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DISTRIBUTION PATTERN OF GENUS DIVERSITY OF CHINESE ENDEMIC SEED PLANTS

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Abstract: China is one of the richest countries in the world in endemic plants, and endemic species account for about 50% of Chinese native plant taxa. Due to natural and anthropogenic impacts, however, many Chinese endemic plants are on the verge of extinction and were listed as "critically endangered species" by the IUCN. To understand the distribution pattern of Chinese endemic-plant diversity and to maintain and conserve plant diversity, we collected data on Chinese endemic plants and their geographic history, topography and climate from the literature. We then calculated the genus richness of Chinese endemic seed plants, compared the genus diversity of 31 provinces or cities using a taxonomic similarity index, and analyzed the relationship between the diversity and environmental factors. In total, 216 Chinese endemic seed-plant genera were found, belonging to 67 families and including 454 species, of which monotypic genera account for 65.7%. The endemic tree species are mostly deciduous, with a ratio of families to genera of more than 50% for endemic deciduous trees. The number of endemic species varies widely between provinces, with highest richness and diversity in Sichuan and Yunnan (southwestern China), and decreasing diversity toward the north. However, endemism is higher on islands than inland. There are different degrees of similarity in endemic plant genera between each province and its adjacent provinces, and the differences are closely related to the different geographic history, topography and climate. The warm, humid areas generally have high endemic-plant diversity. The similarity indices of endemic-genus diversity are usually smaller between provinces on the opposite sides of mountains (e.g. Kunlun, Qinling, Taihang, Yinshan and Nanling mountains).

Keywords: diversity, biogeography, Chinese endemic seed plants, environmental gradients, taxonomic beta-diversity, genus richness, taxonomic similarity

Introduction

Endemism is the term applied to taxa whose distribution area is limited to a specific geographical region [1, 7, 25]. This phenomenon is caused by both historical and contemporary environments (including natural and artificial circumstances) and is closely related to features of biological adaptation and evolution [7, 27, 29, 43]. Endemism shows significant geographical and species differences, as distribution patterns of endemic plants reflect characteristics of the diversity and complexity of floristic composition in different regions [12, 16, 18]. Understanding the distribution patterns of endemic plants not only helps clarify evolutionary and biogeographic processes, but also plays an important role in maintaining and conserving biodiversity.

Studies have shown that spatial patterns of biodiversity are the result of interacting geological history, contemporary climate and disturbance, but the contribution of each factor to shaping distribution patterns is significantly different at different scales. Distributional patterns of endemic species are also influenced more significantly by historical processes [23, 26, 32]. In

recent decades, some studies on distribution patterns of endemic taxa at different scales and taxonomic levels have been reported, emphasizing the importance of historic events, regional and phylogenetic processes [3, 4, 8, 13, 14, 28, 33, 34, 35, 40]. Also, some analytical methods were used for measuring distribution patterns of endemic-species diversity. Methods for estimating endemic species richness involve concepts of threshold endemism [9, 11, 22], weighted endemism [9, 39], corrected weighted endemism [9, 21], parsimony analysis of endemicity [6, 17, 24, 31], phylogenetic diversity [10], evolutionary distinctiveness in phylogenetic endemism [19, 30], biogeographically weighted evolutionary distinctiveness [5], etc.

China has a complex natural-geographical environment and extraordinarily rich biological resources, with one of the highest levels of species richness in the world [41]. The Chinese flora is very old and has a high degree of endemism, with endemic genera of seed plants accounting for about 10% of all Chinese natural plant taxa. China is also one of the important areas for studying the distribution patterns of endemic plant diversity [16, 37]. The distribution pattern of Chinese endemic seed-plant diversity has been studied since the 1980s, but not many relevant reports had been made. Chinese endemic taxa were summarized as mostly sporadic or involving disjunct distributions, and geological events and climate were regarded as the most important factors shaping the distribution patterns of Chinese endemic taxa [14, 36, 38]. Studies at regional scale pointed out the importance of ecological factors in influencing the origin of Chinese endemic taxa [17]. So far, though, studies on distribution patterns of Chinese endemic seed-plant diversity have mostly involved only species richness, with other measures used only rarely [15]. In this paper, we attempt to analyze the distribution pattern of Chinese endemic taxa by comparing patterns of Chinese endemic genera across provinces using, as parameters, endemic richness and taxonomic ß-diversity. Our purposes are to add new insight to understand the distribution pattern of genus diversity of Chinese endemic seed plants, to clarify the spatial taxonomic similarity of Chinese endemic genera, to test hypotheses of how the diversity patterns have arisen, and to provide a better framework for effective maintenance and protection of biological resources.

