



Regular article

Plant resources and diversity analysis of Sejila Mountain in southeast Tibet

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Abstract

Sejila Mountain is located in Linzhi City, southeast Tibet. The terrain is high, and the climate is cold and dry. The special ecological environment determines the richness and diversity of plant resources. In this study, the plant resources and diversity of Sejila Mountain were studied through field investigation, literature review and specimen identification. 282 plant species belonging to 199 genera and 81 families were collected from July to August in 2021. The dominant families are Asteraceae, Ranunculaceae and Rosaceae. In terms of life form, perennial herbs are the main form, accounting for 58.16% of the total. 178 species of medicinal plants were collected, including 33 species of Tibetan medicine. In terms of medicinal parts, the whole grass is mainly used as medicine, followed by roots and rhizomes. In conclusion, our study has updated the plant resources and diversity of Sejila Mountain. Based on the investigation and research, some suggestions were put forward to strengthen the protection and utilization of the plant resources in Sejila Mountain.

Keywords: plant resources; diversity; Tibetan medicine; Sejila Mountain

1 Introduction

The Qinghai-Tibet Plateau is known as the “roof of the world”, and its special geographical environment has created unique plant resources in Tibet [1]. Plant resources are an important part of traditional Chinese medicine resources and many ethnic medicines. They are the material basis for disease prevention and treatment, and they are the

treasure of Chinese civilization. Nowadays, the development and utilization of medicinal plant resources has attracted increasing attention in the world. For a country with rich medicinal plant resources and a long history of Chinese herbal medicine application, the protection, research and development of wild medicinal plant resources have become very important [2]. The ecological environment of Sejila Mountain determines the richness and diversity of its plant resources [3]. In this study, field investigation, specimen collection, literature retrieval and specimen verification were used to investigate the plant resources and diversity of the Sejila Mountain Basin in order to understand the species, distribution and utilization of plant

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resources in the region, and to provide scientific basis for the rational development and effective protection of plant resources in the Sejila Mountain Basin.

Sejila Mountain is located in Linzhi City, southeastern Tibet, 94°25′-94°45′E, 29°35′-29°57′N. It is about 41 km long from north to south, and about 32 km wide from east to west. The lowest altitude of the west slope is 2800-3000 m, the lowest of the east slope is 2100 m, and the main peak is 5200 m high. It is located at the junction of the Nyainqentanglha Mountains and the northern Himalayas. It is the watershed between the Niyang River Basin and the Palongzangbu River. It belongs to the semi-humid area of alpine cold temperate zone. The terrain is high, and the climate is cold and dry, affected by the warm and humid air flow of the Indian Ocean. There is less rainfall in winter and spring, and abundant rainfall in summer and autumn, so the ecosystem types in the region are rich and diverse [4,5]. The average annual temperature is 5.0 °C, the average relative humidity is 73%, and the annual precipitation is 866 mm.

2 Research method

In July 2021, the 15th Scientific Investigation Team of Traditional Chinese Medicine Resources of Shenyang Pharmaceutical University conducted a scientific investigation of plant resources in the territory of Sejila Mountain. According to the topography, landform, altitude and plant types of different areas of Sejila Mountain, scientific investigations were carried out in Lulang Town, Bomi County, Pailong Township and Sejila Mountain. These areas were investigated through route survey. Specimens were collected along the way, photographs were taken, and the information of collection location, time and main morphological characteristics of plants were recorded in detail. The longitude and latitude of the collected plants were

recorded by a GPS recorder. According to “Flora of China” [6], “Economic Plants of Tibet” [7], “Flora of Tibet” [8] and so on, the species and genera of plants in Sejila Mountain were identified, and the list of plant resources was determined, with a total of 282 species. On the basis of this list, a list of plants that can be used as medicine was screened out according to the references of “Chinese Tibetan medicine” [9], “National Chinese Herbal Medicine Compilation” [10], “Chinese Materia Medica” [11] and “Jingzhu Materia Medica” [12], and a total of 178 species belonging to 63 families and 143 genera were recorded with reference to the above literature. Among them, there were 33 species of Tibetan medicine. Finally, the diversity of plant resources in Sejila Mountain was analyzed and evaluated, and corresponding suggestions for development, utilization and protection were put forward.

