



# Chinese Forest Biodiversity Monitoring Network (CForBio) 2016

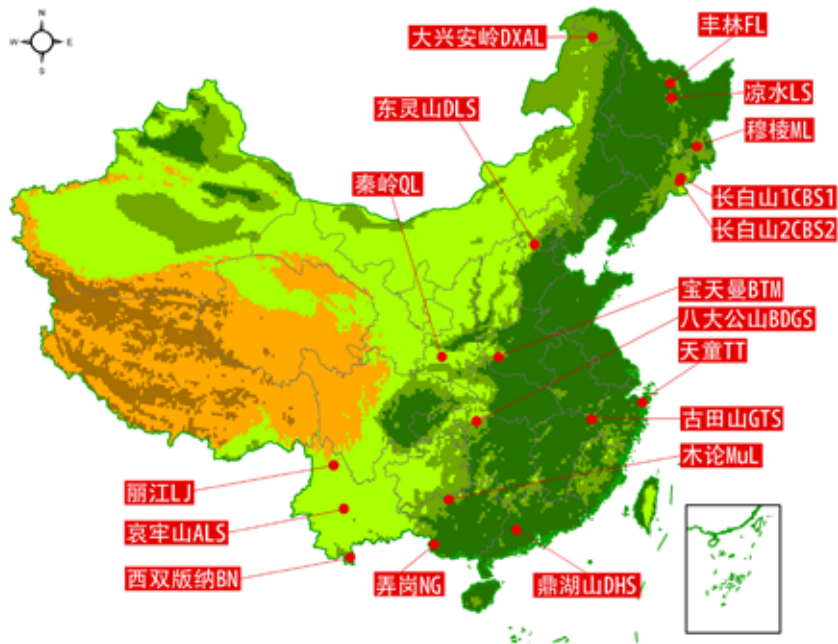


## Chinese Forest Biodiversity Monitoring Network (CForBio)2016

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# Chinese Forest Biodiversity Monitoring Network, CForBio

<http://www.cfbiiodiv.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.cfbiiodiv.org>) was established in 2004. It is a research base for monitoring changes in biodiversity of forest ecosystems in China, and also the most active regional network of 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.

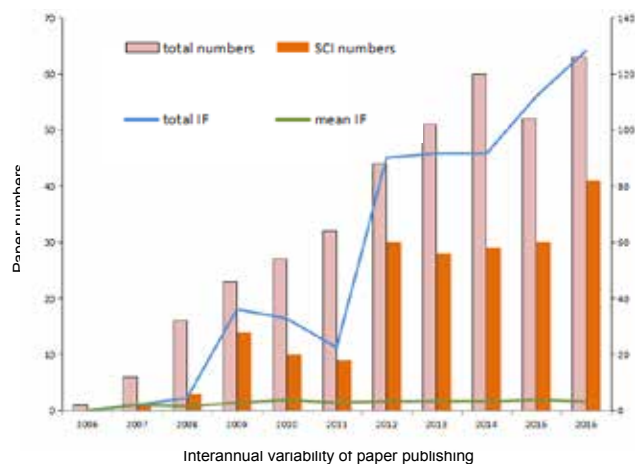
Distinct progress of research on mechanisms of species co-existence and community assembly has been made in recent years, which is being symbolic achievements in community ecology. Approaches of large permanent forest dynamics plots provide unique platform for mechanism studies. By the end of 2016, 18 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 562.6 ha. 2,279,000 individuals belonging to 1737 species (DBH $\geq$ 1 cm) were recorded. The numbers of plots and individuals accounts for 1/4 and 1/3 respectively of the global forest biodiversity monitoring network (ForestGEO) across 24 countries and areas around the world. Among these 18 plots, 13 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 Natural Resources and Ecology, Heilongjiang Academy of Sciences (Daxing'anling plot) and Heilongjiang Province Forest Engineering and Environmental Research Institute (Muling plot).

|    | Location (Province)                          | Plot Type   | Area        |
|----|--|---|-------------|
| 1  | Daxing'anling·Heilongjiang                   | dahurian larch forest   | 25-ha       |
| 2  | Fenglin·Xiaoxing'an Mountains·Heilongjiang   | broadleaved-Korean pine mixed forest  | 30-ha       |
| 3  | Liangshui·Xiaoxing'an Mountains·Heilongjiang | broadleaved-Korean pine mixed forest plot and 9-ha Spruce-fir valley forest | 9-ha / 9-ha |
| 4  | Muling·Heilongjiang                          | Taxus cuspidate forest  | 25-ha       |
| 5  | Changbai Mountain·Jilin                      | deciduous broadleaved Korean pine mixed forest                              | 25-ha       |
| 6  | Changbai Mountain·Jilin                      | secondary poplar-birch forest   | 24-ha       |
| 7  | Dongling Mountain·Beijing                    | deciduous broad-leaved forest   | 20-ha       |
| 8  | Baotianman·Henan                             | deciduous broad-leaved forest   | 25-ha       |
| 9  | Badagong Mountain·Hunan                      | mid-subtropical mountain evergreen and deciduous broadleaved mixed forest   | 25-ha       |
| 10 | Tiantong Mountain·Zhejiang                   | subtropical evergreen broad-leaved forest                                   | 20-ha       |
| 11 | Gutian Mountain·Zhejiang                     | subtropical evergreen broadleaved forest                                    | 24-ha       |
| 12 | Dinghu Mountain·Guangdong                    | lower subtropical evergreen broadleaved forest                              | 20-ha       |
| 13 | Nonggang·Guangxi                             | karst seasonal rain forest  | 15-ha       |
| 14 | Xishuangbanna·Yunnan                         | tropical rain forest  | 20-ha       |
| 15 | Qinling·Shannxi                              | deciduous broadleaved forest  | 25-ha       |
| 16 | Mulun in Guangxi                             | Karst evergreen and deciduous broadleaved mixed forest                      | 25-ha       |
| 17 | Yulong Snow Mountain·Yunan                   | cool-temperate spruce-fir   | 25-ha       |
| 18 | Ailao Mountain · Yunan                       | subtropical evergreen broad-leaved  | 20-ha       |

The same methods followed CTFs procedure 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 the total station. All free-standing trees at least 1 cm in diameter at breast height were tagged, measured and identified to species, and their geographic coordinates were recorded for long term monitoring. Besides the recensu every 5 years, monitoring on seed rains, seedlings, litterfalls, functional traits, tree breast diameters with dendrometers, herbs, soil, logs and wildlife have been carried out.

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, and CForBio has become the most influential and fastest-growing regional research platform. Based on data cross climatic spectrum in CForBio, 375 scientific articles have been published, including 196 SCI papers,

which were published in the mainstream journals, such as *Ecology Letters*, *Ecology* and so on, which including more than 250 worldwide institutions and more than 700 authors 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 ministry of forestry, environmental protection and education of China to carry on biodiversity monitoring projects.



## II. Important Progress

### 1. Plot Maintenance

#### **Routine monitoring:**

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

#### **Plot re-census:**

25-ha mid-subtropical mountain evergreen and deciduous broadleaved mixed forest plot at Badagong Mountain finished the first re-census, 9-ha spruce-fir valley forest plot at Liangshui completed its second re-census, and the third re-census of the 20-ha lower subtropical evergreen broadleaved forest plot and the second re-census of 5 satellite plots of Dinghu Mountain were completed respectively.

#### **Monitoring of tree diameter growth:**

The tree breast diameters monitoring with dendrometers were also carried out in Changbai Mountain plot, Badagong Mountain plot, Gutian Mountain plot, Dinghu Mountain plot and Xishuangbanna plot, which recorded 1,637, 2,088, 3,800, 3000 and 2,175 tree individuals, respectively, 12,760 individuals in total.

#### **Functional traits measurement:**

To further explain the mechanisms of species co-existence and community assembly, besides Changbai Mountain plot, Dongling Mountain plot, Gutian Mountain plot and Xishuangbanna plot, the functional traits at individual level was also measured in Nonggang plot this year.

#### **Other maintenance:**

The 5 ha popular-birch forest plot was expanded to 24 ha in Changbai Mountain site; the forest canopy biodiversity monitoring platform was built up by Gutian Mountain plot, consisting of crane system with 60 m height and 60 m arm length, which covering 1.13 ha area of typical subtropical evergreen broadleaved forest; a 140×160 m<sup>2</sup> plot was established in the 20 m buffer area to the community covered by the crane arm, all free-standing trees at least 1 cm in diameter at breast height were tagged, measured and identified to species, and their geographic coordinates were recorded; unmanned aerial vehicle was used to synchronous monitoring on forest canopies in Dinghu Mountain plot, forest gap and its spatial pattern were analysed; four seed traps were repaired and 10 new ones were set up, and all frames of seedling plots were replaced in Nonggang plot.

#### **Overseas expansion:**

The collaboration with Thailand was promoted by Xishuangbanna Tropical Botanical Garden, Chinese Academy of Sciences, an Asian tropical rain forest dynamics plot network was established to Central South Peninsula of Southeast Asia. There are 10 large permanent forest plots, including one subalpine coniferous forest and one subtropical evergreen broadleaved forest plot. About 3000 species and 1 million individuals were recorded. This regional network is a complement to CForBio for the tropical rain forest.





### Functional traits and tree growth:

Utilizing detailed tree growth and trait data in a subtropical forest, we have demonstrated that individual-level functional traits strongly predict individual tree growth. The strength of these predictions is facilitated by using information regarding the soil environment, identity of neighboring individuals and other trait values for the same individual. Without this contextual information, single trait values taken from an individual are often no better predictors of individual growth than an average trait value for the population or species(Liu et al., Ecology, 2016. 97(9):2396-2405).

### Negative Density dependence:

Shared habitat requirements between closely related individuals are thought to be a cause of observed positive effects of closely related neighbors, which may affect the strength and detectability of conspecific negative density dependence (CNDD) or phylogenetic negative density dependence (PNDD). By comparing models with and without habitat variables, it is found that while habitat filtering affected the detection of CNDD by decreasing its apparent strength, it did not explain the PNDD (Wu et al., Ecology, 2016. 97(5): 1182-1193).

### Spatial patterns and driving factors:

We explored the large-scale patterns of woody species turnover across the latitude gradient based on eight large stem-mapping plots in East Asia. The patterns of woody species turnover increased significantly with increasing latitude differences in East Asia. Our results support the hypothesis that the effect of neutral processes on woody species turnover is more important than the effect of the environment. Neutral processes explained more variation for turnover of tree species and environmental factors explained more variation for the turnover of shrub species on a large scale. Therefore, trees and shrubs should be provided different protection strategies in future biodiversity conservation(Chen et al., *Frontiers in Plant Science*, 2016. 7:1533.).

Using the 20-ha Dinghushan plot as an example, we used lightweight unmanned aerial vehicles (UAVs or drones) to collect fine-resolution (~5 cm) data on forest canopies. By combining drone-derived canopy variables, detailed ground-based stem-mapping data and topographic and edaphic

variables, we evaluated the relative importance of these variables in explaining local-scale variation in forest stand and species measures(Zhang et al., Biological Conservation, 2016. 198: 60-69).