Materials and Methods

China extends from the Pacific Ocean westward into inland Asia, covering a vast territory with tropical, subtropical, warm-temperate, typical temperate, cool-temperate and boreal climatic zones, from south to north. Chinese topography includes numerous large mountain ranges and shows three vertical levels (stages), with average altitudes of about 4000-5000m in the west (first stage), 1000-2000m in the middle (second stage), and around 1000m in the east (third stage; see Fig. 1). China is rich in biological resources and diverse vegetation types, and the Chinese flora is rich, with endemic species accounting for about 50% of all Chinese natural plant taxa. Due to many natural and anthropogenic disturbances, however, many Chinese endemic plants are on the verge of extinction and were listed as “critically endangered species” by the IUCN [42].

For studying distribution patterns of the genus diversity of Chinese endemic seed plants herein, the term 'Chinese endemic genus' is defined as all those vascular plant genera whose natural habitat is limited within the territory of China. In China, 31 provinces (or cities) were selected for comparing regional differences in genus diversity. Data were collected mainly from the literature and scientific data-bases, including the Flora of China, Chinese local floras

(provincial floras), the Chinese virtual herbarium (http://www.cvh.org.cn), and the scientific data-base of Chinese plant species (http://db.kib.ac.cn). Information on geographic distribution and phylogenic group was recorded in detail.

