant height, the community was divided into four layers. The dominant species in the canopy layer are *Abies forrestii*, *Picea likiangensis* and *Quercus guajavifolia*. The three-canopy species exhibited size structures withridge type and reverse-J shapes associated with continuously regenerating populations. *Acanthopanax evodiaefolius*, *Acer pectinatum* and *Padus brachypoda* occupied the sub-canopy layer and became constructive species of community in some fragment habitat, which lacked small size-class trees and declining population in the future. *Sorbus prattii*, *Viburnum betulifolium* and *Rhododendron yunnanense* dominated the sub-tree layer, and the shrub layer was definitely dominated by *Berberis fallax* with the most abundant individuals accounting for 59.51% of all trees and the biggest IV is about 22.75. The shrub layer dominated by *Berberis fallax* presented "L" distribution.



Size-class abundance (A) and cumulative distribution(B) of all tree species in YLXS plot

Important Outputs

1. Huang H, Chen ZF, Liu DT, He GX, Li DZ, Xu K (2017) Species composition and community structure of the Yulongxueshan (Jade Dragon Snow Mountain) forest dynamics plot in the cold temperate spruce-fir forest, Southwest China. Biodiversity Science, 25(3):255–264. (in Chinese with English abstract)

25-ha Karst Evergreen and Deciduous Broadleaved Mixed Forest Plot at Mulun in Guangxi Zhuang Autonomous Region

Principal Investigator

Zeng Fuping, professor at Institute of Subtropical Agriculture, Chinese Academy of Sciences. His research is mainly focused on vegetation ecology and restoration ecology.

Research Team

Song Tongqing
Peng Wanxia
Du Hu
Zhang Hao
Zeng Zhaoxia
Tan Weining

Plot Introduction

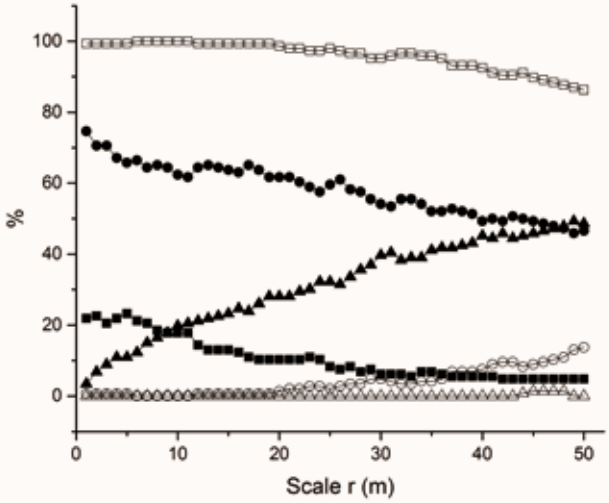
The 25–ha Mulun plot of karst evergreen and deciduous broadleaved mixed forest was established in 2014 at 25°8′N, 108°0′E, located in the area of Mulun National Natural Reserve, Huanjiang Maonan Autonomous County, Guangxi Zhuang Autonomous Region, China. This region belongs to typical karst peak–cluster depression. This forest type has a complicated community structure, rich biodiversity, and high habitat heterogeneity. The altitude of the plot varies from 442.6 m to 651.4 m. The annual mean temperature is 15.0–18.7 °C and the annual mean precipitation is 1530–1820 mm.

There are 108,667 individuals (DBH≥1cm), belonging to 227 species, 147 genera and 61 families. Evergreen woody species account for 62.5% of total species in the plot. The forest communities are dominanted by *Cryptocarya microcarpa*, *Itoa orientalis*, *Platycarya longipes*, *Lindera communis* and *Clausena dunniana*. There are endangered plant species such as *Kmeria septentrionalis*, *Handeliodendron bodinieri*, *Annamocarya sinensis*, *Zenia insignis*, *Eurycorymbus cavaleriei*. The vertical structure of the forest community in the plot is distinguishable, classified into three layers from canopy storey to sub-canopy story and shrub story. The age structure of the forest community in the plot is stable. DBH distribution of all trees followed a reverse "J" shape. The maximum DBH in the plot is 115 cm, the mean DBH is 4.48 cm. Small (DBH<5 cm) individuals account for 72.2% of the total abundance.

