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Dynamics of 18 (*Sophora japonica*) Tree Community's Crown Volume along Elevation Gradient in *Ye County*

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Abstract

Applying plant community diversity techniques and SPSS statistic analysis, we quantified the relationship between crown volume of 18 (*Sophora japonica*) tree communities and elevation along different elevation gradient in *Ye County* in the study. We concluded that there was a significantly positive correlation between crown volume of 18 (*Sophora japonica*) tree communities and elevation gradient ($P < 0.01$). Elevation was the dominant environment driver crown volume of (*Sophora japonica*) tree communities increased along elevation from 50 m to 200 m in *Ye County* in 2018. Therefore, understanding dynamic connecting crown volume of 18 (*Sophora japonica*) communities and elevation can be not just applied to preserve of (*Sophora japonica*) tree communities, but also applied to sustainable of biodiversity and processes of tree community's crown volume along elevation.

Keywords

(*Sophora japonica*) Communities, Crown Volume, Elevation Gradient, Correlation, International Pharmaceutical Materials

1. Introduction

The correlations between tree community's structure and elevation include tree community traits [1], tree community structure [2], tree community growth [3],

tropical tree community growth [4], tree community [5], tree community's leaf structure [6], and community canopy structure [7] in the environmental (size-dependent changes [1], latitudinal [2], climate warming [3], elevation [4], climate variations [5], ecological environment [6] [7]) dynamics along elevation in the forestry ecosystems. However, there is the correlation between crown volume of (*Sophora japonica*) tree communities and elevation along elevation gradient in *Ye County*.

Unfortunately, the concept of different tree community's structure is used as a framework for investigating the linkages between (*Sophora japonica*) communities and elevation habitats in *Ye County* [7]. Moreover, more and more experiments or models have assessed the relationship between plant communities and elevation along elevation or environment or disturbance gradient [7]-[13]. For instance, Liao, *et al*. (2011; 2014) found that importance values of woody species's structure were significantly correlated with elevation along elevation gradient on the northern and southern slope of the *Fu-Niu* Mountain [10] [11]. Liao, *et al*. (2011) proposed that plant species biomass were significantly correlated with elevation gradient in the typical wetland area of *Yi-Luo* River watershed [12]. Liao, *et al*. (2014) suggested that biodiversity were significantly negatively correlated with disturbance gradient [13]. Meanwhile, *Sophora japonica* is an important international pharmaceutical material in *Ye County* in 2018.

2. The Physical Geographic Conditions

Ye County was an important county in *Pingdingshan Region*. The urbanization of ecosystem is results of the historical natural and anthropogenic activities in *Ye County*. It is regional urbanization mostly in the height of more than 600 m (**Figures 1-4**; **Table 1** and **Table 2**). Three fields of biodiversity of investigations were conducted in 2018, investigating the dynamics of biodiversity in *Ye County* (**Figures 1-4**; **Table 1** and **Table 2**).

Therefore, the objective of this research was to define the correlation between crown volume of (*Sophora japonica*) tree communities and elevation gradient at spiral-temporal-environmental scales in the forest ecosystem of *Ye County* in 2018.

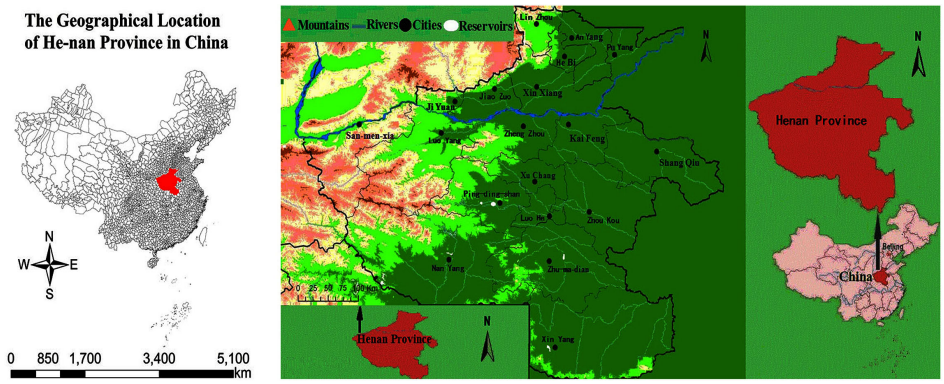

Figure 1. A digital cadastre map of location of *Henan Province* in China.