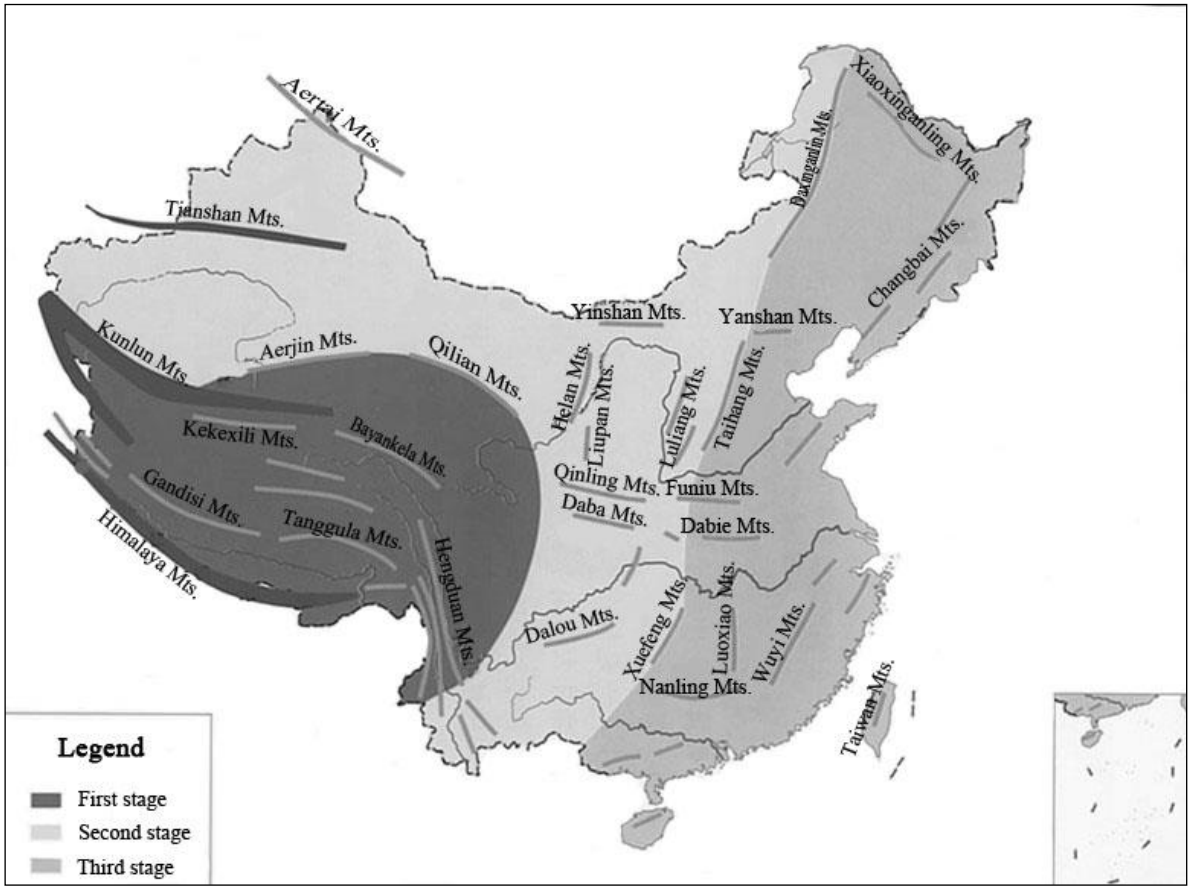

Fig. 1: Topography and Main Mountain Ranges of China.

Distribution differences in genus diversity of Chinese endemic seed plants among the different provinces/cities were assessed by measures of richness and taxonomic ß-diversity. The richness of Chinese endemic seed-plant genera was computed by two parameters, the total number of Chinese endemic seed-plant genera and corrected weighted richness (*CWR*). The *CWR* is an index defining the level of endemism for a given province/city and is measured by the weights of each endemic genus and the total number of endemic genera occurring in a given province/city [9, 22]. The taxonomic ß-diversity is determined from the index of taxonomic similarity (Δ_S), derived from phylogenetic distance [2, 20]. The parameters were computed as follows:

$$CWR = \frac{\sum_{i=1}^{n} W_i}{S}$$

$$\Delta_S = 1 - \frac{\sum_i \omega_{iB} + \sum_j \omega_{jA}}{(n_A + n_B) \times (L - 1)}$$

where W_i is the weight of genus *i*, measured by the inverse of its range size; *n* is the total number of Chinese endemic genera present in each province/city; *S* is the number of Chinese endemic

genera occurring in a given province/city; L is the number of taxonomic levels used for constructing the phylogenetic tree; ω_{iB} is the minimum phylogenetic distance between genus i at province/city A and all genera in province/city B; ω_{jA} is the minimum phylogenetic distance between genus j in province/city B and all genera at province/city A; and n_A and n_B are the number of genera in provinces/cities A and B, respectively. Here, the values of W_i and CWR were standardized between 0 and 1.

A coefficient of variation (CV) is used to measure the distribution difference of the ß-diversity index for each province relative to other provinces.

Results

Chinese endemic genera of seed plants

A total of 216 Chinese endemic genera of seed plants was recorded; these belong to 67 families and include 454 species and varieties. There are 6 endemic gymnosperm genera belonging to four families: *Pseudolarix* (Pinaceae), *Cathaya* (Pinaceae), *Metasequoia* (Taxodiaceae), *Glyptostrobus* (Taxodiaceae), *Pseudotaxus* (Taxaceae) and *Ginkgo* (Ginkgoaceae) (Table 1). Families rich in endemic genera (more than five endemic genera) are the Gesneriaceae (29 genera), Compositae (21 genera), Umbelliferae (13 genera), Labiatae (12 genera), Orchidaceae (10 genera), Cruciferae (9 genera), Gramineae (8 genera) and Melastomataceae (6 genera). There are 27 monotypic families, accounting for 40.3% of all families that include Chinese endemic seed-plant genera. Of the total, 142 Chinese endemic seed-plant genera have only one species, accounting for 65.7% of all Chinese endemic seed-plant genera. Chinese endemic seed-plant genera include 141 genera of herb species (327 species in 34 families) and 75 genera of woody plants (127 species in 40 families). Among the endemic herb species, the fraction of monotypic genera is 60.3% (85 genera); that for the endemic woody plants is 76% (57 genera). This suggests that differentiation is significantly faster in endemic herb genera than in the woody genera.

