

Article

Effects of the Dominate Plant Families on Elevation Gradient Pattern of Community Structure in a Subtropical Forest

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Abstract: Dominant groups and rare groups often coexist in forests. Dominate plant families generally have more species diversity and occupy most of the biomass. However, their effects on community construction and species diversity maintenance remain to be studied. This study aims to investigate this question by using the two dominant plant families in a Chinese subtropical forest (Lauraceae and Fagaceae). In this study, 22 forest dynamic plots were established in the forest distribution area of Daming Mountain Nature Reserve at an elevation of 300–1400 m. We explored the elevational change in the community structure and its relationship with Lauraceae and Fagaceae using generalized additive models (GAM) and a regression analysis. Then we used a correlation analysis to describe the relationship between environmental factors and the community structure. Our results showed the species diversity index showed a hump-shape trend along the elevation, and the total basal area showed no significant change along the elevation. The richness of Lauraceae and Fagaceae showed a positive correlation with the species diversity, but only the richness of Fagaceae showed a positive correlated with the total basal area. Species diversity was positively correlated with soil total nitrogen and soil organic matter. Species diversity and the total basal area were negatively correlated with the soil pH. In summary, Lauraceae and Fagaceae are correlated for community structure, and this correlation is not affected by elevation. Fagaceae has played a more important role than Lauraceae. This study highlights the impact of dominant plant families on the forest community assembly along the elevational transect.

Keywords: dominant plant families; Lauraceae; Fagaceae; subtropical forest; elevation; community structure



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1. Introduction

Dominant species significantly influence species composition, diversity, ecosystem productivity and soil microbes in terrestrial ecosystems [1,2]. Dominant species determine community structure and ecosystem function through their abundance, height, cover, rhizomes or chemical components and can predict community stability under climate change [3–5]. Grime’s mass ratio hypothesis states that ecosystem functioning and stability are determined to an overwhelming extent by the dominant plants [6]. Eckberg et al. found that dominant species reduce the productivity and diversity of non-dominant plants by reducing photosynthetic availability [7], whereas Arnillas et al. [8] suggested that dominant species produce a more stable microclimate environment, reducing environmental stress and thus positively affecting non-dominant plants. Control experiments have shown a significant decrease in the above-ground biomass of the community after the removal of

dominant species [9]. The intraspecific variation of dominant species also affects community species richness [10]. The change in dominant plants showed strong consistency in family and genus along elevations, while changes in specific dominant species were more pronounced along elevations [11]. However, we have little knowledge about how dominant plant families change with elevation and the consequences of community assemblage.

Elevation gradient is the best factor for evaluating species' correspondence to habitat patterns and predicting the effects of environmental change on species diversity [12]. Changes in elevation gradient cause changes in environmental factors, such as temperature, humidity and light, and lead to a series of changes in species composition and diversity along the elevation gradient [13,14]. Due to the elevation gradient, montane forests are a complex ecosystem [15]. Thus, mountains provide a natural research site for studying the response between species diversity and environmental gradients [12].

Species diversity is an important indicator of community structure, plays an important role in the stability and sustainability of ecosystems [16] and significantly affects biodiversity–ecosystem functioning [17]. The study of elevation gradient patterns of species diversity and the main drivers could help us predict the impact of climate change on biodiversity and develop effective biodiversity conservation measures [18]. The distribution pattern of plant species diversity along environmental gradients is one of the topical issues in ecological research [19]. For example, community species diversity can be influenced by environmental factors such as temperature [20], soil [21], and light [22]. Changes in elevation gradient cause changes in environmental factors, such as temperature, humidity and light, and lead to a series of changes in species composition and diversity along the elevation gradient [13,14]. However, it has been shown that the elevational gradient of species diversity has different patterns in different regions that decrease with increasing elevation [23], increase with increasing elevation [24], and have a hump-shape pattern at the highest mid-elevation [25], etc. Whether there is a generalized relationship between species diversity and altitude is unclear [26]. Therefore, the mechanisms and factors influencing the altitudinal gradient pattern of species diversity need to be further investigated in depth.

Another important characteristic of community structure is the total basal area (TBA), the cross-sectional area of a stand at breast height calculated from the diameter at breast height, which is a simple measure widely used by foresters [27]. Basal area is a measure of stand biomass, productivity, carbon storage and dynamics [28]. It can reflect the successional stage, competition response and productive capacity of a plant community, which is also a surrogate for stand characteristics such as biomass and density [29]. Basal area increments can be used to assess tree growth [30]. The basal area is mainly influenced by community succession and the timing of stand growth [31]. The elevational gradient pattern of the basal area also varies in different climatic zones [32,33]. Therefore, understanding the factors influencing TBA is important for forest management.

In a subtropical forest in east Asia, the forest was dominated by some plant families; for instance, Fagaceae and Lauraceae plants are important components of subtropical broadleaf evergreen forests, widely distributed in tropical and subtropical regions [34] and have important ecological and economic values [35,36]. The Lauraceae has many uses, with tall trunks that can be used as garden plants, as well as trunks for timber, branches, leaves and fruits for food, and extracts as raw material for spices [37–39]. Fagaceae is one of the important ecological and economic species and is a key taxa group in global forest ecosystems, enriching terrestrial biodiversity [40]. In China, Fagaceae are economically important plants, edible plants and have some medicinal functions [41,42]. In this study, we selected forest plots with different elevation gradients on Daming Mountain to study the elevation gradient pattern of species diversity and the basal area of Daming Mountain and to explore the following scientific questions: (1) how species diversity and basal area change along elevations on Daming Mountain; (2) how environmental factors affect species diversity and TBA; and (3) how Lauraceae and Fagaceae plants impact species diversity and basal area along the elevational transect.

