Floristic Characteristics of the Guangxi Du'an Candidate Area in the Southwest Karst National Park

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Abstract. To systematically evaluate the floristic characteristics of the Guangxi Du'an candidate area for the Southwest Karst National Park, field investigations were conducted using systematic transect methods. A total of 929 wild plant species belonging to 516 genera and 152 families were recorded in this region. The taxonomic composition is overwhelmingly dominated by angiosperms, comprising 134 families, 494 genera, and 881 species. Analysis of life forms indicates that shrubs constitute the predominant group (46.39%), reflecting the typical vegetation structure of the local karst ecosystem. Floristic geographic analysis revealed pronounced tropical characteristics. At the family level, tropical components account for 78.84%, with the Pantropic distribution being the most dominant type. At the genus level, tropical components represent 75.68%, while temperate components comprise 22.01%, and 11 genera (2.31%) are endemic to China. In conclusion, the flora of the Du'an candidate area exhibits remarkable species diversity and distinct tropical attributes alongside a specific proportion of temperate components. These findings provide a crucial scientific baseline for biodiversity conservation and national park planning in the karst region.

Keywords: Flora; Wild plants; Southwest karst national park; Du'an County, Guangxi

1 Introduction

Flora refers to a natural assemblage of plant species formed over a long evolutionary history under specific natural and historical conditions [1-2]. Its characteristics are profoundly shaped by a synergy of biological and environmental factors, including geographical location, climatic conditions, soil properties, geological history, and vegetation evolution [3-4]. Systematically investigating the flora of a specific region is of dual significance: theoretically, it elucidates the origins, migrations, and environmental correlations of plant taxa [5-6]; practically, it provides a rigorous scientific foundation for the planning of protected areas and the formulation of biodiversity conservation strategies [7-8]. Therefore, floristic research is indispensable for the scientific preservation and rational utilization of wild plant resources [9].

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Du'an Yao Autonomous County (hereafter referred to as Du'an County) is situated in the west-central part of Guangxi, China. It is characterized by extensive and continuous karst landscapes and is located within the Dahua-Du'an section of the candidate area for the Southwest Karst National Park. Positioned at the northern edge of the South Subtropical Monsoon Climate Zone, the county lies on a transitional slope from the Guangxi Basin to the Yunnan-Guizhou Plateau, resulting in distinct transitional climatic features. The highly developed karst topography and abundant cave resources have fostered exceptionally diverse plant communities [10]. Current research in Du'an County has primarily focused on specific facets such as karst cave plant diversity [11] and medicinal plant resources [12], while a comprehensive floristic investigation remains lacking. Conducting an in-depth floristic study of wild plants in Du'an County will provide precise biodiversity baseline data for the Southwest Karst National Park (candidate area), facilitating its planning, construction, and conservation while promoting the protection and sustainable development of regional plant resources [13].

2 Materials and Methods

2.1 Overview of the Study Area

Du'an Yao Autonomous County is located in the west-central part of Guangxi and the southern part of Hechi City, China, spanning from 107°49′ to 108°37′ E and 22°59′ to 23°33′ N. The region covers a total land area of 4,095.2 km². Situated in the subtropical monsoon climate zone, the county exhibits distinct seasonal characteristics: spring is characterized by prolonged and frequent precipitation with weak solar radiation; summer is hot and humid with frequent heavy rainfall events; autumn is dominated by clear weather but is prone to seasonal droughts; and winter is relatively cold with sparse precipitation (Fig.1).

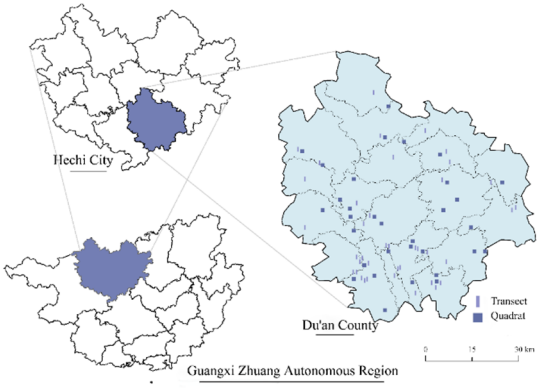

Fig. 1. Botanical survey sites in Guangxi Du'an candidate area in the Southwest Karst National Park

The mean annual precipitation in the region reaches 1,726 mm. However, due to the constraints of complex topography, geological structures, karst hydrology, and vegetation conditions, the microclimate features within the county are highly prominent. Located slightly north of the Tropic of Cancer, the area receives abundant solar radiation, resulting in high temperatures and sufficient thermal energy. Notably, karst landscapes are extensively distributed throughout Du'an, covering approximately 3,863 km², which accounts for 94.5% of the total land area. This region is also characterized by highly developed and abundant karst cave resources [11].

2.2 Survey Methods and Data Analysis

Field Survey and Taxonomic Identification.

The study integrated extensive field investigations with comprehensive literature reviews. Systematic field surveys were conducted from July to December 2022. Based on preliminary reconnaissance, survey transects were strategically established in areas characterized by high biodiversity and intact natural vegetation. At least one 300-m long transect was established in each township, and all plant species within 10 m on both sides of the transect were recorded.