Table 1: Statistics of Chinese endemic genera of seed plants

Life form			Families	Genera			Species	
				Total genera		Monotypic genera	Number	Ratio (%)
				Number	Ratio (%)			
Herb plants	Annual and biennial		11	20	9.3	9	53	11.7
	Perennial		32	121	56.0	76	274	60.4
	Sum		34	141	65.3	85	327	72.0
Woody species	Arbors	EG	10	16	7.4	14	22	4.9
		SEG	1	1	0.4	0	2	0.4
		DEC	18	20	9.3	15	31	6.8
		Sum	26	37	17.1	29	55	12.1
	Shrubs	EG	4	8	3.7	3	32	7.1
		SEG	1	1	0.4	0	4	0.9
		DEC	12	20	9.3	16	27	5.9
		Sum	17	29	13.4	19	63	13.9
	Liana		6	9	4.2	9	9	2.0
	Sum		40	75	34.7	57	127	28.0
Total			67	216	100	142	454	100

Note: EG = evergreen, SEG = semi-evergreen, DEC = deciduous.

Chinese endemic genera of woody species include 37 tree genera, 29 shrub genera and 9 liana genera. The deciduous tree genera (20) belong to 18 families, accounting for 54.1% of all endemic tree genera and 69.2% of the families. The deciduous shrub genera (also 20) belong to 12 families, or 69.0% of all endemic shrub genera and 70.9% of the families. Chinese endemic deciduous-tree genera and their families account for high fractions of all tree taxa, reflecting the notable effect of low temperature on plants surviving in historical periods, such as the Quaternary glacial period.

Richness and endemism of Chinese endemic genera

The numbers of endemic seed-plant genera are very different in the 31 provinces/cities studied (Table 2). Sichuan and Yunnan contain the most Chinese endemic genera (105), and the provinces in central and southern China, including Guizhou (71), Guangxi (71), Hubei (56), Hunan (51), and Guangdong (43), harbor a higher number of endemic genera as well. The richness of endemic seed-plant genera is lowest in the provinces/cities of northern China, including Neimenggu (7), Jilin (4), Ningxia (3), Heilongjiang (2), Beijing (2) and Xinjiang (2). However, the total number of endemic genera for a given province/city does not correspond completely to the level of endemism of that province/city, due to the influences of the geographical ranges of the endemic genera and local area. The results of the *CWR* analysis showed that Hainan and Taiwan (islands) have the highest degree of endemism; the provinces in southern China and southwestern China (e.g. Guangxi, Guizhou, Yunnan and Sichuan) also exhibited higher level of endemism; and the provinces/cities in northern China were generally lower in endemism. The distribution pattern of endemism is related to the special range of the endemic genera, especially, the endemism of provinces/cities increased significantly with an increase in the number of endemic genera restricted to one province/city (r=0.642, P<0.05). For this reason, the two provinces (Hainan and Taiwan) with the highest percentage of endemic genera occurring only in one province (38.89% and 17.65%) showed higher level of endemism than the provinces in southern China (e.g. Yunnan, Sichuan, Guizhou and Guangxi) have more endemic genera.

ß-diversity between provinces/cities

The ß-diversity indices of Chinese endemic seed-plant genera, between any two provinces/cities, are not too large and vary from 0.01 to 0.57 (Table 3, Figure 2). The distribution of these ß-diversity indices is uneven, and ß-diversity indices less than 0.20 occur most often (322 indices, 69.0%).

Four provincial pairs show high similarity of Chinese endemic seed-plant genera, with ß-diversity indices more than 0.50. These provincial pairs are: Sichuan and Yunnan (0.50), Gansu and Shaanxi (0.53), Jiangxi and Zhejiang (0.54), and Jilin and Heilongjiang (0.57). Each province in these pairs is adjacent to the other and has similar richness of Chinese endemic genera, indicating that the genera in each pair are closely related, due to similar geographical history, geomorphology, climatic conditions and other physical environmental factors. There are 19 provincial pairs with ß-diversity indices in the range 0.4-0.5, and most provinces in each pair are adjacent. These 19 pairs occur mainly south of the Qinling and Taihang Mts. and east of the Qinghai-Tibet plateau. The two provinces with the smallest ß-diversity index values are Tibet (XZ) and Hong Kong (XG) (less than 0.02), which are far apart and have significantly different physical environments. Most other provincial pairs with small ß-diversity index values also involve provinces that are well separated from each other, and the ß-diversity values generally

decrease with increasing distance between two provinces/cities. This is because environmental differences between two provinces increase with increasing separation (i.e. positive spatial autocorrelation). For example, Sichuan (SC) is rich in Chinese endemic genera, and the four provinces to its east (Guizhou, Hunan, Jiangxi and Fujian, in that order) have ß-diversity indices, versus Sichuan, of 0.40, 0.31, 0.21 and 0.18, respectively.