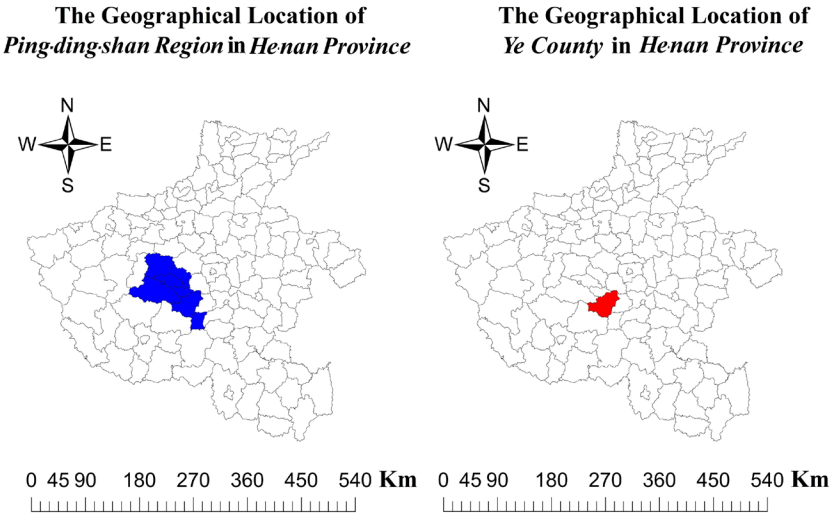

Figure 2. The geographical location of *Pingdingshan Region* in *Henan Province* and the Geographical Location of *Ye County* in *Henan Province*. Note: *Pingdingshan Region* *Ye County*.

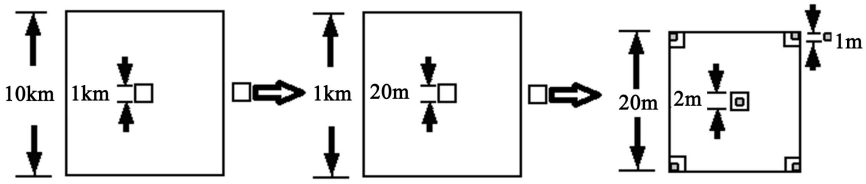

Figure 3. Quadrate settings.

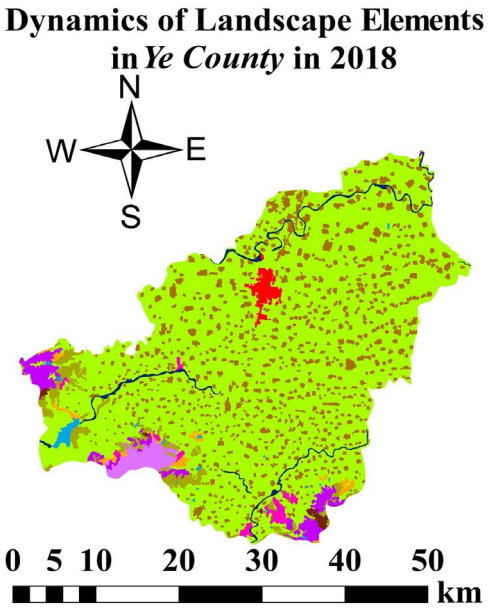

Figure 4. Dynamics of different landscape areas and landscape perimeters and landscape patch numbers in *Ye County* in 2018. Note: Urbanization of Land Use Farmlands of Land Use Rural Settlements of Land Use Reservoirs Rivers and Wetland Plantation of Land Use Natural Forest of Land Use Grassland of Coverage Ratio during 20% - 50% Grassland of Coverage Ratio > 50%.

Table 1. The natural-physical geographic conditions and vegetation in *Ye County*.

Location and Elevation	Climatic/Area	Vegetation (Plant Functional Groups)
Latitude (˚): 33.42 - 33.68	Precipitation (mm): 724	Trees: Ulmaceae/Cupressaceae/Moraceae/Moraceae/Platanaceae, *Sophora japonica*, *et al.*
Longitude (˚): 113.27 - 113.46	Temperature(˚C) (Mean): 15.2	Shrubs: Rhamnaceae/Verbenaceae/Buxaceae/Oleaceae/Rosaceae/Vitaceae/ Bignoniacea/Cornaceae, *et al.*
Elevation (m)†: 50 - 650	Sunlight: 2230 h Area (km^2): 1387	Herbs: Compositae/Leguminosae/Urticaceae/Gramineae/Convolvulaceae/ Cyperaceae/Liliaceae/Umbellferae, *et al.*

†Above sea level.

Table 2. Investigation index along the elevation and disturbance gradient variable.

Investigation	Disturbance Types/ Intensity/Frequency	Layer	Community	Species	Height	Crow	Diameter
Different plant community investigation	Differential Artificial disturbance/ Natural disturbance	Trees/ Shrubs/ Herbs	Coverage/ Community's age structure	Species/ Individual number	Different layer's height	Crow height/ Width	Different basal diameter

3. Study Methods

A field investigation was conducted in 2018, to study the dynamics of crown volume of (*Sophora japonica*) tree communities and elevation along elevation in *Ye County*. The (*Sophora japonica*) tree community's ecosystem of *Ye County* is the dominated by natural ecosystem with tree communities from 50 m to 650 m. Possessing steep environmental gradients along elevation gradient, this area is idea for studying (*Sophora japonica*) tree communities and species (**Figures 1-4**; **Table 1** and **Table 2**).