## III. Program Management

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

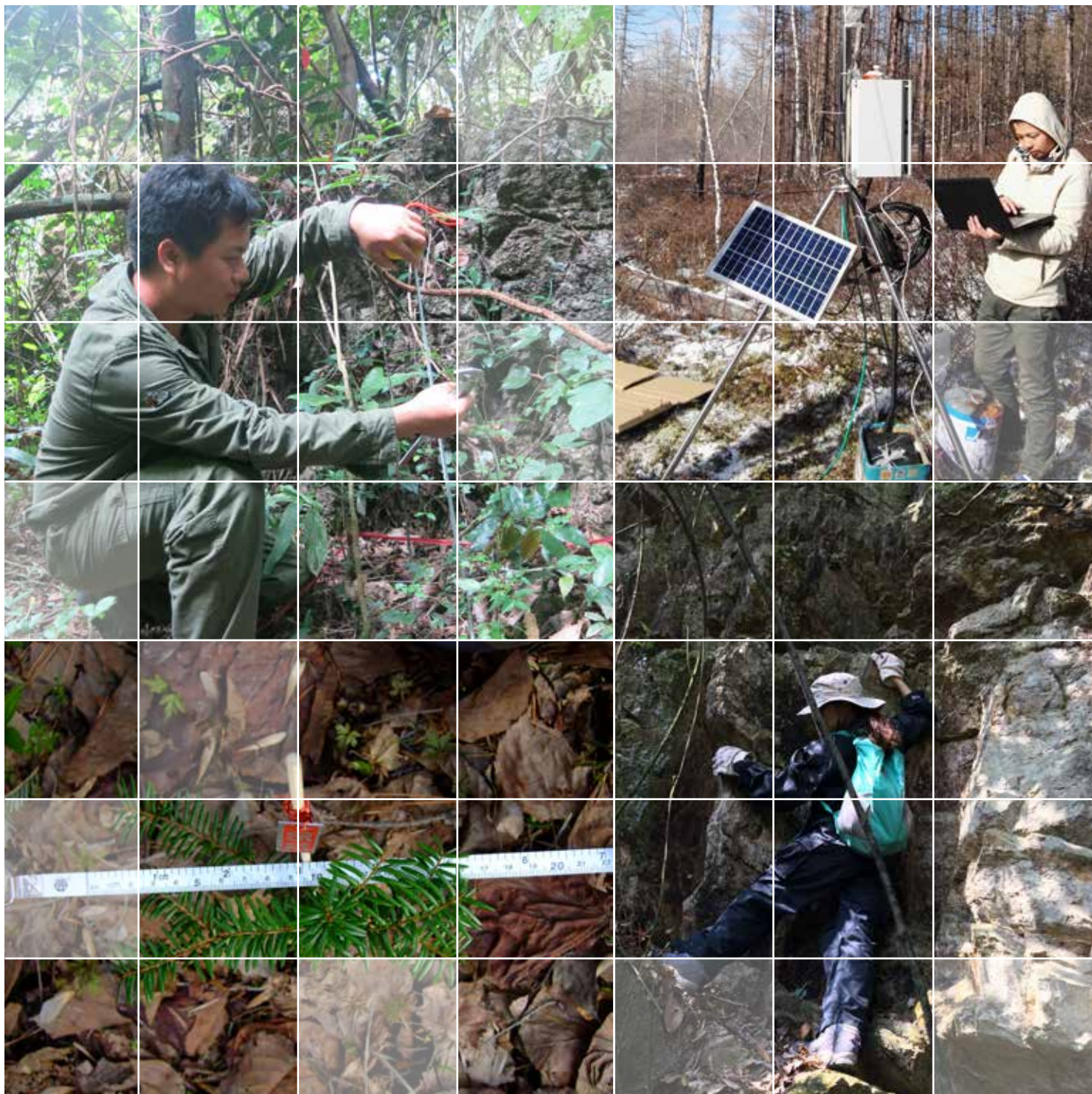
## IV. Paper Publication

Sixty-three research papers were published in 2016. Among them, 41 were in SCI-indexed journals. 17 papers were published in international journals with IF >3.0, such as *Ecography*, *Ecology*, *Biological Conservation* and so on.

## V. Funds-raising

The research teams received 7 regular projects, one Young Investigator project from the National Natural Science Foundation of China (NSFC), two Regional International Cooperation Foundation projects from Southeast Asia Biodiversity Research Institute, Chinese Academy of Sciences, one project from National Regional Science Foundation of China, one project from China Postdoctoral Science Foundation, two projects from Heilongjiang Province Foundation for Overseas Returnees, one project from local entrusted program.







## 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 2016, 151 M, 1.94 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 institutes of Chinese Academy Sciences. Almost 2000 GB of photos (300 thousand) and videos were shared in 2016. 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

### 1. Training course on physiological ecology of natural vegetation

On May 11-13, the workshop of natural vegetation physiological ecology was held in Institute of Botany, CAS. About 100 participants from 14 institutes attended the workshop.

Prof. Christian Felix Körner from the University of Basel set 6 sessions, combined with visual images and graphs, on the following topics: carbohydrate balance analysis of trees under drought conditions, tree phenology and species distribution limits, timberline in high altitude area, growth mechanism of plant in high altitude area, relationship between nutrition and carbon of plants in subalpine ecosystem and low-temperature metabolism. He focused on the mechanism behind the patterns and helped participants be more objective and accurate to understand the mechanism of the feedback of natural vegetation affected by different environmental factors. He also guided them to learn to subvert the existing "common sense", stimulating the students' curiosity and enthusiasm for learning. The workshop was a great success.

## 2.The Second Application of LiDAR to Forest Ecology Workshop

Hosted by Institute of Botany, CAS, the Biodiversity Committee, CAS, Satellite Forestry Application Center of State Forestry Administration and Chinese Biodiversity Observation and Research Network, supported by State Key Laboratory of Vegetation and Environmental Change and BC-CAS, the Second Workshop on Application of LiDAR to Forest Ecology was held on June 3-5. More than 220 participants from over 60 institutions attended the workshop.

The workshop was combined with lectures and practical operations, and focused on feedback and interactions. Profs. Nicholas Coop from University of British Columbia, Keping Ma and Qinghua Guo from Institute of Botany, Zengyuan Li and Yong Pang from Chinese Academy of Forestry, Zhongke Feng and Huaguo Huang from Beijing Forestry University gave lectures on biodiversity monitoring, ecosystem structure and function survey by using LiDAR. The State Key Laboratory of Vegetation and Environmental Change undertook the training on practice and software practices. The course promoted the development and application of LiDAR in China, allowing more researchers to understand and apply this technology.







### 3. The Tenth Cross-Straits Workshop on Forest Dynamics Plots

Hosted by Biodiversity Committee, Chinese Academy of Sciences (BC-CAS), co-organized by Ecological Society of Beijing, funded by CAS, the 10th Cross-Straits Workshop on Forest Dynamics Plots was held in Beijing, China on Oct. 14th, 2016. More than 170 participants attended the workshop.

Two plenary talks were given by Profs. Jian Zhang from East China Normal University and Chengjin Chu from Sun Yat-Sen University. Twenty-six talks were focused on forest dynamics, spatial patterns, diversity and its maintaining mechanisms, and so on. Four talks focused on extension of CForBio, research on functional traits based on forest crane network, establishment of comprehensive monitoring system of plots, and the future of research approach on community assembly. The participants extensively discussed these topics during the workshop.

Some participants attended the workshop in Xinjiang, co-hosted by Key Laboratory of Biogeography and Bioresource in Arid Land, CAS. Nine speakers talked on forest ecology and biodiversity informatics, and discussed about plant community assembly, germplasm conservation and spatial patterns in biodiversity.

The workshop promoted cross-strait academic exchanges and ecology progress. It presented the important results of CForBio, and discussed the future directions of the network.



## VIII. International Cooperation

### 1. Academic Visit

- From June 2015 to June 2016, Dr. Chen Lei from Gutian Mountain plot visited Dr. Nathan Kraft's lab at University of Maryland, College Park and University of California, Los Angeles, and carried out collaborative studies on the ecological effects of climate change on seedling dynamics and specialization of soil pathogens.
- From December 2015 to December 2016, Dr. Liu Xiaojuan from Gutian Mountain plot visited Dr. Nathan Swenson's lab at University of Maryland, College Park for the collaborative research on functional diversity along elevational and latitudinal gradients.
- From January to December, Dr. Zhu Yan from Gutian Mountain plot has been visiting Dr. Liza Comita's lab at Yale University, and carried out collaborative studies on the temporal variation of density dependence.
- In January and June 2016, Prof. Wang Xugao visited Thorsten Wiegand's lab in German Centre of integrative biodiversity research (iDiv), and conducted research on mechanisms of maintenance of tree species diversity in forests.
- On April 10-12, Prof. Jens-Christian Svenning from Aarhus University, Denmark visited Gutian Mountain forest plot.
- On May 10, Dr. Nancy S. Sung, the head of Beijing Office of U.S. National Science Foundation, along with Mr. Sun Bo visited Dongling Mountain Plot, and discussed the future work on forest biodiversity monitoring.
- On July 6, Drs Jan Axmacher and Samul Landers from University College London visited Dongling Mountain Plot, and discussed the experiment on beetle function in the decomposition of coarse woody debris.
- On July 10, Profs. Pamela S. Soltis and Douglas E. Soltis from University of Florida, USA visited Gutian Mountain plot. From August to December, Du Xiaojun from Baotianman plot visited the University of California, Los Angeles, USA.
- On June 20-27, 2016, Dr. Yan Zhu from Gutian Mountain plot visited Prof. He Fangliang's lab in University of Alberta, Canada.
- On August 2, Prof. Bernhard Schmid from University of Zurich, Dr. Wen Xiangying from China office of Botanic Gardens Conservation International and Dr. Wang Zhiheng from Peiking University visited Gutian Mountain plot.
- On August 7-12, Prof. Sang Weiguo from Dongling Mountain plot visited Harvard Forest, including labs, permanent plots and associated experiment facilities, related collaborative projects, especially the visiting of researchers and students of Dongling Mountain to Harvard Forest were discussed.
- On August 12-16, Prof. Hao Zhanqing from Changbai Mountain plot visited University of Maryland, USA to conduct cooperation research on phylogenetic diversity.
- On August 29-31, Dr. William McShea visited Gutian Mountain plot, and discussed on the reserve-wide gridded animal diversity monitoring.
- From August to December, Dr. Jin Yi from Gutian Mountain plot visited Dr. Sabrina E. Russo's Lab at University of Nebraska-Lincoln for 6 months, and discussed with Dr. Russo about canopy gap effects on community regeneration and species coexistence.
- On September 16, Prof. Aaron Ellison visited Dongling Mountain plot, and deeply discussed on data analysis and relationship among distribution of coarse woody debris, topography and living trees.
- From October to December, Li Meng from Dinghu Mountain plot visited Kazimierz Wielki University of Poland, guided by Prof. Jarosław Burczyk and Igor Chybicki, working on genetic structure and mating system of plant population for her Ph.D project.
- From October to December, Chen Jie from Dinghu Mountain plot visited Prof. Yakov Kuzyakov's lab in University of Goettingen, Germany, working on soil microbial phosphorus transformations.
- From November to December, Jia Shihong from Changbai Mountain plot visited University of Connecticut conducting research on seedling dynamics.

- From November to December, Wang Yunyun from Changbai Mountain plot visited University of Sheffield, conducting research on forest seed dynamics.
- From November to December, Dr. Bin Yue from Dinghu Mountain plot visited Sabrina Russo's lab in University of Nebraska, Lincoln, USA, for the collaborative research on seed dispersal and species migration rates.
- On December 4-27, Dr. Yuan Zuoqiang visited University of Sheffield, UK to conduct cooperation research on forest biodiversity and ecosystem function.
- On December 21-29, Prof. Craig Martin from University of Kansas, USA visited Changbai Mountain plot.