Table 2: Richness and endemism of Chinese endemic seed-plant genera in different provinces/cities

Site	Number of genera	Number of endemic genera	Area ($km^2 \times 10^4$)	Endemic genera occurring only in one province/city		*CWR*
				Number	Percent accounting for endemic genera (%)	
SC	1521	105	48.14	4	3.81	0.26
YN	1986	105	38.33	12	11.43	0.26
GZ	1276	71	17.60	3	4.23	0.29
HUB	1355	56	18.59	1	1.79	0.15
HUN	1139	51	21.18	1	1.96	0.17
GX	1580	71	23.60	9	12.68	0.36
GD	1434	43	18.00	1	2.33	0.18
GS	1008	38	45.44	1	2.63	0.11
XZ	1138	31	122.80	3	9.68	0.06
SAX	1115	35	20.56	0	0.00	0.08
JX	1160	35	16.70	0	0.00	0.12
ZJ	1259	33	10.20	3	9.09	0.23
AH	1231	24	13.97	1	4.17	0.13
FJ	1152	26	12.13	1	3.85	0.13
HN	896	18	16.70	0	0.00	0.06
QH	508	20	72.23	1	5.00	0.10
HAN	1201	18	3.40	7	38.89	1.00
SX	816	16	15.63	0	0.00	0.06
TW	1201	17	3.60	3	17.65	0.41
CQ	1127	12	8.23	0	0.00	0.04
HEB	713	14	18.77	0	0.00	0.07
JS	773	12	10.26	0	0.00	0.05
LN	796	9	14.59	1	11.11	0.09
SD	526	8	15.38	0	0.00	0.05
NMG	761	7	118.30	1	14.29	0.01
XG	145	4	0.11	0	0.00	0.16
JL	740	4	18.74	0	0.00	0.01
NX	493	3	6.64	0	0.00	0.01
BJ	524	2	1.68	0	0.00	0.02
HLJ	565	2	45.48	0	0.00	0.00
XJ	733	2	166.00	0	0.00	0.00

Note: SC = Sichuan, YN = Yunnan, GX = Guangxi, GZ = Guizhou, HUB = Hubei, HUN = Hunan, GD = Guangdong, GS = Gansu, XZ = Tibet (Xizang), JX = Jiangxi, SAX = Shaanxi, ZJ = Zhejiang, AH = Anhui, FJ = Fujian, HN = Henan, QH = Qinghai, HAN = Hainan, SX = Shanxi, TW = Taiwan, CQ = Chongqing, HEB = Hebei, JS = Jiangsu, LN = Liaoning, SD = Shandong, NMG = Inner Mongolia (Neimenggu), XG = Hong Kong (Xianggang), JL = Jilin, NX = Ningxia, BJ = Beijing, HLJ = Heilongjiang and XJ = Xinjiang.

Table 3: Phylogenetic similarity of Chinese endemic genera of seed plants between provinces/cities. Site (province/city) is abbreviated same as Table 2.