2. Materials and Methods

2.1. Study Area

The Guangxi Daming Mountain Nature Reserve (23°24' to 23°30' N, 108°20' to 108°34' E) is located in the south-central part of Guangxi. It is a national-level nature reserve with typical zonality, characterized by protecting the subtropical mountain forest ecosystem and cherishing endangered flora and fauna. Daming Mountain belongs to the southern subtropical monsoon climate zone, with an elevation of 115 m to 1760 m and an average elevation of 1200 m. The average annual temperature is 15.1 °C, the hottest temperature recorded is 21.9 °C, the coldest temperature recorded is 5.8 °C and the average annual rainfall is 2630 mm. The distribution of precipitation varies considerably, with June~August accounting for 45.3%~47.5% of annual rainfall, March~May for 23.1%~25.8%, September~November for 14.7%~20.1%, and December~February for 8.4%~10.7%. Soil texture was mainly clay loam and loamy clay with a pH value between 3.9 and 4.7 [43]. The main components of each forest vegetation type on Daming Mountain are those in the Lauraceae and Fagaceae, with warmth-loving species dominating the tree layer at low elevation, such as many kinds of *Litsea elongata*, *Castanopsis hystrix* and *Machilus de-cursinervis*, etc. As the altitude increases, other constituents in the Lauraceae and Fagaceae gradually increase, as well as those in the Theaceae, Hamamelidaceae, Aquifoliaceae, Symplocaceae and Magnoliaceae.

2.2. Data Sampling

In 2017, 22 plots were established in the study area. Based on the vertical change in vegetation at different elevation gradients on Daming Mountain Nature Reserve, seven monitoring points were set up at 300 m, 700 m, 1100 m, 1200 m, 1300 m and 1400 m (Figure 1), which represent the different elevation gradients of subtropics forests. Each monitoring point was set up with 3–6 quadrats. The sample area was 20 m × 20 m (Table 1). Among them, DMS17~19 were originally *illicium verum* forest, which were protected for a shorter period of time and received more anthropogenic disturbances than the other sample plots. They were spaced approximately 50 m from each other to maximize the independence of samples. In the last decade, they have been part of a protected area for reasons related to land policy and are currently in the restoration phase. We recorded all individuals with a diameter at breast height greater (DBH) than or equal to 1 m. We measured the DBH and tree height of all individuals using diameter rulers and height measurement stalks. Finally, each individual was marked with a unique number. A camera with a fisheye lens was used to take an image up the center of each 20 × 20 m sample plot. The proportion of gaps in the photographs was calculated by HemiView 2.1.1, and the canopy density of the plots were obtained. We also recorded latitude, longitude and elevation at the center of each sample plot with a handheld GPS. We measured the slope of each plot using a gradiometer at the center of the plot.

The species of all trees were identified by a local botanical expert. All species were identified with reference to the list of plant species in China (2022 Edition) (<http://www.sp2000.org.cn>, accessed on 10 September 2022). All species encountered in the survey area were collected in triplicate and deposited at the College of Forestry, Guangxi University. The species found in this survey are listed in Supplementary Table S1.

We measured soil factors to explore how they affect species diversity and TBA. In August 2017, we collected soil samples at a depth of 0~20 cm at five randomly selected points in each 20 × 20 m plot and thoroughly mixed the samples before analysis. After removing stones and rhizomes from the soil samples, they were air-dried in a ventilated room to a constant weight. The soil pH, soil total nitrogen (TN), soil total phosphorus (TP) and soil total potassium (TK) contents were measured. Soil total nitrogen, soil total phosphorus and soil total potassium were measured using the Kjeldahl distillation method, vanadium molybdenum yellow colorimetric method and flame photometric method, respectively [44]. The pH of each sample was measured in 1:2.5 mixtures of soil and deionized water with a pH meter [45]. Each soil sample was measured three times, and the average value was

used. The soil organic matter was measured via a drying method in a tubular furnace [46]. Soil bulk weight was determined using the ring-knife method [47]. We also analyzed the elevation gradient pattern of soil nutrients (Supplementary Figure S1).

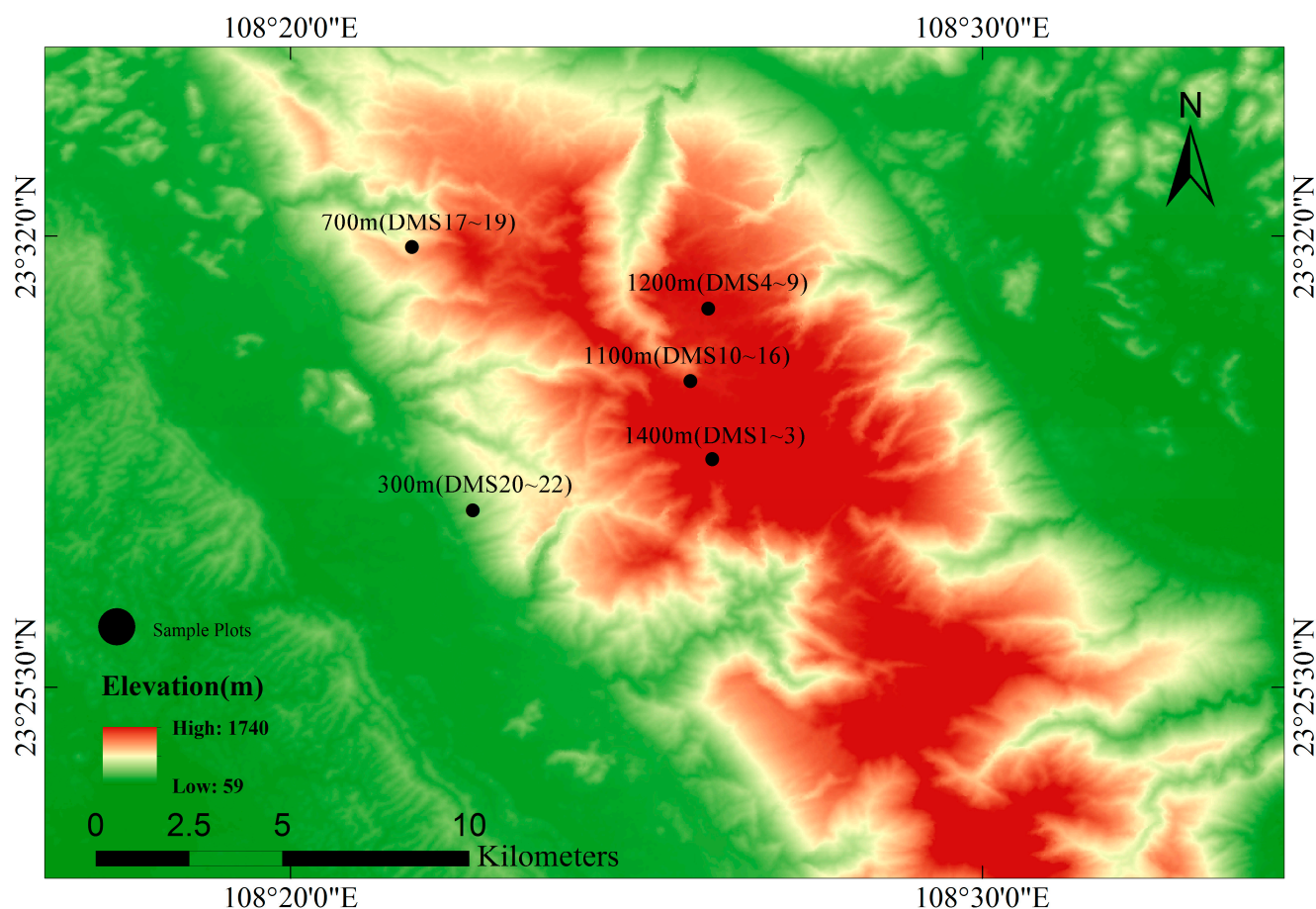


Figure 1. Map of Daming mountain showing the sampling sites along the elevational gradient in the study area.

