

---

AI translation · View original & related papers at  
[chinaxiv.org/items/chinaxiv-201805.00010](https://chinaxiv.org/items/chinaxiv-201805.00010)

---

## Postprint: Population Dynamics of *Schima superba* in the South Subtropical Evergreen Broad-Leaved Forest at Dinghushan

**Authors:** Chen Qing, Li Mengjiao, Li Yao, Shen Hao, Shen Hao

**Date:** 2018-04-28T00:00:00+00:00

### Abstract

*Schima superba* is a dominant species in the subtropical evergreen broad-leaved forest community of Dinghushan, and its population dynamics are of great significance for understanding the community assembly mechanisms of subtropical evergreen broad-leaved forests. This study analyzed the dynamic changes of the *Schima superba* population in a 20-ha plot of subtropical evergreen broad-leaved forest in Dinghushan from 2005 to 2017, and examined the distribution characteristics of its mortality from two aspects: diameter class and habitat. The results showed that the number of individuals in the *Schima superba* population exhibited a decreasing trend from 2005 to 2017. In terms of diameter class, the changes in mortality and relative growth rate of *Schima superba* showed different patterns across different diameter class intervals: for trees in the 1–10 cm diameter class range, the relative growth rate was high and decreased rapidly, while mortality increased and remained at a relatively high level; for trees in the 10–50 cm diameter class range, as the diameter class increased, the relative growth rate slowed and then declined, while mortality continuously decreased; in the diameter class range above 50 cm, *Schima superba* exhibited low relative growth rates and high mortality. Across different habitats, mortality rates showed little variation among habitats in 2010; in 2015, high-elevation habitats (high slopes, ridges, high valleys) had higher mortality than low-elevation habitats (low slopes, low valleys), whereas in 2017, low-elevation habitats exhibited higher mortality than high-elevation ones. The mortality of *Schima superba* was positively correlated with soil pH, and negatively correlated with soil organic matter, total nitrogen, total phosphorus, available potassium, and available nitrogen contents.

## Full Text

### Preamble

#### Population Dynamics of *Schima superba* in a Lower Subtropical Evergreen Broad-Leaved Forest at Dinghu Mountain

CHEN Qing<sup>1,2</sup>, LI Mengjiao<sup>1,2</sup>, LI Yao<sup>3</sup>, SHEN Hao<sup>1\*</sup>

<sup>1</sup>Key Laboratory of Vegetation Restoration and Management of Degraded Ecosystems, South China Botanical Garden, Chinese Academy of Sciences, Guangzhou 510650, China

<sup>2</sup>University of Chinese Academy of Sciences, Beijing 100049, China

<sup>3</sup>South China Agricultural University, Guangzhou 510642, China

DOI: 10.11931/guihaia.gxzw201802022

---

### Abstract

*Schima superba* is a dominant species in the lower subtropical evergreen broad-leaved forest community at Dinghu Mountain, and its population dynamics are crucial for understanding community assembly mechanisms in this forest type. This study analyzed the population dynamics of *S. superba* in a 20-ha plot at Dinghu Mountain from 2005 to 2017, examining mortality distribution patterns across diameter classes and habitats. Results showed a continuous decline in population size during this period. Mortality and relative growth rates exhibited distinct patterns across diameter classes: individuals with DBH of 1-10 cm showed high relative growth rates that rapidly decreased, while mortality increased and remained high; for DBH of 10-50 cm, relative growth rates decelerated after peaking then declined, while mortality continuously decreased; above 50 cm DBH, relative growth rates were low and mortality was high. Among habitats, mortality rates were similar across all habitats in 2010, but by 2015, high-altitude habitats (high slopes, ridges, high valleys) showed greater mortality than low-altitude habitats (low slopes, low valleys), a pattern that reversed by 2017. Mortality was significantly positively correlated with soil pH and negatively correlated with soil organic matter, total nitrogen, total phosphorus, available potassium, and available nitrogen content.