Applying plant community ecology techniques, GIS of techniques, a number of landscape maps, SPSS statistic analysis, we investigated all plant species (dominant and companion communities) on the southern, southeastern, western, eastern, northern, southwestern, northeastern, and northwestern at spiral-temporal-environmental scales along elevation gradient in *Ye County* in 2018 (**Figures 1-4**; **Table 1** and **Table 2**).

There are 8 study plots establishing in per 10 m elevation by different azimuth and direction (East, West, South, Southeast, Southwest, North, Northeast, and Northwest) in 2018. A total of 60 plots were set in three times investigating. Each study plot (**Figures 1-4**), consisted of one 20 × 20 m tree layer quadrate, five (the center and four corners of the study plot) 2 × 2 m shrub layer quadrates and 1 × 1 m herb layer quadrates. Thus, there were 180 tree layer, 900 shrub layer, and 900 herbaceous layer quadrates (**Figures 1-3**; **Table 2** and **Table 3**). Moreover, different plant species identified during this investigation were assigned into three communities according to plant life form: 1) tree communities; 2) shrub communities; 3) herb communities [10] [11] [12] [13].

4. Results

The study showed three rules of the correlation between (*Sophora japonica*) tree communities and elevation along different elevation gradients (**Figure 5**; **Table**

3).

Firstly, these show that there is crown volume of 18 (*Sophora japonica*) tree communities along differential elevation between 50 and 200 m in *Ye County*.

Secondly, this study shows that crown volume of 18 (*Sophora japonica*) tree communities increased along elevation gradients. Meanwhile, the study analyzed the relationship between crown volume of 18 (*Sophora japonica*) communities and elevation in *Ye County*. Regression equation is "$y = 27.341x - 104.43$, ($R^2 = 0.7506$)".

Thirdly, there is a significantly positive correlation between crown volume of 18 (*Sophora japonica*) tree communities and elevation ($P < 0.01$) in this paper.

5. Discussion

In resent years, more and more researches explained the correlation between tree community's crown volume and elevation [7]-[13]. These researches include dynamics of community's crown volume traits [1], tree community's crown volume structure [2], tree community's crown volume growth [3] [4] [5], tree leaf structure of community's crown volume [6], community canopy crown volume and structure [7]-[11] along elevation gradient.

Thus, the results indicate that elevation was the dominant environment driver of crown volume of 18 (*Sophora japonica*) tree communities increased along elevation gradient. This study supported the experiments or models that elevation gradient is an important environmental factor affecting dynamics of tree communities distribution [14], tree community variation [15], composition and biomass of tree community [16], dynamics of tree communities (structure and composition and diversity of tree community) [17] [18] [19] along elevation gradient at spatial-temporal-environmental scales in the future.

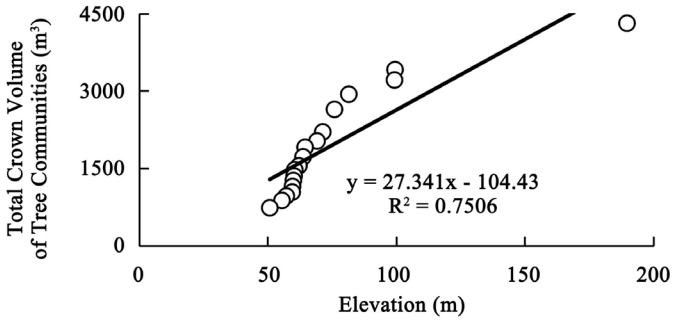

Figure 5. Dynamics of crown volume of 18tree communities along elevation gradient.

Table 3. Correlating to crown volume of tree communities and elevation gradient.

Tree Communities	Correlation between crown volume of 18 (*Sophora japonica*) tree communities and elevation
Crown Volume of (*Sophora japonica*) Tree Communities	0.866**

Note: *, $P < 0.05$; **, $P < 0.01$.

6. Conclusion

In this paper, the study explained that there was a significantly positive correlation between crown volume of 18 (*Sophora japonica*) tree communities and elevation gradient ($P < 0.01$). This study explained that elevation was the key environmental factor driver of crown volume of 18 (*Sophora japonica*) tree communities of international pharmaceutical materials increased along elevation gradient from 50 m to 200 m in *Ye County* in 2018. Therefore, understanding dynamic connecting crown volume of 18 (*Sophora japonica*) tree communities and elevation can be not just applied to preserve of (*Sophora japonica*) tree communities, but also applied to sustainable of biodiversity and processes crown volume of (*Sophora japonica*) tree communities along elevation at spatial-temporal-environmental scales in *Ye County* in the future.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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