Site	SC	YN	GX	GZ	HUB	HUN	GD	GS	XZ	JX	SAX	ZJ	AH	FJ	HN	QH	HAN	SX	TW	CQ	HEB	JS	LN	SD	MN	XG	JL	NX	BJ	HLJ
YN	**0.50**																													
GX	0.23	0.29																												
GZ	0.40	0.40	0.37																											
HUB	0.37	0.27	0.28	0.42																										
HUN	0.31	0.28	0.36	0.43	0.45																									
GD	0.21	0.21	0.45	0.33	0.31	0.39																								
GS	0.28	0.21	0.15	0.25	0.33	0.25	0.15																							
XZ	0.20	0.20	0.09	0.13	0.13	0.13	0.10	0.17																						
JX	0.21	0.22	0.08	0.37	0.36	0.40	0.44	0.21	0.11																					
SAX	0.29	0.21	0.15	0.27	0.40	0.32	0.19	**0.53**	0.15	0.27																				
ZJ	0.18	0.20	0.27	0.30	0.35	0.39	0.36	0.21	0.14	**0.54**	0.26																			
AH	0.15	0.16	0.20	0.26	0.31	0.29	0.28	0.25	0.14	0.42	0.33	0.44																		
FJ	0.18	0.18	0.30	0.29	0.26	0.33	0.43	0.13	0.14	0.48	0.20	0.37	0.26																	
HN	0.16	0.13	0.13	0.21	0.29	0.23	0.18	0.37	0.14	0.25	0.44	0.26	0.35	0.22																
QH	0.14	0.11	0.10	0.10	0.14	0.12	0.11	0.24	0.31	0.15	0.18	0.16	0.16	0.13	0.13															
HAN	0.07	0.09	0.19	0.13	0.10	0.15	0.21	0.09	0.11	0.22	0.07	0.19	0.12	0.27	0.09	0.09														
SX	0.13	0.12	0.11	0.13	0.22	0.18	0.11	0.34	0.11	0.18	0.37	0.17	0.21	0.10	0.37	0.23	0.09													
TW	0.11	0.13	0.18	0.19	0.20	0.20	0.19	0.15	0.18	0.25	0.16	0.16	0.19	0.29	0.12	0.14	0.21	0.12												
CQ	0.12	0.11	0.11	0.16	0.12	0.09	0.09	0.13	0.12	0.13	0.11	0.08	0.10	0.08	0.10	0.14	0.09	0.15	0.11											
HEB	0.12	0.10	0.09	0.10	0.15	0.14	0.11	0.25	0.16	0.15	0.30	0.13	0.19	0.14	0.40	0.17	0.09	0.42	0.13	0.10										
JS	0.10	0.11	0.15	0.18	0.25	0.24	0.22	0.17	0.07	0.35	0.24	0.33	0.39	0.21	0.23	0.16	0.07	0.25	0.17	0.12	0.16									
LN	0.06	0.07	0.08	0.09	0.13	0.09	0.10	0.16	0.12	0.14	0.20	0.15	0.18	0.14	0.18	0.17	0.09	0.38	0.17	0.16	0.38	0.40								
SD	0.07	0.07	0.10	0.10	0.13	0.15	0.13	0.16	0.07	0.16	0.23	0.15	0.22	0.12	0.31	0.15	0.07	0.33	0.10	0.14	0.32	0.33	0.40							
MN	0.07	0.06	0.07	0.07	0.10	0.08	0.09	0.17	0.12	0.11	0.18	0.09	0.14	0.09	0.16	0.19	0.05	0.23	0.15	0.17	0.30	0.18	0.29	0.28						
XG	0.04	0.04	0.09	0.08	0.06	0.05	0.12	0.05	0.02	0.11	0.07	0.09	0.07	0.12	0.09	0.08	0.15	0.10	0.11	0.17	0.09	0.06	0.11	0.08	0.09					
JL	0.04	0.05	0.05	0.05	0.09	0.06	0.06	0.07	0.10	0.07	0.10	0.09	0.09	0.04	0.13	0.10	0.06	0.17	0.15	0.13	0.25	0.17	0.43	0.36	0.33	0.12				
NX	0.05	0.05	0.04	0.04	0.07	0.07	0.04	0.10	0.09	0.07	0.13	0.08	0.08	0.04	0.09	0.14	0.08	0.24	0.11	0.14	0.24	0.11	0.23	0.13	0.21	0.19	0.25			
BJ	0.02	0.03	0.05	0.04	0.04	0.04	0.05	0.06	0.06	0.06	0.08	0.05	0.06	0.06	0.13	0.08	0.10	0.19	0.06	0.09	0.24	0.14	0.30	0.20	0.24	0.24	0.35	0.16		
HLJ	0.02	0.03	0.03	0.02	0.07	0.04	0.04	0.04	0.09	0.04	0.06	0.08	0.06	0.04	0.10	0.09	0.05	0.08	0.17	0.11	0.14	0.12	0.31	0.20	0.22	0.14	**0.57**	0.30	0.19	
XJ	0.02	0.02	0.05	0.05	0.06	0.05	0.07	0.09	0.07	0.08	0.09	0.08	0.10	0.07	0.14	0.15	0.05	0.08	0.17	0.11	0.20	0.10	0.16	0.15	0.24	0.16	0.24	0.30	0.24	0.37
Max	0.50	0.50	0.45	0.43	0.45	0.45	0.45	0.53	0.31	0.54	0.53	0.54	0.44	0.48	0.44	0.31	0.27	0.42	0.29	0.17	0.42	0.40	0.43	0.40	0.33	0.24	0.57	0.30	0.35	0.57
Min	0.02	0.02	0.03	0.02	0.04	0.04	0.04	0.04	0.02	0.04	0.06	0.05	0.06	0.04	0.09	0.08	0.05	0.08	0.06	0.08	0.09	0.06	0.06	0.07	0.05	0.02	0.04	0.04	0.02	0.02
Average	0.16	0.16	0.16	0.20	0.22	0.21	0.19	0.19	0.13	0.22	0.22	0.21	0.21	0.19	0.20	0.14	0.12	0.20	0.16	0.12	0.19	0.19	0.20	0.18	0.16	0.10	0.16	0.13	0.12	0.13
CV (%)	73.8	70.9	68.4	64.8	56.5	61.8	64.6	54.3	42.1	62.0	52.8	58.3	51.2	60.3	49.5	34.1	48.7	50.3	28.9	21.3	50.3	48.3	56.2	52.3	49.7	47.6	81.5	61.0	74.2	95.5