Table 1. Basic information about the forest plots.

Elevation Zone	Forest Type	Elevation (m)	Plot	Latitude	Longitude	Slope (°)	Canopy Density
1400	montane elfin forest	1476	DMS-01	23°28′47.75″	108°26′05.63″	8	0.81
	montane elfin forest	1460	DMS-02	23°28′47.47″	108°26′06.36″	6	0.83
	montane elfin forest	1455	DMS-03	23°28′48.06″	108°26′08.99″	4	0.8
	montane elfin forest	1248	DMS-04	23°30′57.88″	108°26′02.12″	2	0.61
1200	montane elfin forest	1257	DMS-05	23°30′56.39″	108°25′59.27″	2	0.67
	montane elfin forest	1258	DMS-06	23°30′56.04″	108°26′01.25″	2	0.74
	montane elfin forest	1288	DMS-07	23°29′57.90″	108°26′53.92″	3	0.81
	montane elfin forest	1273	DMS-08	23°29′54.32″	108°26′54.89″	2	0.83
	montane elfin forest	1250	DMS-09	23°29′53.69″	108°26′55.92″	2	0.8
	evergreen deciduous mixed forest	1196	DMS-10	23°29′55.56″	108°25′46.66″	10	0.89
	evergreen deciduous mixed forest	1190	DMS-11	23°29′53.80″	108°25′47.38″	9	0.84
1100	evergreen deciduous mixed forest	1165	DMS-12	23°29′58.75″	108°25′48.05″	16	0.86
	evergreen broad-leaved forest	1121	DMS-13	23°31′07.96″	108°23′01.20″	14	0.83
	evergreen broad-leaved forest	1110	DMS-14	23°31′07.34″	108°23′00.61″	11	0.87
	evergreen broad-leaved forest	1130	DMS-15	23°31′07.22″	108°23′02.64″	19	0.78
	evergreen broad-leaved forest	1118	DMS-16	23°31′08.02″	108°23′07.01″	20	0.93

Table 1. Cont.

Elevation Zone	Forest Type	Elevation (m)	Plot	Latitude	Longitude	Slope (°)	Canopy Density
700	<i>illicium verum</i> forest	780	DMS-17	23°31′50.74″	108°21′45.21″	23	0.75
	<i>illicium verum</i> forest	770	DMS-18	23°31′51.43″	108°21′43.35″	20	0.47
	<i>illicium verum</i> forest	774	DMS-19	23°31′57.94″	108°21′46.80″	15	0.45
300	monsoon evergreen broad-leaved forest	358	DMS-20	23°28′03.35″	108°22′38.13″	19	0.79
	monsoon evergreen broad-leaved forest	376	DMS-21	23°28′08.03″	108°22′32.70″	27	0.85
	monsoon evergreen broad-leaved forest	280	DMS-22	23°28′02.10″	108°22′26.35″	28	0.79

2.3. Data Analysis

We calculated the basal area of each individual in the plots according to the formula [48]. The total basal area of each plot is the sum of the basal area of all individuals within that plot (20 × 20 m). In this study, we used the number of species to represent species richness. We recorded the number of species of Lauraceae, the number of species of Fagaceae and the total number of species in each sample plot. Species diversity was characterized using the Shannon–Wiener index and the Simpson index [49]. We used importance value index (IVI) to analyze the dominance of species in the 22 plots [50]. All indices and formulas in this study are listed in Supplementary Table S2.

Data processing and mapping were completed using Origin 2021 and R 4.1.0. The generalized additive models (GAM) were used to fit the elevation gradient pattern of diversity and basal area. GAM was used because it is a semi-parametric approach that permits data to determine the shape of the response curve by applying a smooth spline, allowing the exploration of the shapes of species response curves to environmental gradients [51]. The generalized additive models were realized by the “mgcv” package in R [52]. To explore the relationship between Lauraceae and Fagaceae in relation to species diversity and TBA, we performed regression analyses using the Origin 2021 software.

The relationship between dominant groups and community structure was analyzed using a linear model. The “corrplot” package in R was used to calculate the correlation between environmental factors and species diversity and basal area [53].

Species composition in communities can be affected by elevation [23]. Therefore, we conducted a partial correlation analysis to determine whether and how the Lauraceae and Fagaceae affected communities after removing the elevation factor. We estimated the binary relationship between Lauraceae and Fagaceae and the community by controlling elevation factors and using zero-order correlation and partial correlation (Spearson’s correlation). The 95% confidence interval was calculated using the estimated mean of the correlation coefficients and the standard error. The partial correlation analysis was performed using the “ppcor” R package [54].

3. Results

3.1. The Community Species Composition

Daming Mountain is rich in species and has a high overall diversity. A total of 198 tree species belonging to 104 genera and 53 families were recorded in the 22 plots. The top three families in terms of number of species were Lauraceae (12%), Fagaceae (8%) and Pentaphylacaceae (6%) (Figure 2). Furthermore, the top three families in terms of individual numbers were Lauraceae (14%), Theaceae (10%) and Pentaphylacaceae (8%). This indicates that these three families are the dominant families in the forest community of Daming Mountain. The Fagaceae (24%) have the largest proportion of the TBA, followed by the Lauraceae (12%) and the Theaceae (8%).