**Keywords:** diameter class, mortality rate, relative growth rate, population ecology, habitat

---

### Introduction

Population dynamics—the patterns and processes of change in population size over time and space—has long been a central focus in population ecology research (Andrzejczyk & Brzeziecki, 1995). Traditional analytical approaches include life

table construction (Li et al., 2009), survival curve analysis, spectral analysis (Wu & Han, 1988), and dynamic modeling (Tilman et al., 1994; Rhodes et al., 1996). Life tables provide critical information on mortality and survival rates, while survival curves offer intuitive visualization of population trajectories. Originally developed for insect population studies, spectral analysis was first applied to forest population dynamics by Wu and Han (1988). For spatial distribution patterns, Tilman et al. (1997) advanced the Tilman multi-species assembly model based on Levins' model (Levins, 1969), while Rhodes et al. (1996) distinguished between spatially implicit and spatially explicit models.

Tree mortality is a ubiquitous phenomenon in forest communities that fundamentally alters species composition and community structure, thereby influencing successional processes (Mencuccini et al., 2005). Tree death also drives environmental changes, including increased canopy gaps, altered soil properties, and modified microclimatic conditions (Das et al., 2007). Dead wood from tree mortality participates in ecosystem cycling as a crucial component of forest nutrient dynamics and represents an important mechanism regulating forest ecosystem structure and dynamics (McCoy & Gillooly, 2008; Lewis et al., 2007). Mortality factors include long-term processes such as individual competition, pests and diseases, climate change, and soil moisture conditions, as well as sudden disturbances like fires, insect outbreaks, and extreme weather events (Brandt, 2013).

Lower subtropical evergreen broad-leaved forest represents a typical transitional vegetation type between tropical and subtropical zones (Peng, 1998). The 20-ha Dinghu Mountain plot (hereafter "Dinghu plot") is a core site within China's Forest Biodiversity Monitoring Network (Ye et al., 2008). Due to minimal human disturbance, Dinghu Mountain preserves the structural characteristics of a 400-year-old zonal forest community. Previous research on community assembly mechanisms has examined community structure (Wang et al., 2008; Lin et al., 2010; Ye et al., 2008; Li et al., 2009; Wang et al., 2009), population genetics (Wang et al., 2012), and evolutionary processes (Pei et al., 2011). Wei et al. (2008) analyzed *Erythrophleum fordii* population dynamics in the Dinghu plot, revealing an accelerating growth phase for this species.

*Schima superba* (Theaceae) is a large canopy tree with leathery, elliptical leaves featuring prominent venation and serrated margins. Petioles measure 1-2 cm, with white flowers borne in terminal racemes. Capsules are 1.5-2 cm in diameter, and the flowering period occurs from June to August (Zhang & Ren, 1998). As a dominant and constructive species in the Dinghu plot (Ye et al., 2008), *S. superba* plays a crucial role in forest community assembly and spatial distribution of other species, making its population dynamics representative of subtropical forest community processes. Therefore, investigating mortality, distribution, and quantitative changes in the *S. superba* population provides essential insights into community assembly mechanisms in lower subtropical evergreen broad-leaved forests. This study examines the population dynamics of *S. superba* in the Dinghu plot from 2005 to 2017 and explores potential driving

factors. The findings will not only advance understanding of community assembly mechanisms but also inform conservation and restoration efforts in this forest ecosystem.

---

## Materials and Methods

### 1.1 Study Area

Dinghu Mountain National Nature Reserve (112°30'39" E, 23°09'21" - 23°11'30" N) is located in Zhaoqing City, Guangdong Province. Situated at the southern edge of the subtropical monsoon climate zone near the tropical boundary (Wu, 1982), the area has a mean annual temperature of 20.9°C. Monthly precipitation exceeds 200 mm during the rainy season and falls below 100 mm in the dry season. Soils are classified as lateritic red earth, yellow earth, and mountain shrub-meadow soil (Ye et al., 2008). Peng et al. (1998) delineated six successional stages for Dinghu Mountain forests: (1) coniferous forest, (2) coniferous-dominated mixed forest, (3) light-demanding broadleaf-dominated mixed forest, (4) light-demanding evergreen broad-leaved forest, (5) mesophytic evergreen broad-leaved forest, and (6) mesophytic community. The study forest represents the fifth successional stage.