## 2. International Conference and Exchange

- On July 8-21, Zhu Yu from Liangshui plot, Wang Xugao and Jia Shihong from Changbai Mountain plot, Mi Xiangcheng from Gutian Mountain plot, Du Xiaojun and Wei Boliang from Baotianman plot, Song Xiaoyang, Xia Shawen and Zhang Caicai from Xishuangbanna plot joined the CTFs-CForBio Workshop VI. on data analysis and paper writing.
- On August 5-12, Prof. Hao Zhanqing from Changbai Mountain plot, Profs. Yu Mingjian and Ding Ping, Drs. Jin Yi and Zhu Yan from Gutian Mountain plot attended ESA annual meeting in Lord Lauderdale of Florida in USA and presented oral talks and posters.
- On September 20-24, Prof. Jin Guangze, Drs. Liu Zhili and Cai Huiying et al. participated in the international workshop on lessons learned and challenges from forest long-term ecological research in the Northeast Asian Region organized by Northeast Forestry University, IUFRO Working Party 1.01.13 and Seoul National University. Liu Zhili presented a report on Long-term ecological research progress for typical mixed broadleaved-Korean pine forest.
- On October 19-22, Profs. Ma Keping and Yu Mingjian, Drs. Shen Xiaoli and Mi Xiangcheng joined the US-China biodiversity bilateral workshop in Hanzhou. After the workshop, more than 20 participants visited Gutian Mountain plot.
- On November 1-3, Daxing'an Mountain plot attended the International Forum on Ecosystem Function and Global Change, and a report on snow cover effect on greenhouse gas of *Larix gmelinii* forest soil in great Khingan Mountains was given.
- On November 6-12, Prof. Cao Min, Drs. Aki Nakamura and Yang Jie from Xishuangbanna plot attended the workshop on biodiversity in Great Smoky Mountains National Park, and a speech on biodiversity in Yunnan, with special perspective to future cooperation with ATBI by Prof. Cao Min, and a speech on biodiversity inventory of arthropods in tropical, subtropical and subalpine forests in Yunnan Province by Aki Nakamura, and a speech on tropical, subtropical and subalpine forest dynamics plots in Yunnan Province by Yang Jie were presented respectively.
- On November 17-27, Dr. Lai Jiangshan from Gutian Mountain plot was invited by Kathmandu Center for Research and Education, CAS and Tribhuvan University to present a ten-day R training courses in statistical method. Academician Yao Tandong, Director General of KCRE, and Institute of Tibetan Plateau Research, CAS issued Dr. Lai the letters of appointment. Chandra Mani Paudel, the former vice president of Tribhuvan University and more than 20 teachers participated in the training.
- On November 22-23, Prof. Lin Luxiang attended the Forth workshop on Science and Technology Cooperation - Biodiversity: secure our future, and a speech on advances on the '101°E' forest transect from Southwest China to the Central-Southern Peninsula was presented.
- On December 11-14, Dr. Yuan Zuoqiang and Wang Yunyun attended 2016 annual meeting of British Ecological Society.





## IX. Online Communication Platform

The Website for CForBio (<http://www.cfbiodiv.cn>) is in operation. The column of shared resources released information on conferences and training courses. Over 90 published papers related to hotspots in ecology were recommended to “research update” column, and the page reached 26475 views. Twenty-six news were released in “new notice”, the page reached 11490 views.

**中国森林生物多样性监测网络**  
CHINESE FOREST BIODIVERSITY MONITORING NETWORK

CForBio

首页 网络概况 共享资源 红外照片 研究成果 联系我们 English

**温带**

- 黑龙江大兴安岭25ha样地
- 黑龙江丰林30ha样地
- 黑龙江凉水18ha样地
- 吉林长白山25ha样地
- 吉林长白山5ha样地
- 北京东灵山20ha样地
- 北京东灵山5ha样地
- 河南宝天曼26ha样地

**亚热带**

- 浙江天童山20ha样地
- 湖南八大公山25ha样地
- 浙江古田山24ha样地
- 浙江百山祖5ha样地
- 广东鼎湖山20ha样地

**热带**

**研究动态**

不同取样强度下古田山木本植物幼苗组成及其分布格局比较  
2016-11-27  
《生物多样性》第10期  
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从世界自然保护大会看生物多样性保护的新趋势  
2016-11-21  
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The influence of spatially structured soil properties on tree community assemblages  
2016-11-21  
Accepted manuscript online...  
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## X . Plot Introduction and Annual Progress

25-ha warm temperate deciduous broadleaved forest plot  
Baotianman, Henan province

25-ha deciduous broadleaved-Korean pine mixed forest plot  
Changbai Mountain, Jilin province

9-ha broadleaved-Korean pine mixed forest plot and  
9-ha Spruce-fir valley forest

30-ha broadleaved-Korean pine mixed forest plot  
Fenlin, Xiaoxing'anling, Heilongjiang province

25-ha *Taxus cuspidata* forest plot at  
Muling in Heilongjiang Province

25-ha mid-subtropical mountain  
evergreen and deciduous broadleaved  
mixed forest plot Badagong Mountain,  
Hunan province





20-ha lower subtropical evergreen  
broadleaved forest plot  
Dinghu Mountain, Guangdong  
province

15-ha karst seasonal rain forest plot  
Nonggang, Guangxi Zhuang Autonomous Region

20-ha subtropical evergreen broad-leaved forest plot  
Tiantong Mountain, Zhejiang province

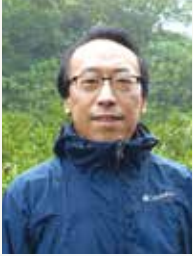
20-ha tropical rain forest plot  
Xishuangbanna, Yunnan province

20-ha warm temperate deciduous broadleaved forest plot  
Dongling Mountain, Beijing

24-ha subtropical evergreen broadleaved forest plot  
Gutian Mountain, Zhejiang province

25-ha dahurian larch forest plot  
Daxing'anling, Heilongjiang province





## 25-ha dahurian larch forest plot at Daxing'anling Mountain in Heilongjiang Province

### Principal Investigator

Ni Hongwei, professor of Institute of Natural Resources, Heilongjiang Academy of Sciences. His research interests focus on, biodiversity science, vegetation ecology and wetland ecology.

### 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'anling Region, which was established in 2011, located in the north slope of Yilehuli mountains, 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.

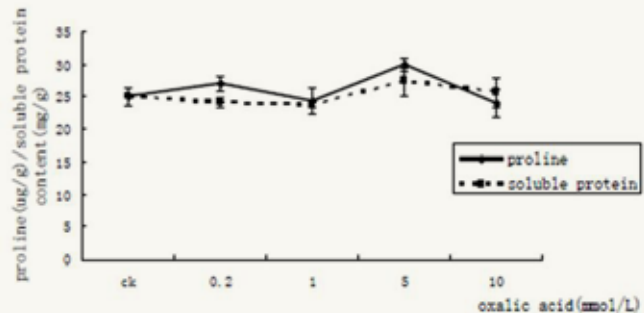
Total number of individuals with DBH $\geq$ 1 cm was 209,785 recorded in the plot, belonging to 18 woody species (4 tree species, 14 shrub species), belonging to 12 genera and 6 families. The maximum DBH in the plot was 52 cm, the mean DBH and basal area were 3.87 cm and 20.93 m<sup>2</sup>/ha, respectively.

## Estimation of seasonal variations of leaf area index using both litterfall collection and optical methods in four mixed evergreen-deciduous forests

Cui Fuxing, Song Jinfeng, Zhu Daoguang, Li Jinbo, Qi Zhenyang, Shan Lin, Ni Hongwei

*International Conference on Biological Sciences and Technology (BST 2016)*. 331-336

Organic acids obviously affect plant survival and growth under soil nutrient deficiency condition. Variable proportion A1 and C horizon mixed cold temperate brown coniferous forest soils was applied to make soil nutrient deficiency condition, and then *Larix gmelinii* seedlings were planted in these soils. On the basis of oxalic acid concentration range of forest litter leachate at the northeast forest region, oxalic acid solution with different concentration was sprayed on the surface of *Larix gmelinii* seedlings, and the effects of oxalic acid on physiological-biochemical traits of *Larix gmelinii* seedlings were studied in our experiment. Results showed that the electrical conductivity and MDA content of *Larix gmelinii* seedlings were decreased with the increase of oxalic acid concentration. Most SOD and POD activity of *Larix gmelinii* seedlings were increased. 5.0 mmol·L<sup>-1</sup> oxalic acid has significant effects on proline and soluble protein osmotic adjustment substances. And *Larix gmelinii* seedlings grew well at the concentration of 10.0 mmol·L<sup>-1</sup> oxalic acid.

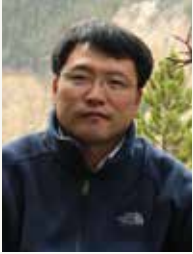


Oxalic acid effect of on *Larix gmelinii* seedlings osmotica content under soil nutrient deficiency

## Important Outputs

1. Cui Fuxing, Song Jinfeng, Zhu Daoguang, Li Jinbo, Qi Zhenyang, Shan Lin and Ni Hongwei. 2016. Effects of oxalic acid on physiological-biochemical traits of cold temperate *Larix gmelinii* seedlings under soil nutrient deficiency. *International Conference on Biological Sciences and Technology (BST 2016)*. 331-336.





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

### Principal Investigator

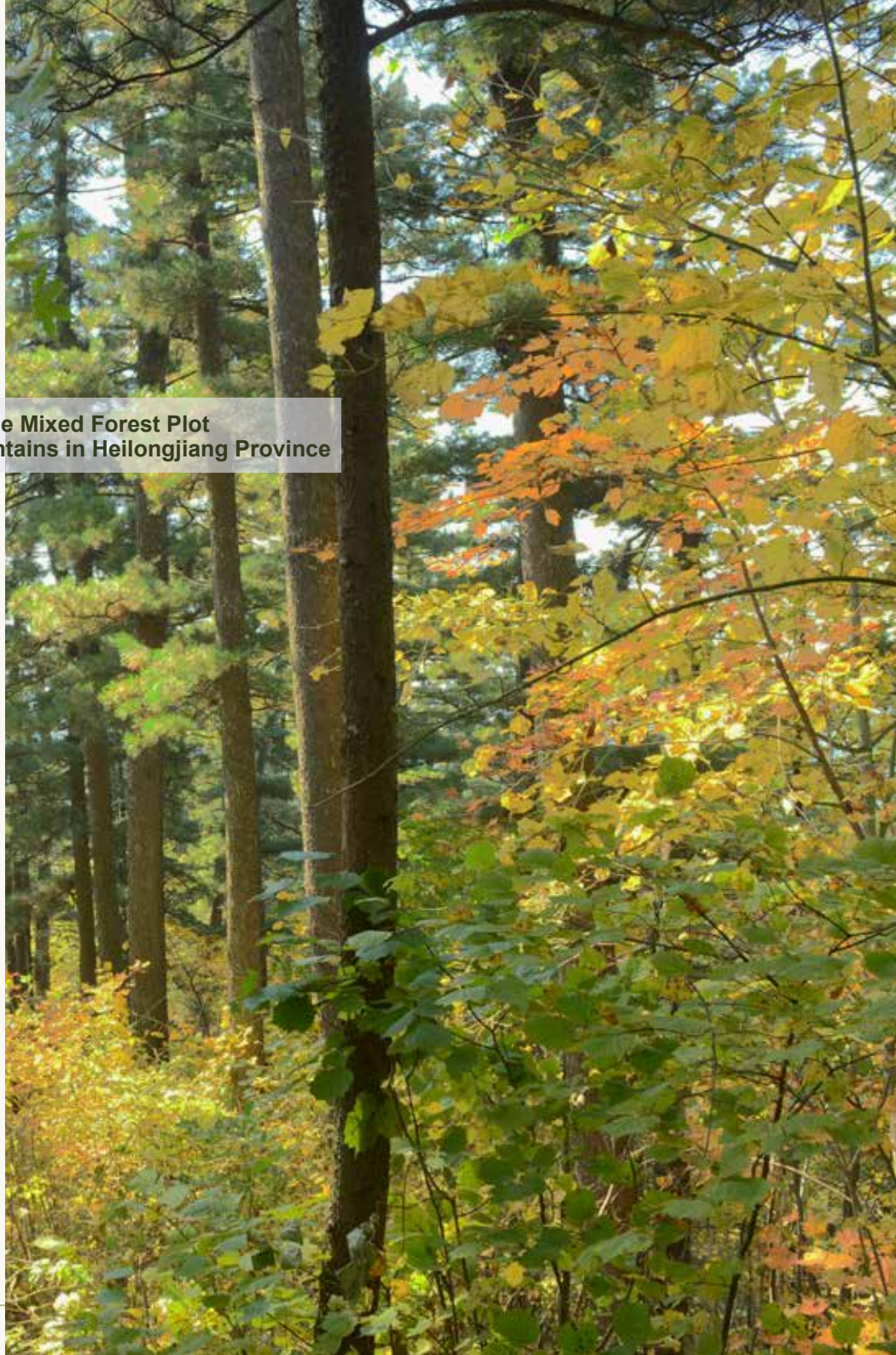
Jin Guangze, Professor of Northeast Forestry University. His research is focused on forest ecology, biodiversity and conservation.