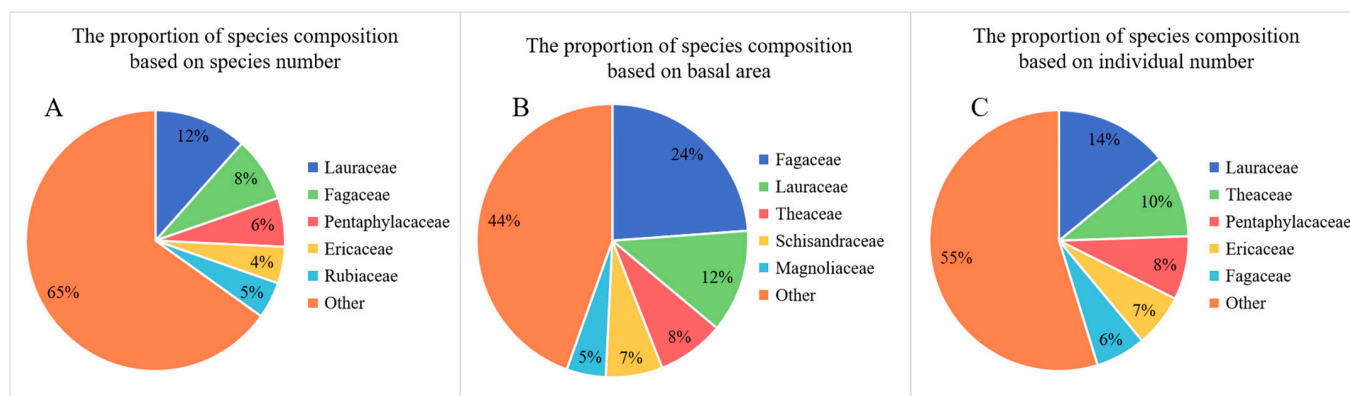


Figure 2. The proportion of species composition for the dominate family in 22 plots based on (A) number of species; (B) number of individuals; (C) basal area.

The proportion of Lauraceae and Fagaceae in the community increases with an increase in elevation. The proportion of richness of both reaches its highest value at the 1200 m elevation zone (Lauraceae, 14.91%; Fagaceae, 9.65%). The proportion of the richness of Lauraceae is greater than that of Fagaceae in each elevation area. The number of Lauraceae species found in this survey was also greater than that of Fagaceae (Supplementary Table S1). The proportion of the basal area of Lauraceae increased with elevation, while the proportion of the basal area of Fagaceae decreased after reaching its maximum at medium elevation. The maximum proportion of basal area for Fagaceae was found at the 1100 m elevation zone (45.64%), while the maximum for Lauraceae was found at the 1400 m elevation zone (21.40%) (Table 2).

Table 2. The proportion of species diversity and basal area of Lauraceae and Fagaceae in different elevational zones.

Elevation	Lauraceae		Fagaceae	
	Proportion of Richness	Proportion of Basal Area	Proportion of Richness	Proportion of Basal Area
300	6.52%	13.75%	8.70%	27.38%
700	4.65%	0.21%	0.00%	0.00%
1100	14.91%	9.72%	9.65%	45.64%
1200	12.68%	15.57%	8.45%	12.57%
1400	14.00%	21.40%	6.00%	13.37%

We used the importance value index to assess the dominance and importance of species in the study area. *Castanopsis fargesii* (13.56) has the highest mean IVI values in the study area, followed by *Machilus thunbergii* (10.42), *Illicium verum* (10.28), *Michelia maudiae* (9.59), *Rhododendron cavaleriei* (9.08), *Schima argentea* (8.92), *Engelhardtia roxburghiana* (7.84), *Castanopsis eyrei* (7.80), *Camellia fraterna* (6.73) and *Cunninghamia lanceolata* (6.57) (Figure 3).

We also analyzed IVI for Lauraceae and Fagaceae on Daming Mountain (Figure 4). In the present study, it was found that the Lauraceae and Fagaceae with the highest IVI were *Machilus thunbergii* (10.42) and *Castanopsis fargesii* (13.56), respectively. Lauraceae and Fagaceae accounted for 13.33% and 12.55% of the total importance values in the study area, respectively (Supplementary Table S1). This suggests that both are important taxa in the study area.

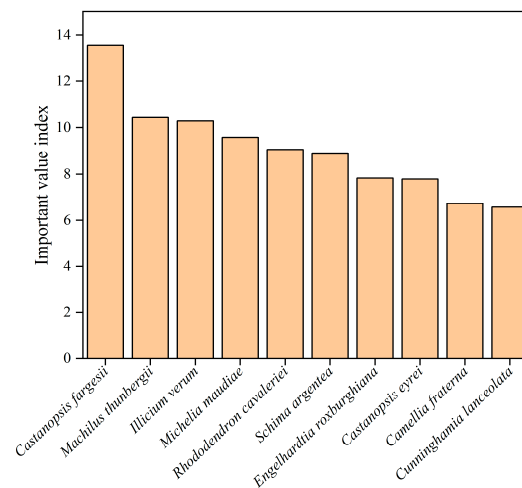


Figure 3. The species with the top 10 IVI on Daming Mountain.

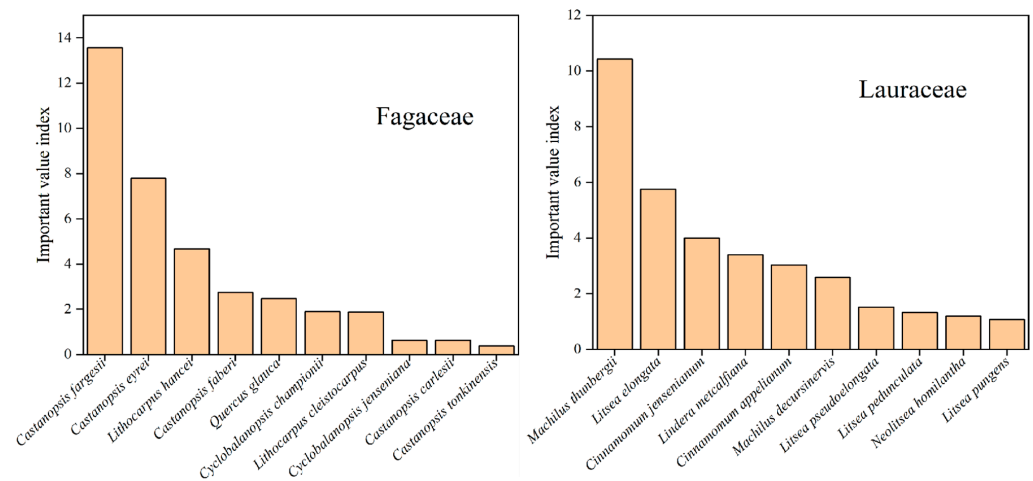


Figure 4. The species of Lauraceae and Fagaceae with higher IVI on Daming Mountain.