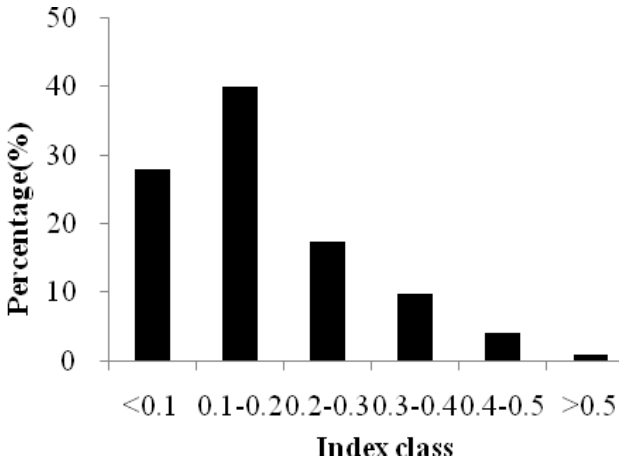

Fig. 2: Distribution of ß-diversity index classes

In addition, for each province/city, the average values of the ß-diversity index are small (0.10-0.22) and the coefficients of variation fluctuate in the range 21.3-95.5%. First, the largest coefficients of variation occur in Heilongjiang (HLJ, 95.5%) and Jilin (JL, 81.5%) in northeastern China, and the average values of the ß-diversity index of these two provinces are smaller (0.13 and 0.16). The ß-diversity index between the two provinces, though, is the largest (0.57), indicating that the relation of Chinese endemic genera between the two provinces and the other provinces/cities is generally lower, except between these two provinces. Second, Chongqing (CQ) has the smallest coefficient of variation (21.3%) and a lower average value of the ß-diversity index, suggesting that Chinese endemic genera of Chongqing are weakly related to those of the other provinces/cities, maybe because Chongqing is located in the eastern Sichuan basin, in an area where the physical environment (climate, landform, etc.) is changing. Third, three provinces, namely Taiwan (TW, 28.9%), Hong Kong (XG, 47.6%) and Hainan (HAN, 48.7%), have smaller coefficients of variation and lower average values of the ß-diversity index (0.16, 0.12 and 0.10 respectively). These are island or coastal provinces, which suggests that Chinese endemic seed-plant genera in island or coastal locations are weakly related to those further inland.

Discussion and Conclusion

The Chinese flora has a high level of endemism. There are 216 Chinese endemic seed-plant genera, belonging to 67 families and containing 454 species and varieties. Most of these endemic genera are angiosperms (210 genera, 97.2%), with only 6 genera (2.8%) of gymnosperms, reflecting the evolutionary order of land plants.

Chinese endemic seed-plant genera include many herbs (141 genera, 65.3%) and fewer woody species (75 genera, 34.7%). The proportion of monotypic genera among all endemic genera is significantly smaller for herb genera (60.3%) than for woody genera (76.0%). suggesting that differentiation is significantly faster for Chinese endemic herb genera than for woody genera. About 70% of all Chinese endemic tree genera are deciduous, showing the notable effects of climate history, especially changes in temperature, on the survival and differentiation of land plants, as in the Quaternary glacial period.