Spatial distribution of tree species in evergreen-deciduous broadleaf karst forests in southwest China

Du Hu, Hu Fang, Zeng Fuping, Wang Kelin, Wanxia Peng, Hao Zhang, Zeng Zhaoxia, Zhang Fang, Song Tongqing
Scientific Reports. 2017. 7: 15664

The univariate pair correlation function was used to analyze the spatial distribution patterns of 146 species with at least one individual per ha in a 25-ha plot in southwest China. We used canonical correspondence analysis (CCA) and the torus-translation test (TTT) to explain the distributions of observed species. Our results show that an aggregated distribution was the dominant pattern in Mulun karst forests; the percentage and intensity of aggregated decreased with increasing spatial scale, abundance, mean diameter at breast height (DBH), and maximum DBH. Rare species were more aggregated than intermediately abundant and abundant species. However, functional traits (e.g., growth form and phenological guild) had no significant effects on the distributions of species. The CCA revealed that the four analyzed topographic variables (elevation, slope, aspect, and convexity) had significant influences on species distributions. The TTT showed that not all species have habitat preferences and that 68.5% (100 out of 146 species) show a strongly positive or negative association with at least one habitat. Most species were inclined to grow on slopes and hilltops.



Proportions of species show significant aggregated (square), random (circle), and regular (triangles) distributions at scales from 0 to 50 m based on the complete spatial randomness (CSR) (open symbols) and heterogeneous Poisson process (HPP) (solid symbols) models for the 25 ha Mulun plot.

Important Outputs

1. Du H, Hu F, Zeng FP, Wang KL, Peng WX, Zhang H, Zeng ZX, Zhang F, Song TQ (2017). Spatial distribution of tree species in evergreen-deciduous broadleaf karst forests in southwest China. Scientific Reports, 7: 15664, doi:10.1038/s41598-017-15789-5.
2. Wang H, Chen L, Song M, Song TQ, Zeng FP, Peng WX, Du H, Su L (2017). Spatial heterogeneity of soil phosphorus and potassium in a mixed evergreen and deciduous broad-leaved forest in karst region of southwest China. Acta Ecologica Sinica, 37(24), 8285–8293. (in Chinese with English abstract)

15-ha Karst Seasonal Rain Forest Plot at Nonggang in Guangxi Zhuang Autonomous Region

Principal Investigator

Li Xiankun, Professor of Guangxi Institute of Botany, CAS. His research focuses on the karst vegetation succession and correlation with the environment.

Research Team

Xiang Wusheng, Guo Yili, Wang Bin, Wen Shujun, Bai Kundong, Ding Tao, Lu Shuhua, Huang Yusong, Liu Yan, Huang Fuzhao, Li Dongxing

Plot Introduction

The 15–ha Nonggang Forest Dynamics Plot was established in southern Guangxi in 2011, with the geographical coordinate 22.45°N, 106.95°E. The mean elevation of the plot is 260m, with elevation change of 190m. The annual mean temperature is 20.8–22.4°C and mean annual precipitation is 1150–1550 mm.

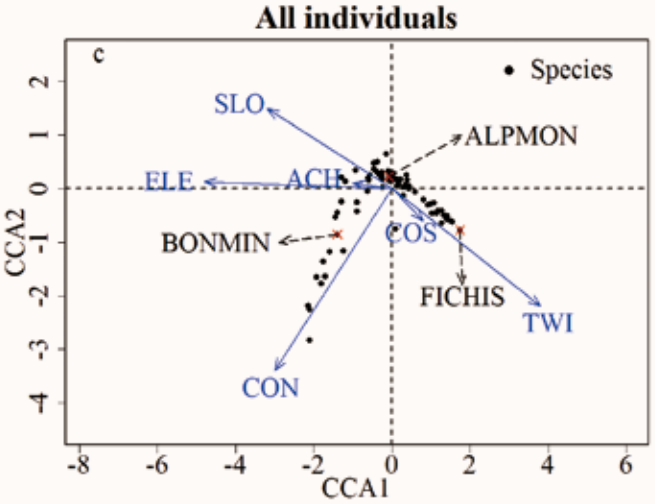
The plot is part of one of the highly important biodiversity hotspots with global significance in China and considered to be typical karst seasonal rainforest. There are 66,718 individual trees with DBH≥1 cm, belonging to 223 species, 153 genera, and 54 families, including 8 species of China's state priority protected wild plants, 30 species of Guangxi endemic plants, and 3 China new recorded species. Representative tree species of the plot is *Excentrodendron tonkinense* (Vulnerable (B1+2c)), *Cephalomappa sinensis* (Endangered, a character species centered in tropical karst forests), *Deutzianthus tonkinensis*, and *Garcinia paucinervis* (Category II national protected species) etc. Trees from Euphorbiaceae, Meliaceae, Moraceae, Annonaceae and Mammea in the plot are typical tree species for the northern part of tropical karst forests. The size distribution of all individuals shows an invert J-shape curve.