3.2. Species Diversity and Basal Area of Different Elevation Communities

Along the elevation gradient, the Shannon–Wiener index and Simpson index show a hump-shape trend (Figure 5, $R^2 = 0.58$, $p < 0.01$; $R^2 = 0.57$, $p < 0.01$). Species diversity increases monotonically from 300 to 1100 m. It peaks at 1100 m and then descends along 1400 m. On the other hand, no significant difference existed in the TBA in different elevation areas ($R^2 = 0.07$, $p > 0.05$).

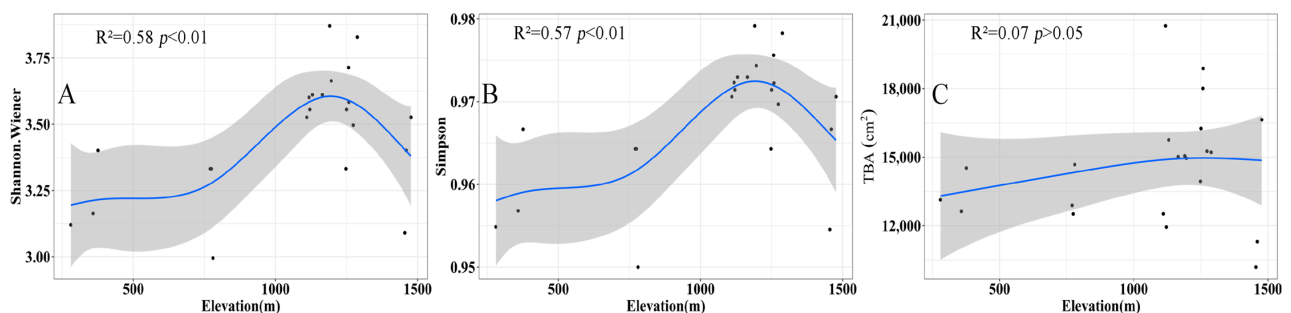


Figure 5. The change in Shannon–Wiener index (A), Simpson index (B) and total basal area (cm^2) (C) with the elevational gradient. In the figure, the black dots are actual measured values, the blue line is the fitted value and the shading is the 95% confidence interval.

3.3. Relationship between Lauraceae, Fagaceae and Species Diversity

The species diversity is correlated with the Lauraceae and Fagaceae. The species richness of Lauraceae and Fagaceae showed a significant positive correlation with the species diversity of the communities. The Shannon–Wiener index and Simpson index showed similar trends. There was no significant difference in the correlation of Lauraceae and Fagaceae with species diversity (Figure 6).

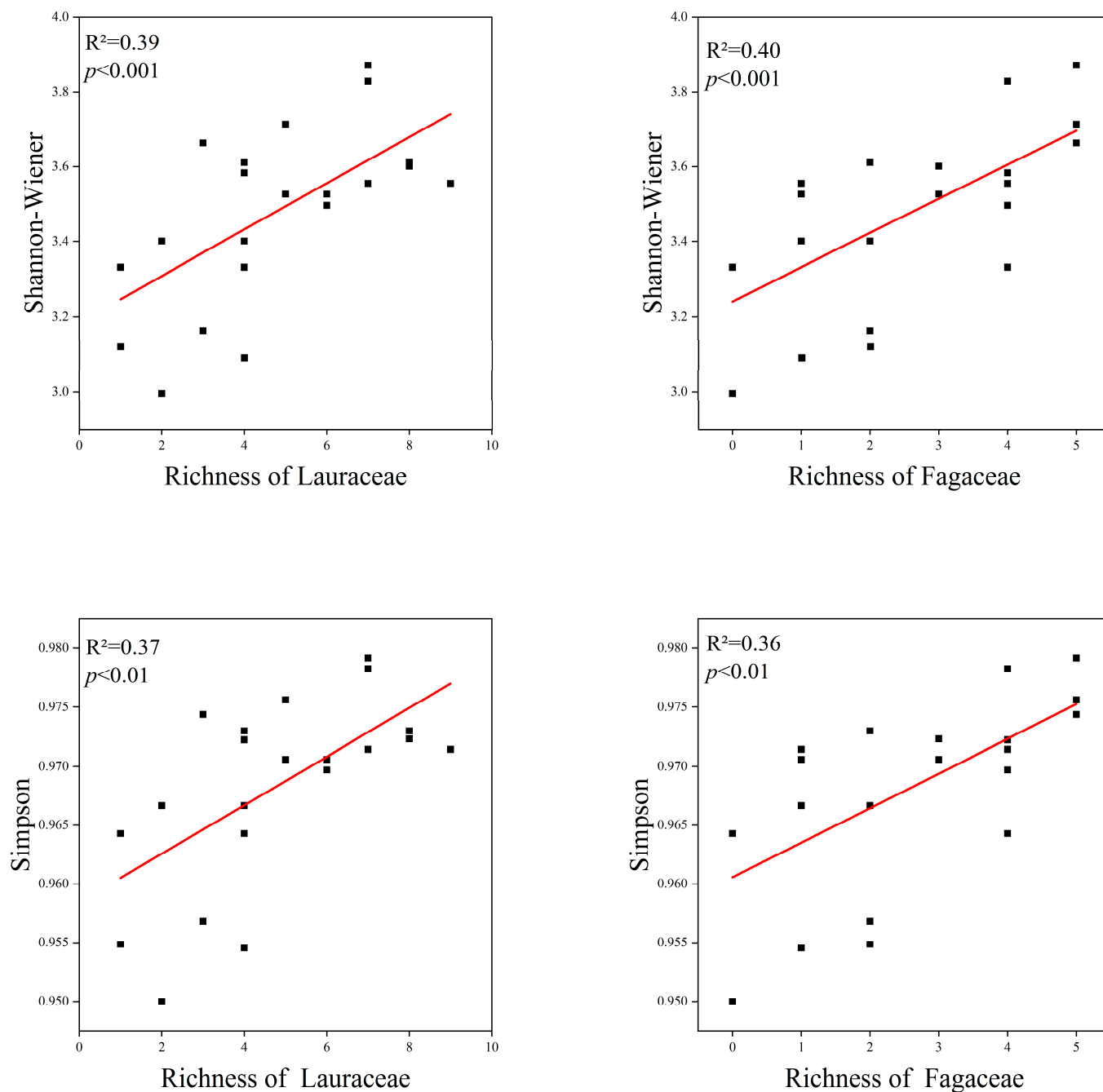


Figure 6. Relationship between Lauraceae, Fagaceae and species diversity. The red lines depicts the regression model.