3 Results

3.1 Analysis of plant species composition in Sejila Mountain

We collected a total of 81 families, 199 genera and 282 species of plants from southeastern Tibet, including 9 families, 13 genera and 18 species of ferns, 1 families, 2 genera and 2 species of gymnosperms, and 71 families, 184 genera and 262 species of angiosperms (62 families, 166 genera and 235 species of dicotyledonous plants, and 9 families, 18 genera and 27 species of monocotyledonous plants) (Table 1). Angiosperms are the most abundant at the levels of family, genus and species, accounting for 87.65% of the total number of families, 92.46% of the total number of genera, and 92.91% of the total number of species. Ferns and monocotyledons are almost the same, and gymnosperms are the least, with only one family, namely Pinaceae Spreng.



Table 1 Plant species in Sejila Mountain

Plant type	No.families	Ratio/%	No.genera	Ratio/%	No.genera	Ratio/%
Pteridophytes	9	11.11	13	6.53	18	6.38
Gymnosperms	1	1.23	2	1.01	2	0.71
Angiosperms	71	87.65	184	92.46	262	92.91
Dicotyledons	62	76.54	166	83.42	235	83.33
Monocotyledons	9	11.11	18	9.05	27	9.57
Total	81	100.00	199	100.00	282	100.00

3.2 Analysis of family and genus composition of plants in Sejila Mountain

It can be seen from Table 2 that there are 65 families containing 1 to 5 species, accounting for 75.31% of the total families. There are 13 families with 6-10 species, accounting for 16.05% of the total

families. There are three families with more than 10 species, including Asteraceae, Ranunculaceae and Rosaceae, with 28, 24 and 13 species respectively. Although these three families account for only 3.70% of the total families, they account for 22.03% of all these species.

Table 2 Plant species in different families in Sejila Mountain

No.species with in families	No.families	Ratio/%	No.species	Ratio/%
One species	30	37.04	30	10.64
2-5 species	37	45.68	112	39.72
6-10 species	11	13.58	78	27.66
>10 species	3	3.70	62	21.99

In terms of genera, there are 199 genera of plants. Table 3 shows that there are 153 genera containing only one species, accounting for 76.88% and 54.26% of the total genera and total species; there are 42 genera containing 2-5 species, accounting for 21.11% of the total genera; there

are only four genera with more than five species, namely Rubus, Primula, Pedicularis and Geranium, with seven, six, six and six species respectively, accounting for only 2.01% and 8.87% of the total number of genera and species.

Table 3 Species number of different genera in Sejila Mountain

No.species with in genus	No.genus	Ratio/%	No.species	Ratio/%
One species	155	77.89	155	54.96
2-5 species	40	20.10	102	36.17
6-10 species	4	2.01	25	8.87



3.3 Analysis of plant life forms in Sejila Mountain

Life forms of 282 species of plants were statistically analyzed. The results showed that perennial herbs are the most, with a total of 164 species, accounting for 58.16% of the total species, followed by shrubs with a total of 64 species,

accounting for 22.70% of the total species. There are 32 species of annual (or 2-year) herbaceous plants, accounting for 11.35% of the total species. There are 13 and 9 species of arbors and vines, accounting for 4.61% and 3.20% of the total species, respectively. In conclusion, herbs and shrubs are the main components of the plants in the Sejila Mountain Basin.