### 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 Mountains (48.08°N, 129.12°E). The flora belongs to Xiaoxing'an Mountains 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.



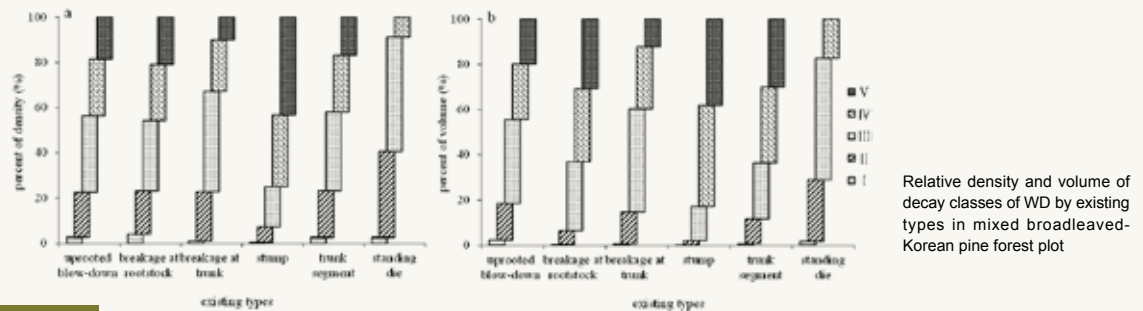
This plot has a complex community composition and high species diversity, which is dominated by *Pinus koraiensis*, with some subtropical vegetation landscape characteristics. The forest remains some tertiary relic species such as *Fraxinus mandshurica*, *Juglans mandshurica*, *Acer mono*, *Tilia amurensis*,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

94,920 individuals with DBH  $\geq 1$  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<sup>2</sup>/ha, respectively.

## Characteristics of woody debris in broadleaved-Korean pine forest plot in Fenglin National Nature Reserve in Xiaoxing'anling Moutains, China

Chen Jingyuan, Bi Lianzhu, Song Guohua, Zhang Wei, Wang Quanbo, Liu Yanyan, Jin Guangze  
*Journal of Nanjing Forestry University (Natural Sciences Edition)*. 40(6): 76-84

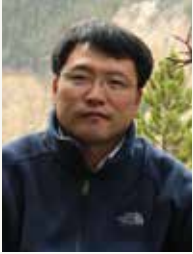
Woody debris (WD), including coarse woody debris (diameter  $\geq 10$  cm, CWD) and fine woody debris (10 cm > diameter  $\geq 1$  cm, FWD), is one of the most important components in forest ecosystems. This study aimed to understand the species composition, diameter distribution, existing types and decay classes of WD, and their relationships with stand factors.(1) The total volume of WD with diameter  $\geq 1$  cm was 104.26 m<sup>3</sup>/hm<sup>2</sup>. The volume proportion of FWD to CWD was 0.5: 99.5; (2)The diameter distribution of WD density showed typical reverse J-shaped curve, the small size WD ( $\leq 20$  cm) was accounted for 52.9% of the total density. The volume of WD showed nearly J-shaped curve. The volume of *Pinus koraiensis* increased with diameter, the other species displayed almost normal distribution; (3) Existing types of WD were mainly composed of trunk segment, uprooted blow-down and breakage at rootstock. As the increasing of diameters, the density and volume percentage of trunk segment decreased, and uprooted blow-down and breakage at rootstock initially increased, then decreased; (4) The decay classes of CWD showed nearly normal distribution curve, peaked at the classes of III and IV; (5) The total density of WD was positively correlated with the total density of living tree ( $P < 0.05$ ); The total basal area of WD was negatively correlated with total volume, max diameter at breast height (DBH) and mean DBH of living tree ( $P < 0.05$ ); The total volume of WD was negatively correlated with the total basal area and the total volume of living tree ( $P < 0.05$ ); On the whole, the density, basal area and volume of the decay classes of III, IV, V were significantly correlated with basic parameters of living tree.



### Important Outputs

1. Chen Jingyuan, Bi Lianzhu, Song Guohua, Zhang Wei, Wang Quanbo, Liu Yanyan and Jin Guangze. 2016. Characteristics of woody debris in broadleaved-Korean pine forest plot in Fenglin National Nature Reserve in Xiaoxing'anling Moutains, China. *Journal of Nanjing Forestry University (Natural Sciences Edition)*. 40(6): 76-84. (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 Mountains 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  
Liu Shuang  
Zhu Yu

### 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 Mountains. The mean annual temperature is -0.3°C and mean annual precipitation is 676 mm.





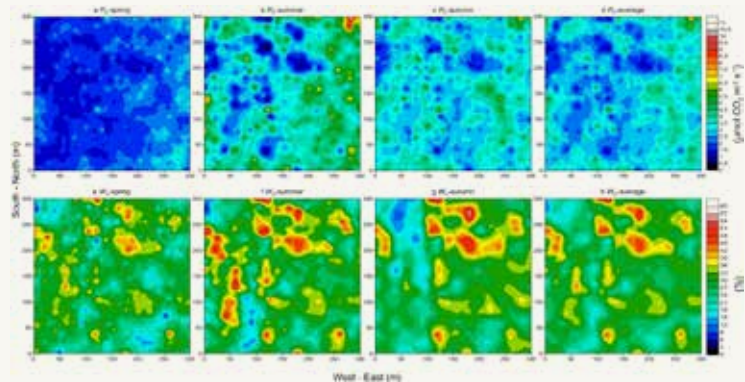
The 9-ha Broadleaved-Korean pine forest plot was established in 2005. *Pinus koraiensis* are dominant species, and major associated tree species include *Tilia amurensis*, *T. mandshurica*, *Betula costata*, *Fraxinus mandshurica* etc. 21,382 independent individuals with DBH $\geq$ 1 cm were recorded, 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<sup>2</sup>/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  $\geq$  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<sup>2</sup>/ha, respectively.

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

Shi Baoku, Gao Weifeng, Cai Huiying, Jin Guangze  
*Plant and Soil*. 2016. 400:263-274

The aim of this study was to quantify and understand the driving factors of the spatial variation of soil respiration (RS) in an old-growth mixed broadleaved-Korean pine forest in northeastern China. All woody stems  $\geq$  1 cm diameter at breast height (DBH) were measured in the 9 ha plot. Simultaneous measurements of RS, soil temperature (TS) and soil water content (WS) were conducted 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 May, July and September of 2014. The results showed that the variogram analyses revealed 87–91% of the sample variance was explained by autocorrelation over a range of 15 to 23 m during the observation periods. The spatial patterns of RS did not remarkably vary from season to season. The spatial variation of RS was tightly linked to the forest stand structure and soil parameters, such as the WS and BD, which were easily obtained. These results have implications for an optimum sampling setup. For example, at a plot or ecosystem scale, it is possible to generate biased average RS estimates if the number of replicates is small or measurement points are located close to each other (<spatial autocorrelation length). These findings enable us to understand the mechanisms underlying RS and estimate the net ecosystem C exchange at the ecosystem scale in an old-growth mixed broadleaved-Korean pine forest in northeastern China.



Spatial distribution of soil respiration (RS) and soil water content (WS) in spring, summer, autumn and the growing season

### Important Outputs

1. Shi Baoku, Gao Weifeng, Cai Huiying and Jin Guangze. 2016. Spatial variation of soil respiration is linked to the forest structure and soil parameters in an old-growth mixed broadleaved-Korean pine forest in northeastern China. *Plant and Soil*. 400:263-274.
2. Cai Huiying, Di Xueying, Scott X. Chang, Wang Chuankuan, Shi Baoku, Geng Pengfei and Jin Guangze. 2016. Carbon storage, net primary production, and net ecosystem production in four major temperate forest types in northeastern China. *Canadian Journal of Forest Research*. 46:143-156.



## 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  
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 °E. The altitude varies from 658 m to 781 m, with a maximum altitude difference of 123m. The mean annual temperature is -2°C, and mean annual precipitation is 530 mm.

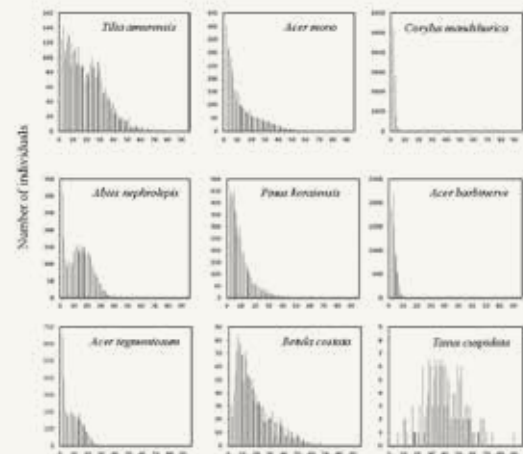
The *Taxus cuspidata* forest plot is a typical middle-aged multi-storied uneven aged forest with obvious dominant species. The main constructive species include *Tilia amurensis*, *Pinus koraiensis*, *Acer mono*, *Abies nephrolepis* and *Betula costata* etc. 63,877 individuals (126,573 individuals including branches at ground surface) with DBH  $\geq$  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<sup>2</sup>/hm<sup>2</sup> 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<sup>2</sup>/hm<sup>2</sup>) was 3.6% of total basal area (26.4 m<sup>2</sup>/hm<sup>2</sup>) by less numbers.

## Species composition and community structure of a *Taxus cuspidata* forest in Muling Nature Reserve of Heilongjiang province, China

Diao Yunfei, Jin Guangze, Tian Songyan, Liu Yankun, Liu Yulong, Han Lidong, Li Yunhong  
*Scientia Silvae Sinicae*. 2016. 52(5):26-36

*Taxus cuspidata* is a tertiary relic species and national level endangered plant. The species composition and community structure of *T. cuspidata* forest and the spatial correlation between *T. cuspidata* and other major tree species were studied to explore the formation and maintenance mechanism of community biodiversity. In the 2014 census, we documented 57 woody species with 63 877 individuals, belonging to 38 genera and 22 families. The DBH distributions of the *T. cuspidata* and *Corylus mandshurica* were approximately normal and “L” type, other major species showed reversed “J” type, including *Tilia amurensis*, *Acer mono*, *Acer barbinerve*, *Acer tegmentosum*, *Betula costata*, *Abies nephrolepis* and *Pinus koraiensis*. *T. cuspidata* forest had a relatively high species richness. Sapling regeneration of most species was fairly good, but very poor for *T. cuspidata*. Spatial distribution of species was significantly correlated with habitat, and the species showed different habitat preferences. *T. cuspidata* may be a niche differentiation with some species, including *Pinus koraiensis*, *Abies nephrolepis*, *Tilia amurensis*, *Acer tegmentosum*, *Corylus mandshurica*, *Betula costata* and *Acer barbinerve*.