#### 1.2.1 Plot Establishment

The 20-ha Dinghu Mountain lower subtropical evergreen broad-leaved forest monitoring plot was established in 2005 following CTFS (Center for Tropical Forest Science) protocols (Condit, 1998) in the core area of the nature reserve. The Dinghu plot is among China's first permanent forest biodiversity monitoring plots (Ye et al., 2008).

#### 1.2.2 Habitat Classification

Following Lian et al. (2015), we classified the Dinghu plot into five habitat types based on median elevation (H), slope (S), and convexity (C):

- **Higher slope (HS):**  $S > \text{median}(S)$ ,  $H \geq \text{median}(H)$ ,  $C > 0$
- **Higher gully (HG):**  $S > \text{median}(S)$ ,  $H \geq \text{median}(H)$ ,  $C < 0$
- **Mountain ridge (MR):**  $S \leq \text{median}(S)$ ,  $H \geq \text{median}(H)$
- **Lower slope (LS):**  $H < \text{median}(H)$ ,  $C > 0$
- **Lower gully (LG):**  $H < \text{median}(H)$ ,  $C < 0$

### 1.4 Data Analysis

All data were analyzed using Excel 13.0 and SPSS 21.0. Calculated parameters included:

- **Mortality rate** =  $(\text{Current survivors} - \text{Previous survivors}) / (\text{Previous survivors} \times \text{years})$

- **Relative growth rate (RGR)** =  $[\lg(\text{Current DBH}) - \lg(\text{Previous DBH})] / [\lg(\text{Previous DBH}) \times \text{years}]$
- **Coefficient of variation (CV)** =  $(\text{Standard deviation} / \text{Mean}) \times 100\%$

Pearson correlation analysis examined relationships between *S. superba* mortality and soil factors (pH, organic matter, total nitrogen, total phosphorus, available potassium, and available nitrogen). Significance was determined at  $P < 0.05$  and highly significant at  $P < 0.01$ .

---

## Results

### 2.1 Overall Population Dynamics

The diameter class structure of *S. superba* in the Dinghu plot exhibited normal distribution across the 2005, 2010, and 2015 censuses, with most individuals concentrated in intermediate diameter classes and fewer in small and large classes—characteristic of an intermediate diameter reserve population (Ye et al., 2008) [Figure 1: see original paper].

Population size declined continuously from 2005 to 2017, with the most rapid decrease and highest mortality occurring in 2015 [Figure 2: see original paper]. Although mortality decreased between 2015 and 2017, the population continued to decline.

### 2.2 Diameter Class Dynamics

When analyzed by diameter class, mortality showed a U-shaped pattern [Figure 3: see original paper], with high mortality ( $>0.5$ ) in small (0–25 cm) and large (50–85 cm) diameter classes, and lower mortality ( $<0.5$ ) in medium diameter classes (25–50 cm). Large individuals in the 55–85 cm classes were scarce in 2010 and completely absent by 2015, resulting in 100% mortality.

The coefficient of variation ( $CV = SD/\text{mean}$ ) for DBH decreased progressively over time, particularly sharply between 2010 and 2015 [Figure 4: see original paper].

### 2.3 Habitat Dynamics

Mortality rates were similar across habitats in 2010, but diverged by 2015 when high-altitude habitats (high slopes, ridges, high valleys) exhibited greater mortality than low-altitude habitats (low slopes, low valleys). This pattern reversed by 2017 [Figure 5: see original paper]. The initial higher mortality in high-altitude habitats likely reflects earlier pest impacts, with weaker competitors being eliminated first, leaving more resistant survivors. Consequently, mortality rates in high-altitude habitats were lower than in low-altitude habitats by 2017.