Specimens were identified using authoritative references such as Flora of Guangxi [14-17], Catalogue of Guangxi Plants [18], and Native Plants of Guangxi and Their Conservation Status [19]. The taxonomic systems followed Qin (1978) for pteridophytes [20-21], Cheng (1978) for gymnosperms, and the APG IV system for angiosperms.

Floristic and Statistical Analysis.

Floristic geographic components at the family and genus levels were categorized according to the systems proposed by Wu (1991, 2003) [22-24]. For newly merged or split families in the APG IV system, components were determined based on the distribution of their constituent genera to ensure scientific consistency.

3 Results

3.1 Taxonomic Composition

In the present survey, a total of 929 species of wild plants belonging to 516 genera and 152 families were recorded in Du'an County. These included 16 families, 19 genera, and 45 species of Fern (representing 10.52%, 3.68%, and 4.84% of the total families, genera, and species, respectively); 2 families, 3 genera, and 3 species of Gymnosperm (1.32%, 0.58%, and 0.32%); and 134 families, 494 genera, and 881 species of angiosperms (88.16%, 95.73%, and 94.83%). Among the angiosperms, there were 58 families, 246 genera, and 349 species of Monocotyledon, compared to 76 families, 248 genera, and 532 species of Dicotyledon (Table 1). The wild flora of Du'an is characterized by the absolute dominance of angiosperms, with Dicotyledon significantly outnumbering Monocotyledon. Furthermore, the statistical analysis of life forms categorized the

recorded species into four groups: trees (66 species, 7.10%), shrubs (431 species, 46.39%), vines (92 species, 9.90%), and herbs (340 species, 36.60%). Shrubs constitute the predominant life form in the study area, reflecting the typical vegetation structure of the karst ecosystem.

Table 1. Species composition of wild plants in Guangxi Du'an candidate area in the Southwest Karst National Park

	Number of family	Percentages in Number of family	Number of genus	Percentages in Number of genus	Number of species	Percentages in Number of species
Fern	16	10.52	19	3.68	45	4.84
Gymnosperm	2	1.32	3	0.58	3	0.32
Monocotyledon	58	38.16	246	47.67	349	37.57
Dicotyledon	76	50.00	248	48.06	532	57.27
Total	152	100	516	100	929	100

3.2 Analysis of Distribution Area Types

Floristic Characteristics at the Family Level.

According to Wu's classification system, the wild plant families in Du'an County are categorized into 15 distinct distribution types (Table 2). Widespread (Cosmopolitan) distributions comprise 48 families, predominantly Angiosperms (e.g., Fabaceae and Gramineae) alongside five ancient Fern families.

Tropical Components dominate the flora with 82 families, accounting for 78.84% of the total. Within this group, the Pantropic type is the most abundant (54 families, 51.92%), serving as the fundamental structural element of local plant communities. This is followed by the Trop. & Subtr. E. Asia & (S.) Trop. Amer. disjuncted type (10 families, 9.62%). Other minor tropical elements, such as Old World Tropics and Trop. Asia to Trop. Australasia, make up the remaining small fraction.

Temperate Components consist of 22 families, representing 21.15% of the total. This group is primarily characterized by the N. Temp. & S. Temp. disjuncted type (11 families, 10.58%), which includes ancient Angiosperm taxa like Fagaceae, and the North Temperate type (7 families, 6.73%). A few other temperate types, such as the East Asia distribution, represent the remaining minor components.

Table 2. Distribution area types of wild plant families in Guangxi Du'an candidate area in the Southwest Karst National Park

Distribution Area Types and Variants	Number of family	Percentages in Number of family
1. Widespread (Cosmopolitan)	48	
2. Pantropic	54	51.92

2-1. Trop. Asia-Australasia and Trop. Amer. disjuncted	1	0.96
2-2. Trop. Asia-Trop. Afr.-Trop. Amer. disjuncted	3	2.88
2S. Pantropic especially S. Hemisphere	4	3.85
3. Trop. & Subtr. E. Asia & (S.) Trop. Amer. disjuncted	10	9.62
4. Old World Tropics (OW Trop.)	5	4.81
5. Trop. Asia to Trop. Australasia	3	2.88
6. Trop. Asia to Trop. Africa	1	0.96
7. Trop. Asia	1	0.96
Subtotal of Tropical Components	82	78.84
8. North Temperate (N. Temp.)	7	6.73
8-4. N. Temp. & S. Temp. disjuncted	11	10.58
9. E. Asia & N. Amer. disjuncted	1	0.96
12. Mediterranea, W. Asia to C. Asia	1	0.96
14. East Asia (E. Asia)	2	1.92
Subtotal of Temperate Components	22	21.15

Floristic Characteristics at the Genus Level.

According to Wu's classification system, the wild plant genera in Du'an County are classified into 36 distinct distribution types (Table 3). Widespread (Cosmopolitan) distributions comprise 39 genera (7.56%), exhibiting broad climatic adaptability (e.g., Ceratophyllum and Cystopteris).