3.4. Relationship between Lauraceae, Fagaceae and TBA

The richness ($R^2 = 0.25$, $p < 0.01$) of Fagaceae had a significant positive linear relationship with the TBA in the communities. This proves that Fagaceae species are the main contributors to TBA. However, there was no correlation between the sum of species numbers and the basal area of Lauraceae and the TBA of the communities (Figure 7).

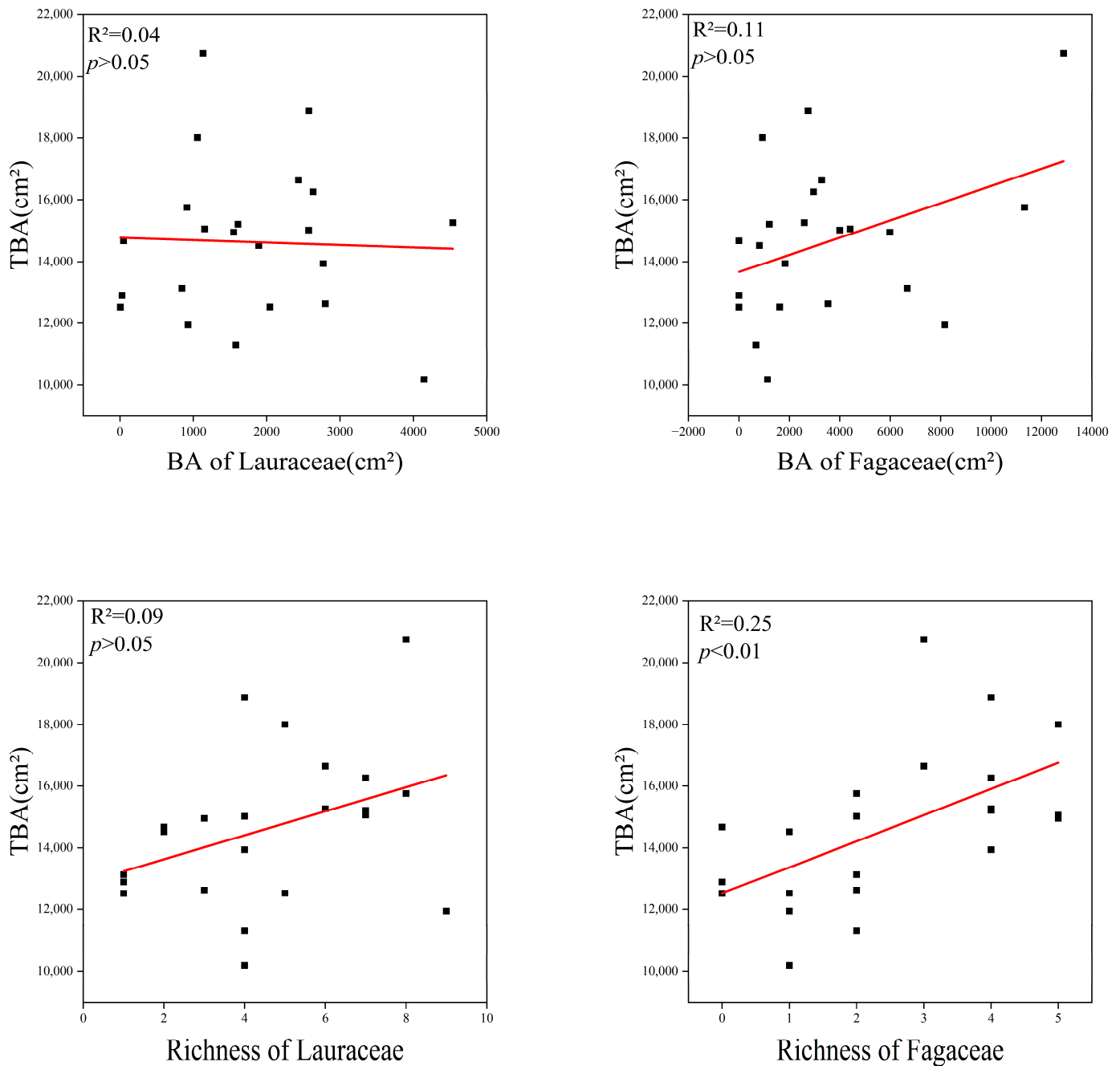


Figure 7. Relationship between Lauraceae, Fagaceae and total basal area, TBA = total basal area; BA = basal area. The red lines depicts the regression model.

3.5. Influence of Plant Factors on Species Diversity and TBA

According to the partial correlation analysis, Lauraceae and Fagaceae were still able to exert a stabilizing influence on the community after removing the elevation factors (Figure 8). The positive correlation between the richness of Lauraceae and the richness of Fagaceae with species diversity (the zero-order correlation with Spearson's $r = 0.64$ and 0.67 ,

$p < 0.01$) was slightly decreased ($r = 0.57$ and 0.61) after removing the effect of elevation factors, but the correlation between FBA ($r = 0.43$, $p < 0.05$) and species diversity increased ($r = 0.49$). Furthermore, the positive correlation between the richness of Lauraceae with TBA ($r = 0.45$, $p < 0.05$) was no longer significantly correlated ($r = 0.36$, $p < 0.05$) after removing the effect of elevation factors. However, the richness of Fagaceae ($r = 0.64$, $p < 0.01$) remained significantly positively correlated with TBA ($r = 0.60$).