#### 2.4.1 Relationship Between Mortality and Relative Growth Rate

Analysis by diameter class revealed three distinct patterns [Figure 6: see original paper]: (1) For 1-10 cm DBH, relative growth rate declined to its lowest point while mortality peaked; (2) For 10-50 cm DBH, relative growth rate decelerated after reaching a peak then declined, while mortality continuously decreased; (3) Above 50 cm DBH, relative growth rates were low while mortality remained high.

#### 2.4.2 Relationship Between Mortality and Soil Factors

Pearson correlation analysis revealed significant relationships between mortality and soil factors. Mortality was positively correlated with soil pH and negatively correlated with soil organic matter, total nitrogen, total phosphorus, available potassium, and available nitrogen content. These results indicate that *S. superba* thrives in acidic soils, and that higher levels of soil organic matter, available potassium, total phosphorus, total nitrogen, and available nitrogen promote survival.

---

## Discussion

### 3.1 Overall Population Trends

In forest communities, dominant and constructive tree species effectively reflect successional status because their dynamics determine community structure and characteristics (Ni, 2001). Zhang et al. (1955) noted that as a light-demanding species with low shade tolerance, *S. superba* functions primarily as a pioneer species at forest edges and cannot persist in the interior of Dinghu Mountain forests, indicating an unbalanced community state where *S. superba* has reached maturity and is declining. This is associated with poor seedling regeneration capacity. Peng and Fang (1995) proposed that Dinghu Mountain evergreen broad-leaved forest succession progresses from a *Castanopsis chinensis*-*Castanopsis*-*S. superba* community toward a *Castanopsis chinensis*-*Castanopsis* community. Our findings of continuous population decline from 2005-2017, particularly the rapid decrease and peak mortality in 2015, and the drop in importance value from second rank in 2005 (Ye et al., 2008) to eighth rank in 2017, support these earlier predictions.

### 3.2 Diameter Class Dynamics

Tree diameter correlates positively with age, making diameter class a practical proxy for age in field studies where direct age determination is impractical. However, mortality rates often vary across diameter classes. Liu et al. (2010) found that tree mortality in Hainan's Bawangling tropical monsoon rainforest concentrated in trees <30 cm DBH, while Liang et al. (2011) reported high mortality proportions in saplings <10 cm DBH in Kunyushan's natural forest.

Our results show high mortality in both small (<25 cm) and large (>50 cm) *S. superba* individuals, with 100% mortality above 55 cm DBH. This aligns with Nepstad et al.'s (2007) findings from Amazonian forests showing higher mortality in large trees. Large trees are more vulnerable to natural disturbances due to reproductive costs and senescence (Mueller et al., 2005). However, under pest disturbance, sapling mortality can be severe (Liang, 2011). The Dinghu plot experienced pest outbreaks during 2010–2015, explaining the high mortality in both small and large trees while mid-sized individuals survived, leading to decreasing DBH variation and reduced diameter dispersion over time.

### 3.3 Habitat Dynamics

In heterogeneous forest communities, population distribution and survival status are closely linked to habitat conditions, which influence community characteristics (Wang et al., 2015). Habitat factors affect tree mortality and functional group structure (Liu et al., 2010; Zhou et al., 2016), thereby altering community composition and species viability. Although mortality was similar across habitats in 2010, it increased dramatically by 2015, with high-altitude habitats (ridges, high slopes, high valleys) showing significantly higher mortality than low-altitude habitats (low slopes, low valleys). This likely relates to pest outbreaks during 2005–2015. High-altitude habitats in the Dinghu plot have larger mean gap areas and higher gap fraction rates than low-altitude habitats (Sui et al., 2017), and previous research (Wang & Cai, 2009) demonstrated higher herbivory rates on *S. superba* in gap habitats, potentially explaining the greater mortality in high-altitude habitats during the pest outbreak.