Tropical Components absolutely dominate the flora with 361 genera, representing 75.68% of the total. The Pantropic type is the most abundant (115 genera, 24.11%), represented by typical genera such as Ficus and Celtis. Other major tropical elements include the Trop. Asia to Trop. Australasia type (50 genera, 10.48%), the Old World Tropics type (48 genera, 10.06%), and the Trop. & Subtr. E. Asia & (S.) Trop. Amer. disjuncted type (25 genera, 5.24%). The remaining tropical genera are distributed across several minor types and variants.

Temperate Components consist of 105 genera, accounting for 22.01% of the total. The predominant temperate elements are the East Asia type (24 genera, 5.03%, e.g., Perilla), the North Temperate type (22 genera, 4.64%, e.g., Acer and Rosa), and the E. Asia & N. Amer. disjuncted type (19 genera, 3.98%). Minor temperate types and their variants represent the remainder. Finally, 11 genera are Endemic to China (2.31%), including Speranskia and Heteroplexis.

Table 3. Distribution area types of wild plant genera in Guangxi Du'an candidate area in the Southwest Karst National Park

Distribution Area Types and Variants	Number of genus	Percentages in Number of genus
1. Widespread (Cosmopolitan)	39	
2. Pantropic	115	24.11
2-1. Trop. Asia-Australasia and Trop. Am	8	1.68
2-2. Trop. Asia-Trop. Afr-Trop. Amer. (S. Amer.)	8	1.68

3. Trop. & Subtr. E. Asia & (S.) Trop. Amer. disjuncted	25	5.24
4. Old World Tropics	48	10.06
4-1. Trop. Asia, Afr. & Australasia disjuncted or diffused	4	0.84
5. Trop. Asia to Trop. Australasia	50	10.48
6. Trop. Asia to Trop. Africa	26	5.45
6-1. S. & SW. China to India & Trop. Afr. disjuncted	1	0.21
6-2. Trop. Asia & E. Afr. disjuncted	2	0.42
7. Trop. Asia (Indo-Malesia)	4	0.84
7-1. Java, Himalaya & S. China	7	1.47
7-2. Trop. India to S. China	1	0.21
7-3. Myanmar, Thailand to SW. China	5	1.05
7-4. Vietnam (or Indochina) to S. (or SW.) China	12	2.52
7a. West Malesia	28	5.87
7b. Central Malesia	1	0.21
7c. East Malesia	2	0.42
7d. Distribution extending east to New Guinea	7	1.47
7e. Distribution extending southeast to W. Pacific Islands	7	1.47
Subtotal of Tropical Components	361	75.68
8. North Temperate (N. Temp.)	22	4.61
8-4. N. Temp. & S. Temp. disjuncted	12	2.52
8-5. Eurasia & Temp. S. Amer. disjuncted	2	0.42
9. E. Asia & N. Amer. disjuncted	19	3.98
10. Old World Temperate	6	1.26
10-1. Mediterranea, W. Asia & E. Asia disjuncted	4	0.84
10-3. Eurasia & S. Afr. disjuncted	1	0.21
11. Temperate Asia	1	0.21
12 . Mediterranea, W. Asia to C. Asia	2	0.42
12-1. East Asia widespread (H-S-J)	1	0.21
12-1. Mediterranea to C. Asia & Mexico disjuncted	1	0.21
14 . East Asia (E. Asia)	24	5.03
14-1. Sino-Himalaya	5	1.05
14-2. Sino-Japan	5	1.05
Subtotal of Temperate Components	105	22.01
15. Endemic to China	11	2.31

4 Conclusion

4.1 Species Diversity

The flora of the Guangxi Du'an candidate area for the Southwest Karst National Park of China exhibits remarkable species diversity, with a total of 929 wild plant species recorded. Angiosperms absolutely dominate this flora, accounting for 94.83% of the total species. Additionally, the predominance of shrubs closely reflects the harsh environmental constraints imposed by the local karst rocky ecosystems.

4.2 Floristic Characteristics

The Guangxi Du'an candidate area for the Southwest Karst National Park of China is located in a low-latitude zone slightly north of the Tropic of Cancer. Influenced by the mountainous karst geomorphology, the region experiences prolonged solar radiation, high temperatures, abundant thermal energy, and plentiful rainfall. Consequently, the wild flora in this region exhibits pronounced tropical characteristics alongside a specific proportion of temperate components. This aligns perfectly with the fundamental floristic properties of Guangxi as revealed by Wei [25].

Specifically, within the floristic composition, tropical components account for 78.84% at the family level and 75.68% at the genus level, while temperate components comprise 21.15% and 22.01%, respectively. At both the family and genus levels, the Pantropic distribution constitutes the primary manifestation of the tropical components, whereas the temperate components are mainly represented by the N. Temp. & S. Temp. disjuncted and East Asia distributions. The overwhelming richness of tropical elements unequivocally indicates that the regional flora possesses distinct tropical attributes.

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