The distribution of genus richness of Chinese endemic seed plants shows significant provincial differences, with the greatest richness occurring in Sichuan (105 genera) and Yunnan (105 genera), both warm, humid areas. The provinces/cities with higher richness levels of Chinese endemic genera are mostly in southwestern China, and less rich provinces are mainly in northern China, with richness decreasing gradually away from Sichuan and Yunnan. However, the distribution pattern of the endemism does not correspond completely to that of genus richness, and the provinces with the highest endemism include especially the islands (Hainan and Taiwan), because these locations harbor more narrow-range genera of Chinese endemic seed plants.

The similarity of Chinese endemic genera between provinces/cities is mostly small and shows significant geographic differences. Endemic genera are generally more similar between provinces/cities in eastern and southeastern China than in northern and northwestern China, also for similarity between adjacent provinces. Similarity between island or coastal provinces and other provinces is generally lower than between two inland provinces. The phylogenetic correlation of Chinese endemic seed-plant genera between provinces/cities decreases with increasing distance between them.

The similarities of endemic plant genera between each province and its adjacent provinces are different, and the difference seems related to differences in geographic history, topography and climate. The similarity indices of endemic-genus diversity are usually smaller between provinces on the opposite sides of mountains (e.g. Kunlun, Hengduan, Qinling, Taihang, Changbai, Yinshan and Nanling mountains), not only because mountains protect plants from adverse environmental conditions, but also because they hinder the dispersal and differentiation of some endemic plants.

Some other studies on Chinese endemic seed-plant genera [36, 38] showed similar patterns of diversity. The results of similarity analysis in this paper are slightly different, though, in that the similarity values for endemic genera between provinces are mostly smaller than in past studies. This may be due to different measurement and analytical methods. Similarity in past studies was based mainly on taxon presence/absence, but here we used a taxonomic ß-diversity index to measure similarity between provinces/cities. The taxonomic ß-diversity index contains much phylogenetic information and can reflect evolutionary relationships between plants, whereas presence/absence ignores much information. So the similarity values obtained herein are smaller but perhaps more accurate than in past studies.

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MODEL DE DISTRIBUŢIE A DIVERSITĂŢII GENURILOR DE SPERMATOFITE ENDEMICE DIN CHINA

(Rezumat)

China este una dintre ţările cele mai bogate în specii de plante endemice, cu circa 50 % din totalul taxonilor vegetali nativi. Datorită impactului cauzat de factori naturali şi antropici, multe plante endemice sunt pe cale de dispariţie şi sunt listate ca "specii cu grad crescut de periclitare" de către IUCN. Pentru a înţelege modelul de distribuţie a diversităţii plantelor endemice din China şi pentru a menţine şi conserva diversitatea acestora, au fost colectate informaţii din literatură despre plantele endemice din China, istoria lor geografică, topografie şi climă. A fost calculată bogăţia generică a plantelor endemice din China, comparativ cu diversitatea generică din 31 provincii sau oraşe prin utilizarea unui index de similaritate taxonomică şi s-a analizat relaţia dintre diversitate şi factorii de mediu. S-au studiat 216 genuri de plante endemice în China, aparţinând la 67 familii şi incluzând 454 specii, din care 65,7% sunt genuri monotipice. Speciile de arbori endemici sunt majoritatea cu frunze căzătoare, cu un raport familii : genuri de peste 50%. Numărul de specii endemice variază foarte mult între provincii, cu bogăţia şi diversitatea cea mai ridicată în Sichuan şi Yunnan (sud-vestul Chinei), diversitatea scăzând spre nord. În toate situaţiile, endemismul este mai ridicat în insule decât pe continent. Există diferite grade de similaritate ale genurilor de plante endemice între fiecare provincie şi provinciile adiacente, iar diferenţele sunt strâns legate de istoria geografică, topografia şi clima diferite. În general, zonele calde şi umede au o diversitate ridicată de plante endemice. Indicii de similaritate ai diversităţii genurilor endemice sunt de regulă mai mici între provinciile de pe versanţi muntoşi opuşi (ex.: munţii Kunlun, Qinling, Taihang, Yinshan şi Nanling).

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