The reversal in 2017, with higher mortality in low-altitude habitats, may reflect: (1) reduced survivor numbers in high-altitude habitats from 2010, (2) delayed pest impacts in low-altitude habitats, and (3) the light-demanding characteristics (shade intolerance) of *S. superba* (Zhang et al., 1955).

### 3.4 Underlying Causes of Population Change

The dramatic population changes in *S. superba* from 2005–2017 reflect a cumulative process from quantitative to qualitative change (Franklin et al., 1987). Mortality drivers include biotic factors (herbivory, inter- and intraspecific competition) and abiotic factors (topography, soil conditions).

Our results show that 1–10 cm DBH individuals had high relative growth rates but also high mortality. Young *S. superba* exhibit strong cellular activity and high growth rates but lack the stability of mature trees (Wu et al., 2010). The declining growth rates and increasing mortality in 5–10 cm DBH classes likely reflect sensitivity to environmental disturbances such as pest outbreaks. For 10–50 cm DBH classes, decelerating growth after peaking and continuously decreasing mortality indicate that prime-aged trees have the strongest resistance to disturbance, allowing survivors to resume growth performance. Large, senescent trees >50 cm DBH showed low growth rates and high mortality due to functional

organ aging, reduced resistance to disturbance, and natural senescence.

Soil factors significantly influenced *S. superba* mortality. The positive correlation with pH and negative correlations with organic matter, nitrogen, phosphorus, and potassium align with An et al.'s (1997) findings from Nanjing's Zijin Mountain forests, where soil pH, thickness, moisture, available nitrogen, and available phosphorus critically affected subtropical forest communities. Nitrogen deposition at Dinghu Mountain has increased from  $36 \text{ kg} \cdot \text{hm}^{-2} \cdot \text{a}^{-1}$  in the 1980s to  $38 \text{ kg} \cdot \text{hm}^{-2} \cdot \text{a}^{-1}$  in the 1990s (Huang et al., 1998; Zhou & Yan, 2001), comparable to high-deposition regions in Europe and North America. This nitrogen deposition may exacerbate soil acidification (Lu et al., 2014), potentially affecting soil microbial communities and rhizosphere environments (Liu et al., 2003), thereby indirectly influencing water and nutrient uptake, growth capacity, and defense mechanisms in *S. superba*.

Understanding the thirteen-year dynamics and influencing factors of *S. superba* under current climatic conditions enhances our comprehension of community assembly and succession in subtropical forests, providing valuable insights for predicting population trajectories and improving forest resistance to disturbances.

---

## References

- AN SQ, WANG ZF, ZHU XL, et al, 1997. Effects of soil factors on species diversity in secondary forest communities[J]. J Wuhan Bot Res 15(2): 143-150.
- ANDRZEJCZYK T, BRZEZIECKI B, 1995. The structure and dynamics of old-growth *Pinus sylvestris* (L.) stands in the Wigry National Park, north-eastern Poland[J]. Vegetatio, 117(1):81-94.
- BRANDT AJ, KROON H, REYNOLDS HL, et al, 2013. Soil heterogeneity generated by plant-soil feedbacks has implications for species recruitment and coexistence[J]. J Ecol, 101(2): 277-287.
- CONDIT R, 1998. Tropical forest census plots: methods and results from Barro Colorado Island, Panama and a comparison with other plots[M]. Berlin: Springer: 23-55.
- DAS AJ, BATTLES JJ, STEPHENSON NL, et al, 2007. The relationship between tree growth patterns and likelihood of mortality: a study of two tree species in the Sierra Nevada[J]. Can J For Res, 37(3): 580-597.
- FRANKLIN JF, SHUGART HH, HARMON ME, 1987. Tree Death as an Ecological Process[J]. Bioscience, 37(8): 550-556.
- GU YY, ZHANG SQ, LI XY, et al, 2013. Relationship between diameter at breast height and age of endangered species *Populus euphratica* Oliv[J]. J Tarim Univ, 25(2): 66-69.