Topographic species–habitat associations of tree species in a heterogeneous tropical karst seasonal rain forest, China

Guo Yili, Wang Bin, Azim UM, Huang Fuzhao, Xiang Wusheng, Ding Tao, Wen Shujun, Lu Shuhua, Li Dongxing, He Yunlin, Li Xiankun

Journal of Plant Ecology. 2017. 10, 450–460.

Of the 74 species subjected to torus-translation test, 63 had significantly positive and 70 had significantly negative associations with one or more of the eight habitats. Positive associations were more frequent in higher elevation habitats and negative associations were more frequent in lower elevation habitats. This suggests that edaphic and hydrological variation related to topography play important roles in habitat partitioning in heterogeneous karst forests. The canonical correspondence analysis revealed that the six topographic variables considered had consistent relationships with species distribution among all individuals and their two life stages. This indicates that most of the karst forest tree species show consistent associations with a single habitat through-out their life. We conclude that niche differentiation plays an important role in maintaining the diversity of this heterogeneous species-rich karst forest.



Canonical correspondence analysis diagram showing the relationship of species with the six topographic variables

Important Outputs

1. Guo YL, Wang B, Li DX, Azim UM, Xiang WS, Ding T, Wen SJ, Lu SH, Huang FZ, He YL, Li XK (2017) Effects of topography and spatial processes on structuring tree species composition in a diverse heterogeneous tropical karst seasonal rainforest. Flora, 231, 21–28.

2. Guo YL, Wang B, Azim UM, Huang FZ, Xiang WS, Ding T, Wen SJ, Lu SH, Li DX, He YL, Li XK (2017) Topographic species–habitat associations of tree species in a heterogeneous tropical karst seasonal rain forest, China. Journal of Plant Ecology, 10, 450–460.

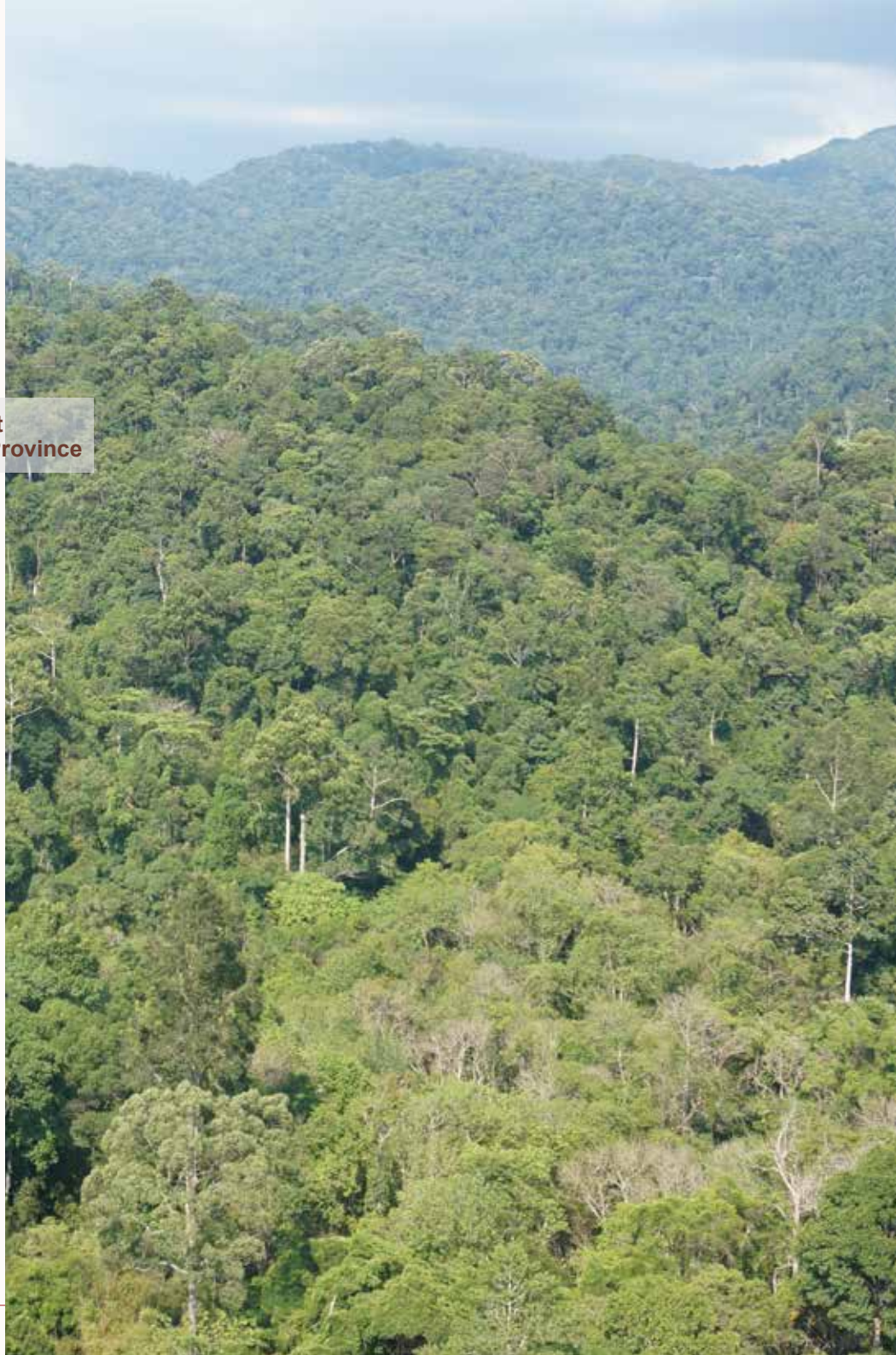
20-ha Tropical Rain Forest Plot at Xishuangbanna in Yunnan Province