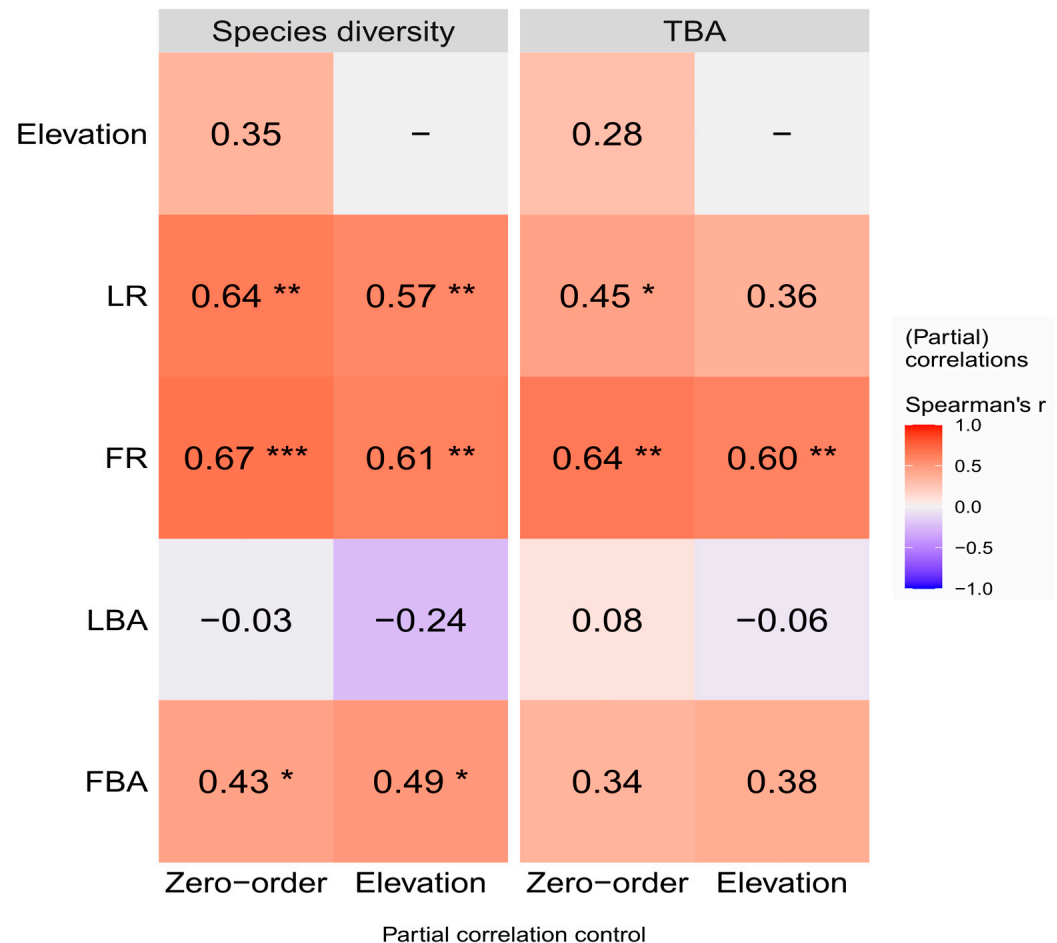


Figure 8. Partial correlations (Spearson's r) between Species diversity, TBA and the plant index on Daming Mountain. The intensity of colors and numbers indicate the strength of the correlation. Significant levels are *: $p < 0.05$, **: $p < 0.01$ and ***: $p < 0.001$. Species diversity, the Shannon–Wiener index; TBA, total basal area; LR, richness of Lauraceae; FR, richness of Fagaceae; LBA, total basal area of Lauraceae; FBA, total basal area of Fagaceae.

3.6. Relationship between Species Diversity, TBA and Environmental Factors

We analyzed the relationship between species diversity and TBA with environmental factors using a Spearman correlation analysis (Figure 9). The species diversity was significantly positively correlated with soil total nitrogen and soil organic matter. The TBA was significantly negatively correlated with soil pH and had no significant relationship with any other environmental factor. Meanwhile, it can be seen that species diversity and TBA had a significant positive correlation.

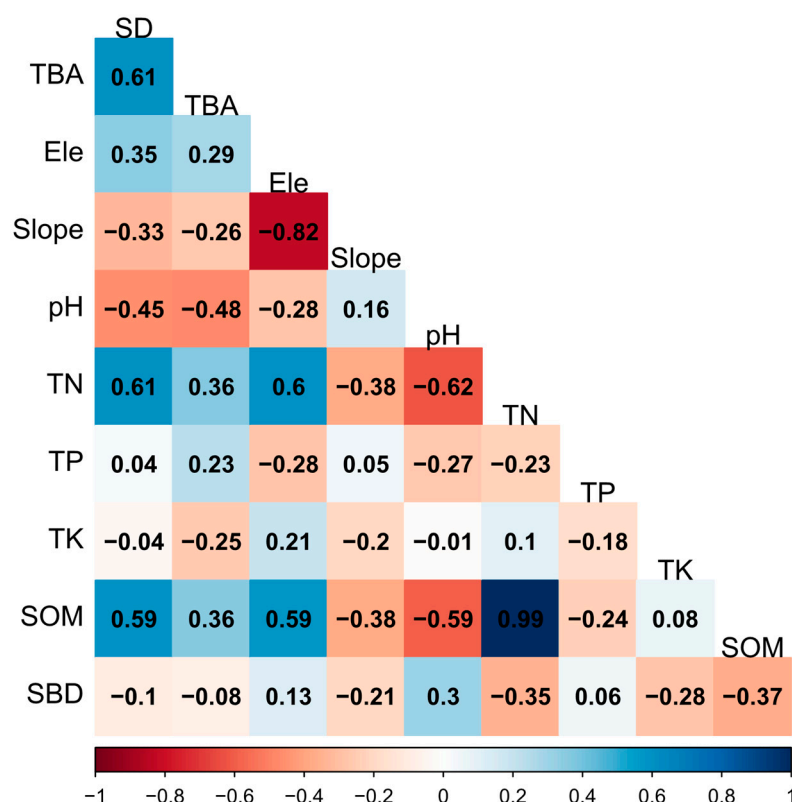


Figure 9. The Spearman correlation analysis results among the species diversity and the total basal area with elevation and environmental factors. Positive correlations are shown in blue, while negative correlations are represented by red. The correlation coefficients are proportional to the color intensity. TBA, total basal area; SD, species diversity, here we use the Shannon–Wiener Index; pH, soil pH; TK, soil total potassium; TN, soil total nitrogen; TP, soil total phosphorus; SOM, soil organic matter; SBD, soil bulk weight; Ele, elevation; Slope, slope of the center of the plot.