- HUANG ZL, KONG GH, WEI P, 1998. Plant species diversity dynamics in Dinghu Mountain forests[J]. *Chin Biodivers*, 6(2): 116-121.
- LEVINS R. Some demographic and genetic consequences of environmental heterogeneity for biological control[J]. *Entomol Soc Amer Bull*, 1969, 15(3):237-240.
- LEWIS SL, PHILLIPS OL, SHEIL D, et al, 2004. Tropical forest tree mortality, recruitment and turnover rates: calculation, interpretation and comparison when census intervals vary[J]. *J Ecol*, 92(6): 929-944.
- LI L, HUANG ZL, YE WH, et al, 2009. Spatial distributions of tree species in a subtropical forest of China[J]. *Oikos*, 118(4): 495-502.
- LI QH, GAO TT, LIU JF, et al, 2009. The age structure and life table of rare eremophyte *Helianthemum ordosicum* population[J]. *Bull Bot Res*, 29(2): 176-181.
- LIAN JY, HUANG ZL, CAO HL, et al, 2015. Community composition and stand age in a subtropical forest, southern China[J]. *Biodivers Sci*, 23(2): 174-182.
- LIANG J, SUN ZQ, ZHU YP, et al, 2011. 13-years succession dynamic of Kunyushan natural forest[J]. *J Cent S Univ of For & Technol*, 31(1): 9-17.
- LIN JG, HUANG ZL, ZHU L, et al, 2010. Beta diversity of forest community on Dinghushan[J]. *Acta Ecol Sin*, 30(18): 4875-4880.
- LIU JX, ZHOU GY, ZHANG DQ, 2003. The cumulative effects of acid rain on the soil and responses of *Schima superba* at Dinghushan[J]. *Chin Environ Sci*, 23(1): 90-94.
- LIU WD, ZANG RG, DING Y, et al, 2010. Mortality of woody plants in tropical monsoon rainforests of Bawangling National Nature Reserve on Hainan Island, South China[J]. *Chin J Plant Ecol*, 34(8): 62-72.
- LU XK, MAO QG, GILLIAM FS, et al, 2014. Nitrogen deposition contributes to soil acidification in tropical ecosystems[J]. *Glob Change Biol*, 20(12): 3790-3801.
- MARBA N, DUARTE CM, AGUSTI S, 2007. Allometric scaling of plant life history[J]. *Proc National Acad USA*, 104(40): 15777-15780.
- MCCOY MW, GILLOOLY JF, 2008. Predicting natural mortality rates of plants and animals[J]. *Ecol Lett*, 11(7): 710-716.
- MENCUCCINI M, MARTINEZ-VILALTA J, VANDERKLEIN D, et al, 2005. Size-mediated ageing reduces vigour in trees[J]. *Ecol Lett*, 8(11): 1183-1190.
- MUELLER RC, SCUDDER CM, PORTER ME, et al, 2005. Differential tree mortality in response to severe drought: evidence for long-term vegetation shifts[J]. *J Ecol*, 93(6): 1085-1095.