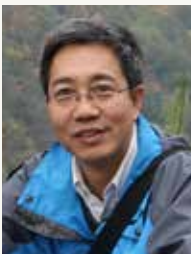


Size-class distribution of nine major species of a 25 ha *Taxus cuspidata* forest dynamics plot in Muling Nature Reserve

## Important Outputs

1. Diao Yunfei, Jin Guangze, Tian Songyan, Liu Yankun, Liu Yulong, Han Lidong and Li Yunhong. 2016. Species composition and community structure of a *Taxus cuspidata* forest in Muling Nature Reserve of Heilongjiang province, China. *Scientia Silvae Sinicae*. 52(5):26-36. (In Chinese with English abstract)





## 25-ha deciduous broadleaved-Korean pine mixed forest plot at Changbai Mountain in Jilin province

### Principal Investigator

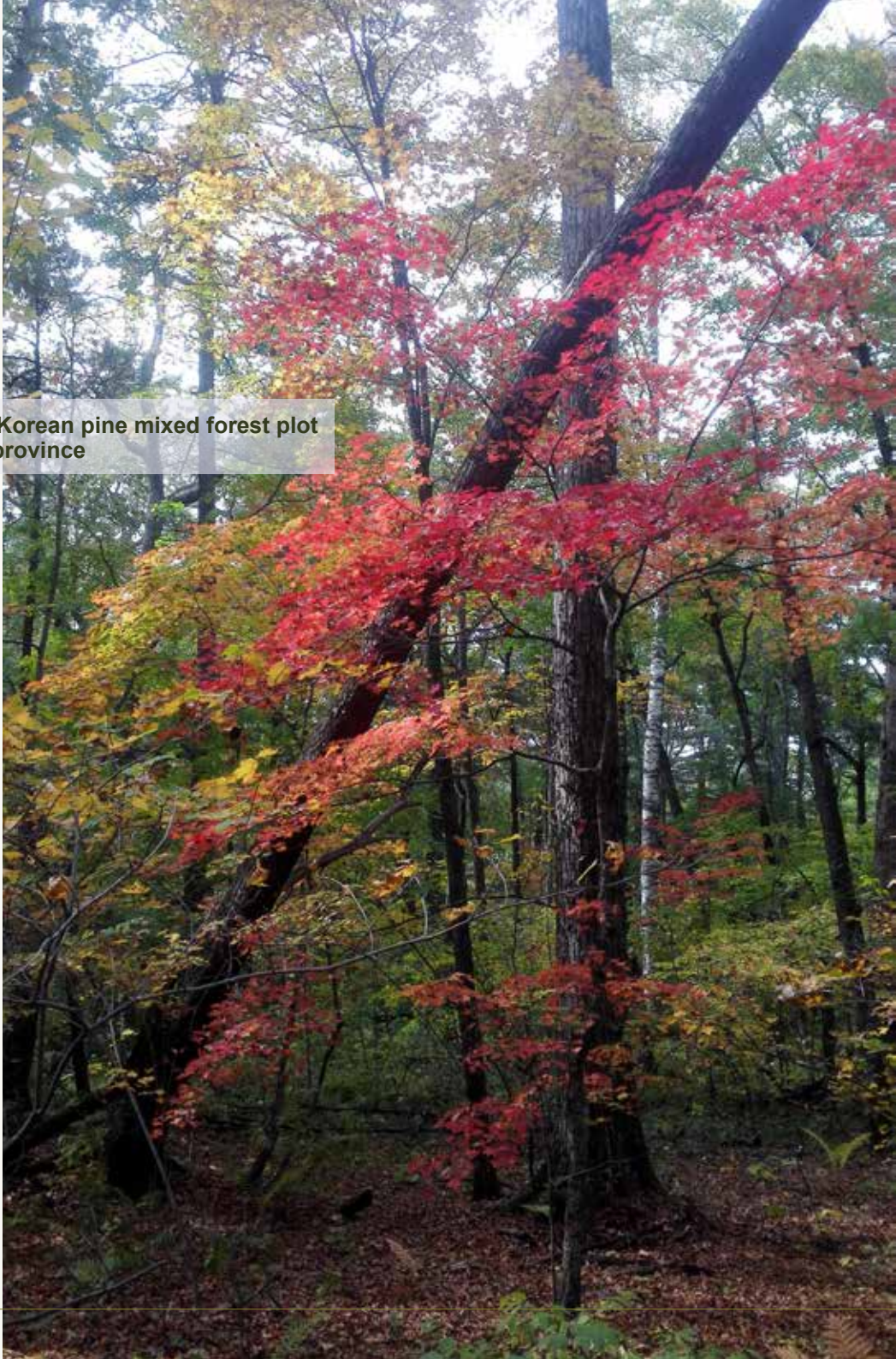
Hao Zhanqing, professor of Institute of Applied Ecology, CAS. He mainly conducts studies on forest ecology and biodiversity.

### Research Team

Wang Xugao  
Ye Ji  
Lin Fei  
Yuan Zuoqiang

### Plot Introduction

A 25ha 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 of 17.7 m. Seasonal changes are distinctly recognizable here. Mean annual



temperature is 3.6°C, and mean annual precipitation is approximately 700mm.

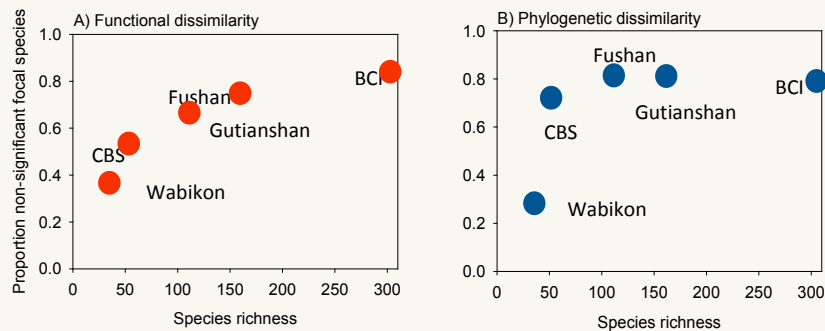
The main constructive species of the Changbai Mountain Plot include *Pinus koraiensis*, *Tilia amurensis*, *Quercus mongolica* and *Fraxinus mandshurica* etc. 38,902 individuals with DBH  $\geq$  1cm were recorded, belonging to 18 families, 32 genera and 52 species. It is a typical old-growth multi-storied uneven aged forest with obvious dominant species. The height of main canopy species was nearly 30m, and the oldest trees are about 300 years. The mean DBH and basal area were 10.52 cm and 43.23 m<sup>2</sup>/ha, respectively.

## Stochastic dilution effects weaken deterministic effects of niche-based processes in species rich forests

Wang Xugao, Thorsten Wiegand, Nathan J. B. Kraft, Nathan G. Swenson, Stuart J. Davies, Hao Zhanqing, Robert W. Howe, Lin Yijing, Ma Keping, Mi Xiangcheng

*Ecology*. 2016. 97(2):347-360

Recent studies showed that the proportion of species with significant effects in species-poor temperate forests was higher than in species-rich tropical forests, which seem to contradict the traditional view that the effects of species interaction increased with species richness. To resolve the problem, we proposed the stochastic dilution hypothesis. The hypothesis predicted the proportion of species that were placed independently with regard to their biotic neighborhood (neutral species) increased with species richness, because large variability among the biotic neighborhoods of individuals of a focal species did not allow for directed responses of the species with respect to their biotic neighborhood. We used data on phylogenetic and functional similarity of tree species in five large forest dynamics plots located across a gradient of species richness (36-304) to test the stochastic dilution hypothesis. Our results were consistent with the predictions of the stochastic dilution hypothesis, and suggested that stochasticity may play a stronger role in shaping the spatial structure of species rich tropical forest communities than it does in species poorer forests.



The proportion of non-significant species increased with species richness

### Important Outputs

1. Wang Xugao, Thorsten Wiegand, Nathan J. B. Kraft, Nathan G. Swenson, Stuart J. Davies, Hao Zhanqing, Robert W. Howe, Lin Yijing, Ma Keping and Mi Xiangcheng. 2016. Stochastic dilution effects weaken deterministic effects of niche-based processes in species rich forests. *Ecology*. 97(2):347-360.
2. Yuan Zuoqiang, Wang Shaoping, Antonio Gazol, Jarad Mellard, Lin Fei, Ye Ji, Hao Zhanqing, Wang Xugao, Michel Loreau. 2016. Multiple metrics of diversity have different effects on temperate forest functioning over succession. *Oecologia*. 182 (4): 1175-1185.





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

### Principal Investigator

Sang Weiguo, Professor of Institute of Botany, CAS. 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 1395m, 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,



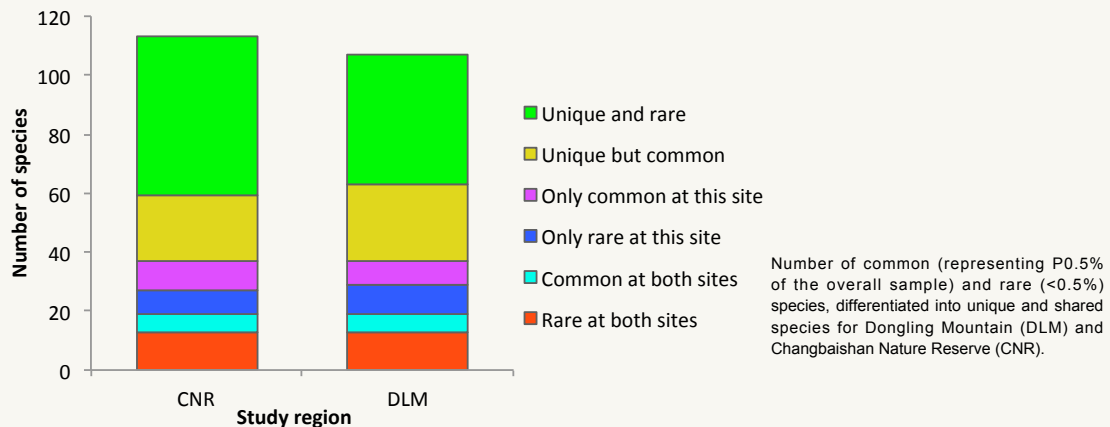


midstory layer and a shrub layer, the first five species comprised 61% of all individuals, and the first 20 species comprised 92% of all individuals, and there were 52,136 individuals with DBH  $\geq$  1cm, belonging to 58 species, 33 genera and 18 families.

## Geometrid moth assemblages reflect high conservation value of naturally regenerated secondary forests in temperate China.

Zou Yi, Sang Weiguo, Eleanor Warren-Thomas and Jan Christoph Axmacher  
*Forest Ecology and Management*. 2016.374:111-118.

The widespread destruction of mature forests in China has led to massive ecological degradation, counteracted in recent decades by substantial efforts to promote forest plantations and protect secondary forest ecosystems. The value of the resulting forests for biodiversity conservation is not clear enough, particularly in relation to highly diverse invertebrate taxa that fulfill important ecosystem services. We aimed to address this knowledge gap, establishing the conservation value of secondary forests in Dongling Mountain, North China based on the diversity of geometrid moths – a species-rich family of nocturnal pollinators that also influences plant assemblages through caterpillar herbivory. Results showed that secondary forests harboured geometrid moth assemblages similar in species richness and phylogenetic diversity, but with a species composition distinctly different to assemblages in one of China's last remaining mature temperate forests in the Changbaishan Nature Reserve. Species overlap between these sites was about 30%, and species did not form separate phylogenetic clusters according to site. Species assemblages at Dongling Mountain were strongly differentiated according to forest type; a pattern not found at Changbaishan. Our results indicate that protected naturally regenerated secondary forests in northern China provide suitable habitats for species-rich and genetically diverse geometrid moth assemblages, highlighting the potential importance of these forests for conservation and ecosystem function provision across the wider landscape.



### Important Outputs

1. Zou Yi, Sang Weiguo, Eleanor Warren-Thomas and Jan Christoph Axmacher. 2016. Geometrid moth assemblages reflect high conservation value of naturally regenerated secondary forests in temperate China. *Forest Ecology and Management*. 374:111-118.