4. Discussion

4.1. Response of Community Structure to Dominate Plant Families

Lauraceae and Fagaceae showed a significant positive correlation with species diversity. This may be due to the high diversity of Lauraceae and Fagaceae on Daming Mountain [55]. In this study, we found a total of 25 species of Lauraceae belonging to 6 genera and 16 species of Fagaceae belonging to 3 genera (Supplementary Table S1). This is one of the reasons for the correlation of the Lauraceae and Fagaceae with species diversity. We analyzed the effect of elevational gradient on the abundance of Lauraceae and Fagaceae (Supplementary Figure S2) and found the same trend as for species diversity. This also proves their correlation. This result may be caused by the high rainfall on Daming Mountain at mid-elevation [56]. Both Lauraceae and Fagaceae have high diversity in humid and warm environments [57,58]. Our result was in line with Kamimura et al., who showed that the number of individuals in Lauraceae was positively correlated with community richness [59]. This suggests that species diversity on Daming Mountain is affected by the Lauraceae and Fagaceae.

Fagaceae is a major contributor to basal area in subtropical forests [60]. This is consistent with our results. The specific ecological traits that favor adaptation to cool montane habitats and the long evolutionary history may have led to the unique importance in terms of biomass of Fagaceae [61]. Moreover, some Fagaceae species have high seed yields, high germination capacity and fast growth rates that drive the production of more biomass [62].

4.2. Response of Community Structure to Elevation

Elevation plays an important role in driving the spatial distribution of plants [63]. In this study, species diversity had a hump-shaped trend with elevation, showing a peak at 1100 m. The hump-shaped distribution in species richness is the most commonly observed pattern in many taxa of various ecosystems. Species diversity tends to rise with increasing elevation, reaching a maximum at medium elevation and then declining with increasing elevation [64]. The hump-shaped species diversity patterns have been found in other regions, such as on Dhauladhar mountain [25], Bolivian Andes [26] and Mount Kenya [65]. The elevational gradients in species diversity result from a combination of ecological and evolutionary processes rather than the presumed independent effects of one overriding force [66]. The higher diversity of plants recorded at mid-elevation is likely due to the optimum climatic conditions that allow many species to coexist [67]. Probably the most important climatic factors determining species distributions in mountains are water availability and temperature [68]. For example, in the Himalayas, a survey found that temperature and water availability are the main drivers of plant species diversity patterns at different elevations [69]. Extreme weather, such as low temperatures, can occur at high elevations, which affects the survival of species [70]. Water availability can also determine species diversity [71]. Precipitation is higher in the middle elevation zones of Daming Mountain than in the lower and higher elevation zones [56]. High precipitation means high water utilization, which increases the length of the growing season and promotes plant growth, survival and renewal, thus increasing species diversity [72]. The greater susceptibility of lower elevations to perceived disturbance also contributes to their lower species diversity [12]. The mid-domain effect (MDE) may be another reason for the hump-like elevation gradient pattern of species diversity [73,74]. The mid-domain effect is the increasing overlap of species ranges toward the center of a shared geographic domain due to geometric boundary constraints in relation to the distribution of species range sizes and midpoints [73]. Previous studies have shown that the MDE was a robust predictor of observed species diversity and was substantial in explaining elevational biodiversity patterns [75–77].

There was no significant change in TBA with elevation. This may be because the 700 m plot received disturbance. There is a difference in the rate of recovery of forest attributes after a disturbance occurs, with species diversity recovering faster than biomass [78]. The regression analysis was repeated after removing the sample plots from the 700 m elevation zone, and we found no significant relationship between basal area and elevation (Supplementary Figure S3). Therefore, we presume that the diversity of species in the herbaceous and shrub layers has been restored thanks to the conservation of the reserve's closure. Within this time of conservation, TBA may also exhibit a hump-shape trend with an elevation in species diversity. The 700 m plots have a shorter duration of protection and are more susceptible to human disturbance than the other sample plots due to their location. We believe that these factors have contributed to the 700 m plots' slower rate of recovery. The pattern of elevation gradients in the thoracic high cross-sectional area of the Daming Mountain community is likely to shift to a hump-shape trend. A gently sloping terrain is more conducive to the growth of large trees [79]. The 1200 m plots are more gently sloping, allowing more large trees to survive (Table 1).

4.3. Response of Community Structure to Environmental Factors

Soil nutrients determine plant growth rates and also significantly influence the diversity of species in a community [80]. In this study, we found that total soil nitrogen and soil organic are positively correlated with species diversity (Figure 8). This is consistent with previous research that found that increases in soil organic matter and soil total nitrogen positively affect species diversity [81]. Moreover, the two dominant families on Daming Mountain (Lauraceae and Fagaceae) are better suited to growing in acidic soils [82,83]. Thus, soil pH is negatively correlated with species diversity and the TBA on Daming Mountain.

4.4. Implications

This study expands and enriches conservation methods and ideas for nature reserves. In the management of nature reserves, there tends to be a greater focus on the search for and protection of rare species. However, research has shown that rare species are not a significant contributor to species diversity [84,85]. In the process of long-term evolution and succession, one or more dominant species will appear in the community, and these dominant species will often become the key species or umbrella species in the community. As our study explains, dominant plants have an effect on both species diversity and TBA. Therefore, in the construction of nature reserves, it is important to emphasize the conservation of common species and dominant species. We hope that this study will serve as a reference for biodiversity conservation in other regions.

The limitation of this study is that it was conducted in only one nature reserve. Lauraceae and Fagaceae are important in subtropical forests. However, there are fewer studies on the mechanisms of their effects. Furthermore, we have also only found a correlation, and the reasons behind it need to be explored. Future studies should be conducted in different regions to consider their variation across more gradients (elevation, latitude, etc.). Furthermore, the mechanisms and causes should be studied to provide a theoretical basis for the management of nature reserves.

5. Conclusions

The Lauraceae and Fagaceae hold great economic and ecological value to people [35,36]. However, few studies have analyzed in detail the contribution of these two families to subtropical forests. Our results indicate Lauraceae and Fagaceae are key taxa that drive species diversity and the total basal area of the plant community. Moreover, Fagaceae has played more important role than Lauraceae. However, our study lacks an exploration of the mechanisms behind this. It is of great significance to study the dynamics of dominant plant families for forest management and community conservation.

Supplementary Materials: The following supporting information can be downloaded at: <https://www.mdpi.com/article/10.3390/f14091860/s1>, Figure S1: Patterns of elevational gradients in soil nutrients. Figure S2: Patterns of elevational gradients in richness of Lauraceae and Fagaceae. Figure S3: Regression after removal of 700 m. Table S1: List of species in this study. Table S2: All indices and formulas in this study.

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