- NEPSTAD DC, TOHVER IM, RAY D, et al, 2007. Mortality of large trees and lianas following experimental drought in an Amazon forest[J]. *Ecology*, 88(9): 2259-2269.
- NI J, 2001. Plant functional types and biomes of China at a regional scale[J]. *Acta Bot Sin*, 43(4):419-425.
- PEI NC, LIAN JY, ERICKSON DL, et al, 2011. Exploring tree-habitat associations in a Chinese subtropical forest plot using a molecular phylogeny generated from DNA barcode loci[J]. *PLoS ONE*, 6(6): e21273.
- PENG SL, FANG W, 1995. Studies on dynamics of *Castanopsis chinensis* and *Schima superba* population in forest succession of Dinghushan mountain[J]. *Acta Phytoecol Sin*, 19(4): 311-318.
- PENG SL, FANG W, REN H, et al, 1998. The dynamics on organization in the successional process of Dinghushan *Cryptocarya* community[J]. *Acta Phytoecol Sin*, 22(3): 245-249.
- RHODES OE, CHESSER RK, SMITH MH, 1996. Population dynamics in ecological space and time[M]. University of Chicago Press: 122-123.
- RICE KJ, MATZNER SL, BYER W, et al, 2004. Patterns of tree dieback in Queensland, Australia: the importance of drought stress and the role of resistance to cavitation[J]. *Oecologia*, 139(2): 206-217.
- SUI DD, WANG Y, LIAN JY, et al, 2017. Gap distribution patterns in the south subtropical evergreen broad-leaved forest of Dinghushan[J]. *Biodivers Sci*, 25(4): 382-392.
- TILMAN D, LEHMAN CL, YIN C, 1997. Habitat destruction, dispersal, and deterministic extinction in competitive communities[J]. *Am Nat*, 149(3): 407-435.
- TILMAN D, MAY RM, LEHMAN CL, 1994. Habitat destruction and the extinction debt[J]. *Nature*, 371:65-66.
- WANG HW, CAI YL, 2009. Spatial variations in insect herbivory leaves in subtropical evergreen broad leaved Forest[J]. *J Shanghai Inst Technol*, 9(2):110-114.
- WANG LL, WANG L, ZHANG LF, et al, 2015. Structure and dynamic characteristics of *Gymnocarpus przewalskii* in different habitats[J]. *Chin J Plant Ecol*, 39(10): 980-989.
- WANG ZF, LIAN JY, HUANG GM, et al, 2012. Genetic groups in the common plant species *Castanopsis chinensis* and their associations with topographic habitats[J]. *Oikos*, 121(12): 1853-1861.
- WANG ZG, YE WH, CAO HL, et al, 2008. Spatial distribution of species diversity indices in a monsoon evergreen broadleaved forest at Dinghushan Mountain[J]. *Biodivers Sci*, 16(5):454-461.

- WANG ZG, YE WH, CAO HL, et al, 2009. Species-topography association in a species-rich subtropical forest of China[J]. *Basic Appl Ecol*, 10(7): 648-655.
- WEI SG, LI L, LIU HG, et al, 2008. Analyses of the dynamic state of *Erythrophleum fordii* population[J]. *Ecol Environ*, 17(1): 285-289.
- WU HS, 1982. Dinghu mountain nature reserve in hydrothermal condition and its relationship with ecological environment[J]. *Trop Geogr*, 2(4): 14-20.
- WU K, YIN MF, ZHOU YB, et al, 2010. Current Annual Growth Rate of Forest Volume in Baishilazi National Nature Reserve[J]. *J NW For Univers*, 25(6): 203-206.
- WU YG, HAN JX, 1988. A spectral analysis of the population dynamics of korean pine in the mixed broad-leaved *Pinus koraiensis* forest[J]. *Chin J Ecol*, (1): 19-23.
- YE WH, CAO HL, HUANG ZL, et al, 2008. Community structure of a 20 hm<sup>2</sup> lower subtropical evergreen broadleaved forest plot in Dinghushan, China[J]. *J Plant Ecol (Chin Version)*, 32(2): 274-286.
- ZHANG HD, REN SX, 1998. *Flora of China*: [M]. Beijing: Science Press, 49(3): 1-251.
- ZHANG HD, WANG BS, ZHANG CC, et al, 1955. The study on the plant community of Dinghu mountain in Guangdong province[J]. *J Zhongshan Univ(Nat Sci Ed)*, (3):161-229.
- ZHOU GX, HUANG LX, ZANG XW, et al, 2016. Effects of habitat heterogeneity on community functional diversity of Dinghu Mountain evergreen broad-leaved forest[J]. *Guihaia*, 36(2): 127-136.
- ZHOU GY, YAN JH, 2001. The influences of regional atmospheric precipitation characteristics and its element inputs on the existence and development of Dinghushan forest ecosystems[J]. *Acta Ecol Sinica*, 21(12): 2002-2012.

*Note: Figure translations are in progress. See original paper for figures.*

*Source: ChinaXiv – Machine translation. Verify with original.*