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

### Principal Investigator

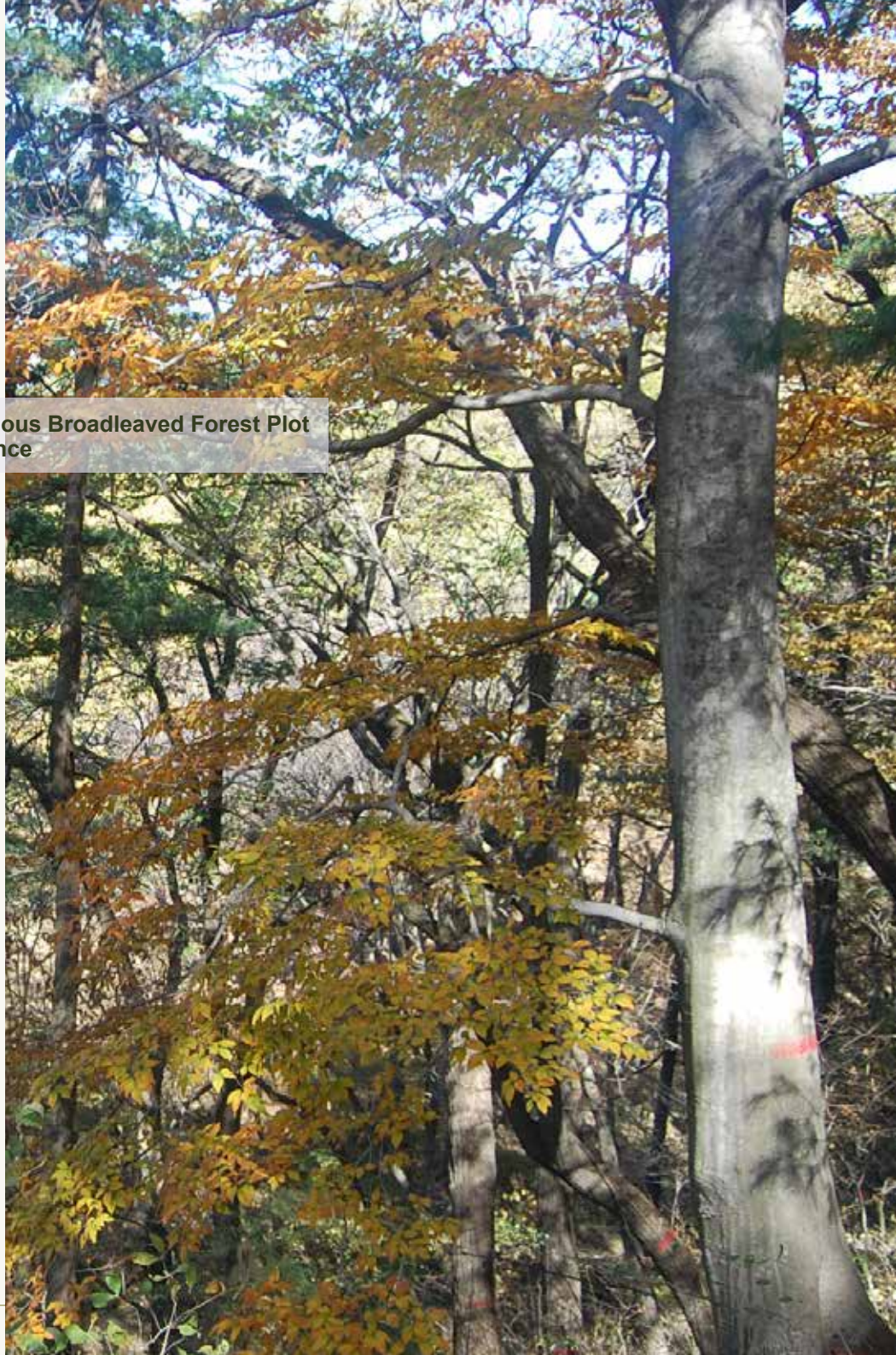
Du Xiaojun, Institute of Botany, CAS. His research interests focus on forest ecology, biodiversity and restoration ecology.

### 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 (33.49° N, 111.94 °E). The mean annual temperature is 15.1 °C, and mean annual precipitation is 885.6 mm.





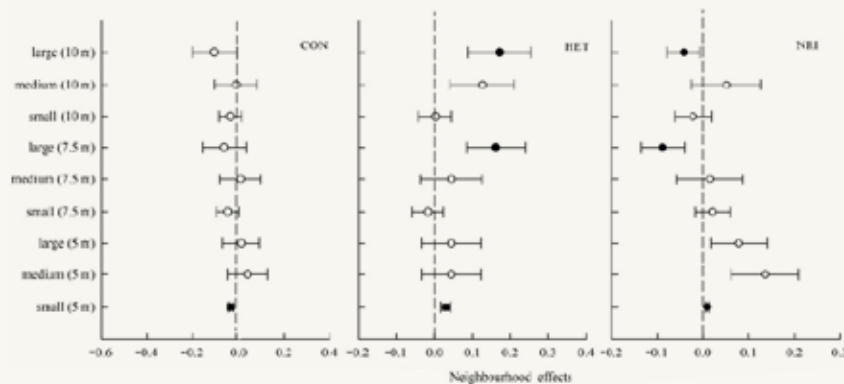
The woody species are composed by the family of the Fagaceae, Tiliaceae, Aceraceae, Pinaceae, Cornaceae, Betulaceae, etc. The dominant tree species are *Quercus aliena* var. *acutiserrata*, *Acer grosseri*, *Pinus armandii* etc.; *Cercidiphyllum japonicum* is the Category II national protected species,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

## Detecting density dependence on tree survival in a deciduous broadleaved forest in Baotianman National Nature Reserve

Xiaoqing Liu, Siyuan Ren, Luxin Li, Yongzhong Ye, Zhiliang Yuan, Ting Wang

*Biodiversity Science*. 2016. 24(6): 639-648.

Based on two census datasets in 2009 and 2014 of the 1-ha deciduous broadleaved forest plot in Baotianman National Nature Reserve, generalized linear mixed models (GLMMs) were used to examine the density dependence on individual survival of the top 11 species (with high important value) at different neighborhood scales and different DBH sizes (1 cm ≤ DBH, 5 cm, 5 cm ≤ DBH < 10 cm, DBH ≥ 10 cm). The results showed: mean annual mortality and recruitment rate of individuals (DBH ≥ 1 cm) were 5.85% and 0.27%, respectively; survival rate of 5 tree species was negatively correlated with abundance or neighbor conspecific basal area; density dependence and phylogenetic diversity exerted significant effects on survival of small individuals (at 5 m neighborhood scale), whereas no significant influence on medium trees. With increasing tree size, phylogenetic diversity exerted important effect on large individuals at 7.5 m and 10 m neighborhood scales. In conclusion, density dependence and phylogenetic diversity play different roles on tree survival at different life stages and neighborhood scales in the deciduous broad-leaved forest in Baotianman National Nature Reserve.



Neighborhood effects of conspecific neighbors (CON), heterospecific neighbors (HET) and neighborhood relatedness index (NRI) on individual survival.

### Important Outputs

1. Xiaoqing Liu, Siyuan Ren, Luxin Li, Yongzhong Ye, Zhiliang Yuan, Ting Wang. 2016. Detecting density dependence on tree survival in a deciduous broadleaved forest in Baotianman National Nature Reserve. *Biodiversity Science*. 24(6): 639-648. (In Chinese with English abstract)
2. Yun Chen, Zhiliang Yuan, Peikun Li, Ruofan Cao, Hongru Jia, Yongzhong Ye. 2016. Effects of environment and space on species turnover of woody plants across multiple forest dynamics plots in East Asia. *Frontiers in Plant Science*. 7:1533.



## 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

Lu Zhijun  
Wei Xinzeng  
Huang Handong  
Qiao Xiujuan  
Xu Yaozhan  
Yu Xunlin  
Yan Yuehong

### 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.

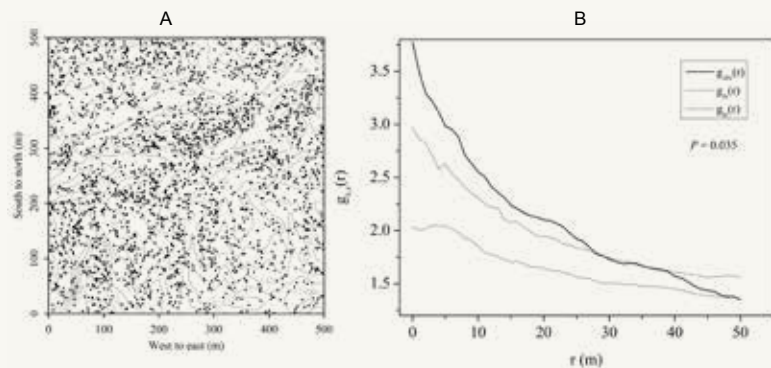
The dominant trees include evergreen species such as *Cyclobalanopsis multinervis*, *C. gracilis* and *Schima parviflora* etc, and deciduous species, like *Fagus lucida*, *Carpinus fargesii* and *Sassafras tzumu* etc.

## Relative importance of density dependence and topography on tree mortality in a subtropical mountain forest.

Wu Hao, Franklin Scott, Liu Jianming, Lu Zhijun  
*Forest Ecology and Management*. 2016.  
<http://dx.doi.org/10.1016/j.foreco.2016.10.049>

Based on this survey data, we used the univariate, bivariate pair correlation function,  $g(r)$ , to analyze the spatial distribution pattern of snags and the association between snags and living trees. In addition, we used generalized linear mixed models (GLMM) to examine the relative importance of neighbor and topographical factors on tree mortality. Analyses demonstrated two main results. First, at the community level, snags showed a consistent aggregated distribution at 0–30 m scales, and snags and living trees were significantly negatively correlated at 1–12 m scales. At the species level, 10 of the 18 common species displayed significant negative associations between living trees and snags at different scales in the 0–50 m range.

Second, both basal area of conspecific neighbors and basal area of heterospecific neighbors showed a significant positive relationship on the occurrence of snags at different levels (community, guild and species). Topographic factors showed limited correlations with the occurrence of snags. Additionally, tree size was significantly negatively correlated with adult and large tree mortality, but non-significantly correlated with old trees. In summary, tree mortality is nonrandom and mainly driven by interspecific competition and intraspecific negative density dependence in this subtropical mountain evergreen and deciduous broad-leaved mixed forest in China. Topographic conditions had little relation on tree mortality, but tree size was an important predictor of tree death at the community level.



Distribution map (A) and point pattern analysis (B) of all snags >10 cm DBH in the 25-ha Badagongshan forest plot.

### Important Outputs

1. Wu Hao, Franklin Scott, Liu Jianming, Lu Zhijun. 2016. Relative importance of density dependence and topography on tree mortality in a subtropical mountain forest. *Forest Ecology and Management*.

<http://dx.doi.org/10.1016/j.foreco.2016.10.049>

2. Li Qianxi, Wang Xinggang, Jiang Mingxi, Wu Yu, Yang Xiaolu, Liao Chang and Liu Feng. 2016. How environmental and vegetation factors affect spatial patterns of soil carbon and nitrogen in a subtropical mixed forest in Central China. *Journal of Soils and Sediments*. DOI 10.1007/s11368-016-1491-5.



## 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 Qionsong  
Zheng Zemei  
Yao Fangfang

### Plot Introduction

The 20-ha Tiantong plot was established in 2009 at 29.8°N, 121.8°E, located in 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





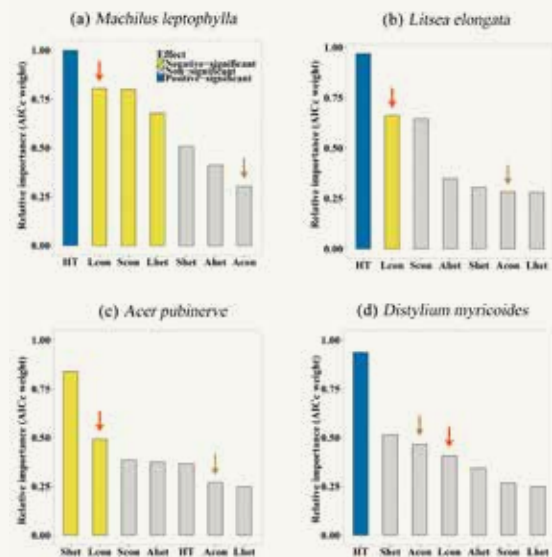
51 families. Dominant species in the plot mainly belongs to Theaceae, Lauraceae and Fagaceae. Evergreen species are largely dominated, which account for 80.3% of total importance values of all species in the plot. The first three most important species are *Eurya loquaiana*, *Litsea elongata* and *Choerospondias axillaris*. 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%.