Principal Investigator

Cao Min, Professor of Xishuangbanna Tropical Botanical Garden, CAS.

Research Team

Deng Xiaobao
Lin Luxiang
Hu Yuehua
Yang Jie
Sun Zhenhua
Akihiro Nakamura
Li Yuwu
Li Qiaoming
Deng Yun
Zhang Wenfu
Dong Jinlong
Yuan Shengdong
Xu Guorui
Song Xiaoyang



Plot Introduction

A 20-ha tropical seasonal rain forest in Xishuangbanna was established in 2007, with the geographical coordinate 21.61°N, 101.57°E. The topography of this plot is diverse, with an elevation ranging from 709 m to 869 m and three perennial creeks that joined together in the south-eastern corner of the plot. The mean annual temperature is 21.0°C, and the mean annual precipitation is 1532 mm. A total of 95,834 free-standing individuals with DBH≥1cm were recorded in the 20 ha plot, belonging to 468 species, 213 genera and 70 families. The forest has three or four tree layers. The forest was dominated by *Parashorea chinensis* (Category I national protected species), up to 50-60m high in the emergent layer, and its importance value is ranked second. The second and understory layers are dominated by *Sloanea tomentosa, Pometia pinata* (Category III national protected species), and *Pittosporopsis kerrii* etc. This forest is believed to be the northern extension of Southeast Asian tropical rain forest, based on the analysis on floristic composition and community structure of the forest.

Forests and their canopies: achievements and horizons in canopy science

Akihiro Nakamura, Roger L. Kitching, Cao Min, Thomas J. Creedy, Tom M. Fayle, Martin Freiberg, C. N. Hewitt, Takao Itioka, Lian Pin Koh, Ma Keping, Yadvinder Malhi, Andrew Mitchell, Vojtech Novotny, Claire M. P. Ozanne, Song Liang, Wang Han, Louise A. Ashton

Trends in Ecology & Evolution. 2017. 32, 438–451

Canopy is a key ecological interface between forest and atmosphere. With the development of equipment and technology, it has become possible to carry out large-scale cross-regional forest canopy research. This paper reviewed progress and prospective in the canopy science and proposed a number of research directions. How do human disturbances affect forest canopy biodiversity globally? What are the impacts of changes in atmospheric circulation on forest canopy biodiversity? The study of forest crowns is about to unveil a new chapter.

Important Outputs

1. Akihiro N, Roger L. K, Cao M, Thomas J. C, J, Tom M. F, Martin F, C. N. Hewitt, Takao I, Lian PK, Ma KP, Yadvinder M, Andrew M, Vojtech N, Claire M. P. O, Song L, Wang H, Louise A. A (2017) Forests and their canopies: achievements and horizons in canopy science. Trends in Ecology & Evolution, 32, 438–451.
2. Mengesha A, Cao M, Zhang GC, Ci XQ, Li J, Yang J (2017) Environmental filtering structures tree functional traits combination and lineages across space in tropical tree assemblages. Scientific Reports, 7:132, doi:10.1038/s41598-017-00166-z.