## Conspecific leaf litter-mediated effect of conspecific adult neighborhood on early-stage seedling survival in a subtropical forest

Liu Heming, Shen Guochun, Ma Zunping, Yang Qingsong, Xia Jianyang, Fang Xiaofeng, Wang Xihua  
*Scientific Reports*. 2016. 6:37830

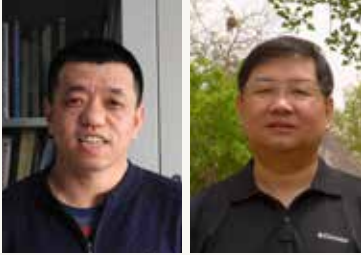
Conspecific adults have strong negative effect on the survival of nearby early-stage seedlings and thus can promote species coexistence by providing space for the regeneration of heterospecifics. The leaf litter fall from the conspecific adults, and it could mediate this conspecific negative adult effect. However, field evidence for such effect of conspecific leaf litter remains absent. In this study, we used generalized linear mixed models to assess the effects of conspecific leaf litter on the early-stage seedling survival of four dominant species (*Machilus leptophylla*, *Litsea elongata*, *Acer pubinerve* and *Distylium myricoides*) in early-stage seedlings in a subtropical evergreen broad-leaved forest in eastern China. Our results consistently showed that the conspecific leaf litter of three species negatively affected the seedling survival. Meanwhile, the traditional conspecific adult neighborhood indices failed to detect this negative conspecific adult effect. Our study revealed that the accumulation of conspecific leaf litter around adults can largely reduce the survival rate of nearby seedlings. Ignoring it could result in underestimation of the importance of negative density dependence and negative species interactions in the natural forest communities.



The relative importance of potential factors influencing on early-stage seedlings survival of four species. The red and brown arrows highlight the variable of conspecific leaf litter and conspecific adult neighborhood indices respectively.

### Important Outputs

1. Liu Heming, Shen Guochun, Ma Zunping, Yang Qingsong, Xia Jianyang, Fang Xiaofeng and Wang Xihua. 2016. Conspecific leaf litter-mediated effect of conspecific adult neighborhood on early-stage seedling survival in a subtropical forest. *Scientific Reports*. 6:37830.
2. Yang Qingsong, Shen Guochun, Liu Heming, Wang Zhanghua, Ma Zunping, Fang Xiaofeng, Zhang Jian and Wang Xihua. 2016. Detangling the effects of environmental filtering and dispersal limitation on aggregated distributions of tree and shrub species: life stage matters. *PLoS ONE*. 11:e0156326.



## 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  
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Liang Yu  
Zhu Yan  
Shen Xiaoli  
Ding Ping  
Chen Jianhua  
Bao Yixin  
Guo Liangdong  
Li Minghong  
Liu Jinsong





## Plot Introduction

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.

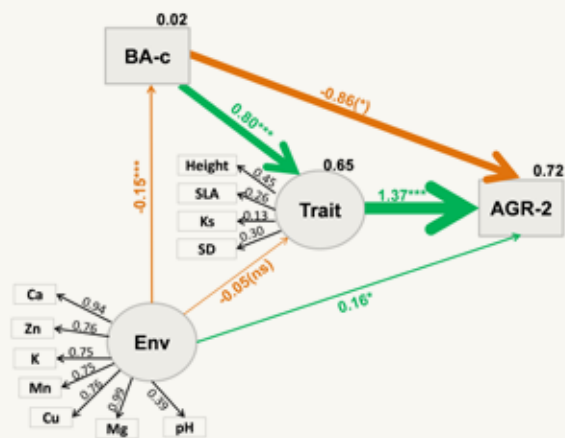
There are 140,700 individuals (DBH ≥ 1 cm) in the plot, belonging to 159 species, 104 genera and 49 families. Trees from Fabaceae, Lauraceae and Theaceae are dominant in the plot, such as *Castanopsis eyrei* and *Schima superba*. Thirty-two species have more than 1000 individuals in the plot, 59 rare 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.

## Linking individual-level functional traits to tree growth in a subtropical forest.

Liu Xiaojuan, Nathan G. Swenson, Lin Dunmei, Mi Xiangcheng, María Natalia Umana, Bernhard Schmid, Ma Keping *Ecology*. 2016.97(9):2396-2405.

Forging strong links between traits and performance is essential for understanding and predicting community assembly and dynamics. The work utilizing detailed tree growth and trait data in a subtropical forest has demonstrated that individual-level functional traits strongly predict individual tree growth. The strength of these predictions is facilitated by using information regarding the soil environment, identity of neighboring individuals and other trait values for the same individual. Without this contextual information, single trait values taken from an individual are often no better predictors of individual growth than an average trait value for the population or species. Furthermore, neighborhood demographic modeling analyses that utilize species mean trait values across all individuals miss a great deal of information regarding the drivers of individual demography and ultimately community structure because individual level traits and demographic rates within species vary in relation to the abiotic and biotic environment. Given these results, our understanding of trait–performance relationships can be greatly improved with individual-level data so long as that data is put into the proper context.



The structural equation models for the effect of functional traits at individual level, environmental factors and neighborhood composition on growth rate.

## Important Outputs

1. Liu Xiaojuan, Nathan G. Swenson, Lin Dunmei, Mi Xiangcheng, María Natalia Umana, Bernhard Schmid and Ma Keping. 2016. Linking individual-level functional traits to tree growth in a subtropical forest. *Ecology*. 97(9):2396-2405.
2. Han Baocai, Wei Wei, Mi Xiangcheng and Ma Keping. 2016. De novo sequencing and comparative analysis of *Schima superba* seedlings to explore the response to drought stress. PLoS ONE. 11(12): e0166975.



## 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 on maintenance of community species diversity and ecology of invasive alien species.

### Research Team

Cao Honglin, Lian Juyu, 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 23.10°N, 112.32°E and altitudes ranging from 230 to 470m, 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 DBH $\geq$ 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.



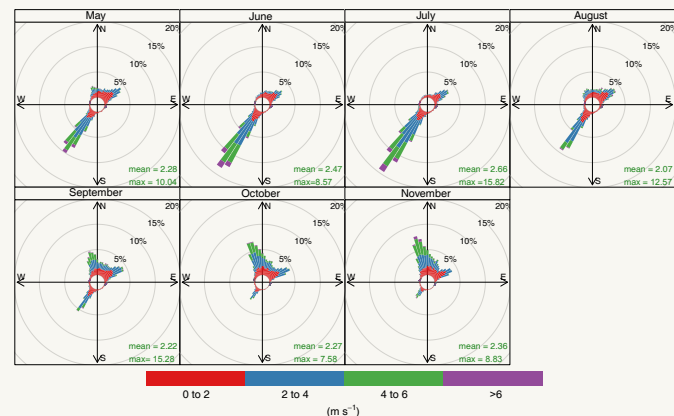


The four research priorities in DHS Plot are as follows. (1) Research on the adaptive mechanism and epigenetic diversity pattern of *Castanopsis chinensis* populations in Dinghu mountain; (2) Distribution patterns of tree species in a lower subtropical forest: Linking plant functional traits and hydraulic 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.

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

Wang, Zhengfeng; Lian, Juyu; Ye, Wanhui; Cao, Honglin; Zhang, Qianmei; Wang, Zhangmin  
*Tree Genetics & Genomes*, 2016, 12:19.

In most plants, the contributions of pollen and seed flow to their genetic structures are generally difficult to disentangle. For typical wind-pollinated and wind-dispersed species *Engelhardia roxburghiana* in a 20-ha natural forest plot in lower subtropical 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 could result primarily from pollen or seed flow. Furthermore, because the plot has undergone from an open to a closed 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 that greater pollen flow led to biased gene flow in the pollen dispersal predominant direction (pollen direction), while greater seed flow generated less spatial genetic structure in the seed dispersal-predominant direction (seed direction). The results predicted from generalized additive models indicated that canopy closure enhanced resistance to gene flow from the old generation to the new generation. Analyses with landscape genetic models for the new generation revealed that gene flow associated with pollen direction was more strongly affected by canopy than 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.



Mean wind directions and speeds from May–November for eight years (2003–2012). 2005 and 2008 were excluded due to incomplete records. May–July corresponds to the flowering seasons, and September–November corresponds to seed-dispersal seasons for *Engelhardia roxburghiana*. For each month, mean and max wind speeds were shown on lower right corner, media wind direction were represented by an arrow.

### Important Outputs

1. Wang Zhengfeng, Lian Juyu, Ye Wanhui, Cao Honglin, Zhang Qianmei and Wang Zhangmin. 2016. Pollen and seed flow under different predominant winds in wind-pollinated and wind-dispersed species *Engelhardia roxburghiana*. *Tree Genetics & Genomes*. 12:19. DOI 10.1007/s11295-016-0973-3.
2. Shen Yong, Yu Shixiao, Lian Juyu, Shen Hao, Cao Honglin, Lu Huanping and Ye Wanhui. 2016. Tree aboveground carbon storage correlates with environmental gradients and functional diversity in a tropical forest. *Scientific Reports*. 6:25304.



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

### Principal Investigator

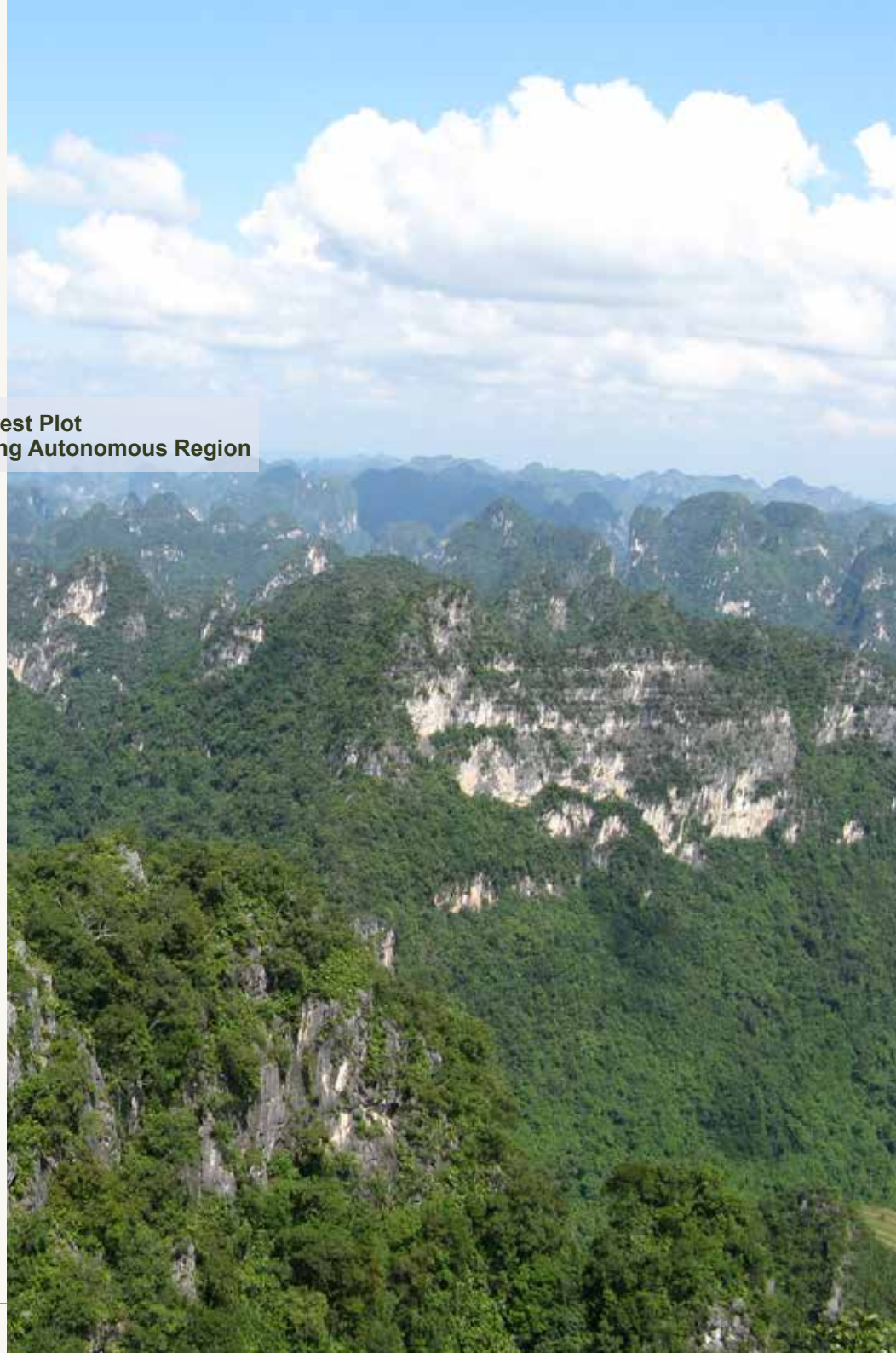
Li Xiankun, Professor of Guangxi Institute of Botany, CAS. His research focuses on the karst vegetation succession and correlation with environment.

### 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 260 m, with elevation change of 190 m. Annual mean temperature is 20.8-22.4°C and mean annual precipitation is 1150-1550mm. The plot is part of one of the 14 highly important biodiversity hotspots with global significance in China





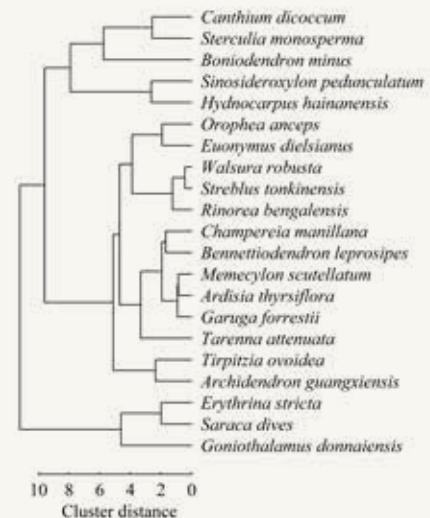
and considered to be typical karst seasonal rainforest. There are 66,718 individual trees with DBH $\geq$ 1 cm, belonging to 223 species, 153 genera, and 54 families, including 8 species of China's state priority protected wild plants, 30 species of Guangxi endemic plants, and 3 China new recorded species.

Representative tree species of the plot is principally *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.

## Floral traits of woody plants and their habitat differentiations in a northern tropical karst forest

Yuliang Jiang, Kundong Bai, Yili Guo, Bin Wang, Dongxing Li, Xiankun Li, Zhishang Liu  
*Biodiversity Science*. 2016. 24(2): 148-156.

The diversification of floral traits is the outcome of evolution by natural selection. And the variation of floral traits between species has a certain correlation with the difference of plant habitats. To analyze the variation of plant traits and their relationship with habitats in this forest, can help to understand the species coexistence, coevolution and adaptation to habitat, and provide clues for revealing the ecological adaptability of plants and the sustaining mechanisms of biodiversity in karst forest. We conducted a preliminary study in 15 ha Northern Tropical Karst Seasonal Rain Forest Plot at Nonggang to examine the differences of floral traits among species and how floral traits vary with habitats. The survey was during the time when a relatively larger number of plants bloomed synchronously, and a total of 21 species were found flowering. We divided them into three types: the valley bottom, the mountain slope and the mountain peak, taking into account spatial distribution of species and as well as their habitat characteristics. Then to compare the three types with a three main groups which was categorized by cluster analysis on floral traits. The result showed that the dominance of species was significantly negatively correlative with the flower size and the flower color vividness. That meant it should have been a favored trait for trees to have small flower size or unattractive flower color in the community. And only the flower color lightness had significant difference among the three types, other floral traits had no significant difference. However, the three main groups had a weak but doubtless consistence with the three types, which showed that changes in habitat should be reasonable for flower traits differences. In conclusion, we believed the northern tropical karst's floral trait was closely relative to the dominance of species and habitat.



Dendrogram based on clustering of floral traits for 21 coflowering species in the plot during a certain time, showing general clustering according to the habitat type of species. The floral traits include flower diameter, length, color vividness, color lightness, no. of flowers per inflorescence and no. of flowers per flowering individual

### Important Outputs

1. Jiang Yuliang, Bai Kundong, Guo Yili, Wang Bin, Li Dongxing, Li Xiankun, and Liu Zhishang. 2016. Floral traits of woody plants and their habitat differentiations in a northern tropical karst forest. *Biodiversity Science*. 24(2): 148-156. (In Chinese with English abstract)
2. Guo Yili, Wang Bin, Xiang Wusheng, Ding Tao, Lu Shuhua, Huang Fuzhao, Wen Shujun, Li Dongxing, He Yunlin and Li Xiankun. 2016. Responses of spatial pattern of woody plants' basal area to topographic factors in a tropical karst seasonal rainforest in Nonggang, Guangxi, southern China. *Biodiversity Science*. 24(1):30-39. (In Chinese with English abstract)



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

### Principal Investigator

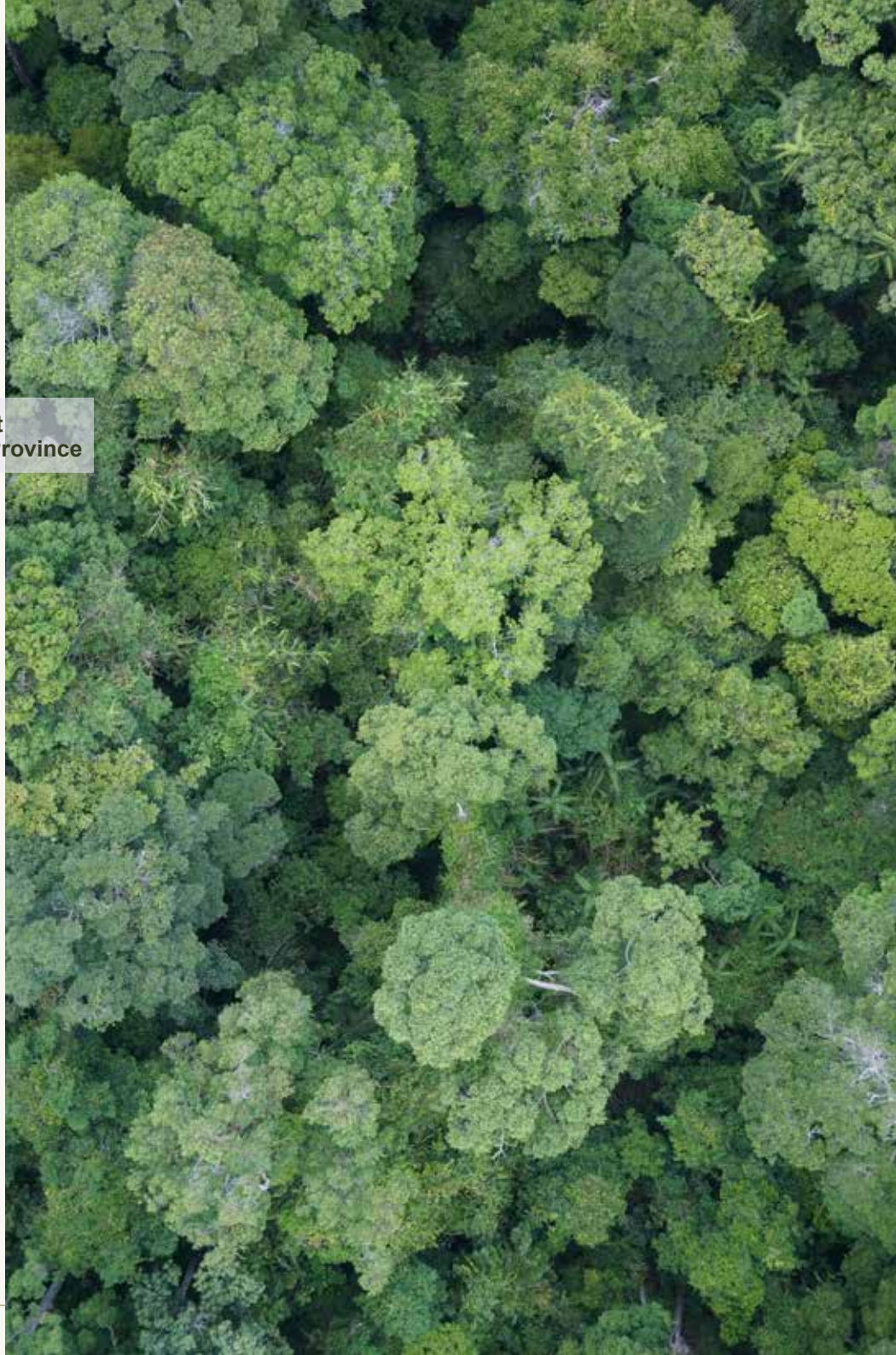
Cao Min, Professor of Xishuangbanna  
Tropical Botanical Garden, CAS

### Research Team

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

### 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 was diverse, with an elevation ranging from 709 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.





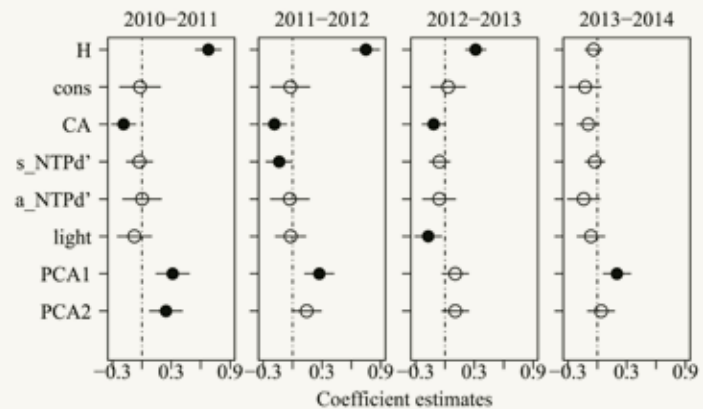
A total of 95,834 free-standing individuals with DBH  $\geq$  1cm were recorded in the 20 ha plot, belonging to 468 species, 213 genera and 70 families. The forest has three or four tree layers. The forest was dominated by *Parashorea chinensis* (Category I national protected species), up to 50-60 m high in emergent layer, and its importance value 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.

## How does habitat filtering affect the detection of conspecific and phylogenetic density dependence?

Wu Junjie, Nathan G. Swenson, Calum Brown, Zhang Caicai, Yang Jie, Ci Xiuqin, Li Jie, Sha Liqing, Cao Min and Lin Luxiang.

*Ecology*. 2016. 97(5): 1182-1193.

Conspecific negative density dependence (CNDD) has been recognized as a key mechanism underlying species coexistence, especially in tropical forests. Recently, some studies have reported that seedling survival is also negatively correlated with the phylogenetic relatedness between neighbors and focal individuals, termed phylogenetic negative density dependence (PNDD). In contrast to CNDD or PNDD, shared habitat requirements between closely related individuals are thought to be a cause of observed positive effects of closely related neighbors, which may affect the strength and detectability of CNDD or PNDD. In order to investigate the relative importance of these mechanisms for tropical tree seedling survival, we used generalized linear mixed models to analyze how the survival of more than 10 000 seedlings of woody plant species related to neighborhood and habitat variables in a tropical rainforest in southwest China. By comparing models with and without habitat variables, we tested how habitat filtering affected the detection of CNDD and PNDD. The best-fitting model suggested that CNDD and habitat filtering played key roles in seedling survival, but that, contrary to our expectations, phylogenetic positive density dependence (PPDD) had a distinct and important effect. While habitat filtering affected the detection of CNDD by decreasing its apparent strength, it did not explain the positive effects of closely related neighbors. Our results demonstrate that a failure to control for habitat variables and phylogenetic relationships may obscure the importance of conspecific and heterospecific neighbor densities for seedling survival.



Estimated effects ( $\pm$  2SE) of neighborhood variables and habitat variables on seedling survival for each of the four one-year census intervals in phylogenetic + habitat model. Filled circles indicate significant effects ( $P < 0.05$ )

### Important Outputs

1. Wu Junjie, Nathan G. Swenson, Calum Brown, Zhang Caicai, Yang Jie, Ci Xiuqin, Li Jie, Sha Liqing, Cao Min and Lin Luxiang. 2016. How does habitat filtering affect the detection of conspecific and phylogenetic density dependence? *Ecology*. 97(5): 1182-1193.