By the end of 2017, 17 permanent forest dynamics plots and more than 50 associated plots with the size 1 ha or larger have been set up for CForBio. The total plot area is 513.6 ha. 2,209,400 individuals belonging to 1614 species (DBH≥1 cm) were recorded. The 17 permanent plots are:

No.	Plot	Forest Type	Hectare
1	Dahurian larch forest plot in Daxing'anling	Dahurian larch forest	25
2	Broadleaved-Korean pine mixed forest plot at Fenglin in Xiaoxing'an Mountain	Broadleaved-Korean pine mixed forest	30
3	Broadleaved-Korean pine mixed forest plot & fir valley forest plot at Liangshui in Xiaoxing'an Mountain	Broadleaved-Korean pine mixed forest, Spruce-fir valley forest	9+9
4	Taxus cuspidata forest at Muling	Taxus cuspidata forest	25
5	Deciduous broadleaved Korean pine mixed forest plot at Changbai Mountain	Broadleaved Korean pine mixed forest	25
6	Poplar-birch forest plot at Changbai Mountain	Poplar-birch forest	24
7	Warm temperate deciduous broadleaved forest plot at Dongling Mountain	Warm temperate deciduous broadleaved forest	20
8	Warm temperate deciduous broadleaved forest plot at Baotianman	Warm temperate deciduous broadleaved forest	25
9	Deciduous broadleaved forest plot in a temperate-subtropical ecological transition zone at Qinling in Shannxi province	Deciduous broadleaved forest	25
10	Mid-subtropical mountain evergreen and deciduous broadleaved mixed forest plot at Badagong Mountain	Subtropical evergreen and deciduous broadleaved mixed forest	25
11	Subtropical evergreen broad-leaved forest plot at Tiantong Mountain	Subtropical evergreen broad-leaved forest	20
12	Subtropical evergreen broadleaved forest plot at Gutian Mountain	Subtropical evergreen broad-leaved forest	24
13	Cool-temperate spruce-fir forest at Yulong Snow Mountain	Cool-temperate spruce-fir forest	25
14	Karst evergreen and deciduous broadleaved mixed forest plot at Mulun	Karst evergreen and deciduous broadleaved mixed forest	25
15	Lower subtropical evergreen broadleaved forest plot at Dinghu Mountain	Lower subtropical evergreen broadleaved forest	20
16	Karst seasonal rain forest plot at Nonggang	Karst seasonal rain forest	15
17	Tropical rain forest plot at Xishuangbanna	Tropical rain forest	20

North latitude	East longitude	Establishment	Principle Investigator	Responsible unit	Species number	Family number	Genera number
51.82°	122.99°	2011	Hongwei Ni	Institute of Natural Resources and Ecology,Heilongjiang Academy of Sciences	18	6	12
48.08°	129.12°	2009	Guangze Jin	Northeast Forestry University	46	21	39
47.18 /47.2°	128.88 /128.85°	2006 2005	Guangze Jin	Northeast Forestry University	44/48	15/20	30/34
43.95°	130.07°	2014	Songyan Tian	Heilongjiang Forest Engineering and Environment Institute	57	22	38
42.38°	128.08°	2004	Zhanqing Hao	Institute of Applied Ecology, CAS	52	18	32
42.37°	128.00°	2016	Zhanqing Hao	Institute of Applied Ecology, CAS	63	21	37
39.96°	115.43°	2010	Weiguo Sang Li Zhu	Institute of Botany, CAS	58	18	33
33.49°	111.94°	2009	Xiaojun Du	Institute of Botany, CAS	126	39	77
33.69°	107.82°	2014	Quanfa Zhang	Wuhan Botanical Garden, CAS	119	35	66
29.77°	110.09°	2011	Mingxi Jiang	Wuhan Botanical Garden, CAS	232	53	114
29.8°	121.8°	2009	Xihua Wang	East China Normal University	152	51	94
29.25°	118.12°	2005	Xiangcheng Mi Mingjian Yu	Institute of Botany, CAS; Zhejiang University	159	49	104
27.14°	100.23°	2014	Kun Xu	Kunming Institute of Botany, CAS	62	26	41
25.13°	108.00°	2014	Fuping Zeng	Institute of Subtropical Agriculture, CAS	254	64	161
23.10°	112.32°	2005	Wanhui Ye	South China Botanical Garden, CAS	210	56	119
22.43°	106.95°	2011	Xiankun Li	Guangxi Institute of Botany	223	54	153
21.61°	101.57°	2007	Min Cao	Xishuangbanna Tropical Botanical Garden, CAS	468	70	213