Table 4 Different life forms of plants in Sejila Mountain

Plant type	No. species	Ratio/%
Perennialherbs	164	58.16
Shrub	64	22.70
Therophyte/Biennial	32	11.35
Arbor	13	4.61
Fujimoto	9	3.20

3.4 Diversity analysis of medicinal plants in Sejila Mountain Basin

Table 5 shows that there are 178 species of medicinal plants belonging to 143 genera and 63 families in the Sejila Mountain Basin, 77.78% of the total number of families, 71.86% of the total number of genera and 63.12% of the total number of species. The main families of medicinal plants are Asteraceae (16), Rosaceae (12) and Ranunculaceae (9), accounting for 25.40%, 19.05% and 14.29% of the

total families of medicinal plants, respectively. There are 28 families with only one species, accounting for 44.45% of the total families of medicinal plants. In terms of genera, there are 120 genera containing only one species, accounting for 83.92% of the total genera of medicinal plants, and the most is Rubus containing 5 species, accounting for 3.50% of the total genera of medicinal plants. In addition, the life form of medicinal plants is also dominated by herbs, with 132 species, accounting for 74.16% of the total number of medicinal plants.

Table 5 Diversity of medicinal plants in Sejila Mountain

Species composition (ratio)	63 Family (77.78%)	143 genus (71.86%)	178 species (63.12%)
Main families and genera (No. species)	Asteraceae (16) Rosaceae (12) Ranunculaceae (9)		Rubus (5)
Plant type (No. species)	herb Shrub Fujimoto	132 (74.16%) 38 (21.35%) 6 (3.37%)	

Medicinal plants in the Sejila Mountain Basin can be divided into whole grass, roots and rhizomes, fruits, stems and leaves, flowers and seeds according to the medicinal parts. Table 6 showed

that the whole grass medicinal plants are the most, with 84 species, accounting for 47.19% of the total number of medicinal plants, followed by roots and rhizomes, with 72 species, accounting for 40.45% of



the total number of medicinal plants. Fruits, stems and leaves, flowers account for 5.61%, 3.37% and 2.81%, respectively. There is only one seed species, *Piptanthus nepalensis*.

Table 6 Medicinal parts of medicinal plants in Sejila Mountain

Medicinal part	No. species	Ratio/%
Entire plant	84	47.19
Underground stem	72	40.45
Flower	5	2.81
Branch and leaf	6	3.37
Fruit	10	5.62
Seed	1	0.56

3.5 Analysis of Tibetan medicine resources in Sejila Mountain Basin

Tibetan medicine resources have always been an important part of traditional Chinese medicine, with national characteristics. The Sejila Mountain Basin is rich in medicinal plant resources, including a large number of famous ethnic medicine resources. According to the statistical results of medicinal

plants in the Sejila Mountain Basin, 33 species are Tibetan medicines, accounting for 18.54% of medicinal plants, belonging to 23 families and 30 genera (Table 7). Among them, there are 5 and 4 species of Compositae and Polygonaceae, respectively, accounting for 15.15% and 12.12% of Tibetan medicinal resources. The medicinal parts are diverse, with 21 species of whole grass as the most, accounting for 63.64% of Tibetan medicine resources.

Table 7 Tibetan medicine resources in Sejila Mountain

Species	Family	Genus	Medicinal part
<i>Ribes himalense</i> Royle ex Decne.	Grossulariaceae	Ribes	Fruit
<i>Hemiphragma heterophyllum</i> Wall.	Plantaginaceae	Hemiphragma	Entire plant
<i>Piptanthus nepalensis</i> auct. non (Hook.) D. Don: Turner	Fabaceae	Piptanthus	Seed
<i>Codonopsis foetens</i> subsp. <i>nervosa</i> (Chipp) D. Y. Hong	Campanulaceae	Codonopsis	Underground stem
<i>Aster souliei</i> Franch.	Asteraceae	Aster	Entire plant
<i>Saussurea obvallata</i> (DC.) Edgew.	Asteraceae	Saussurea	Entire plant
<i>Tanacetum tatsienense</i> (Bureau & Franch.) K. Bremer & Humphries	Asteraceae	Tanacetum	Entire plant
<i>Cremanthodium campanulatum</i> (Franch.) Diels	Asteraceae	Cremanthodium	Entire plant
<i>Blumea balsamifera</i> (L.) DC.	Asteraceae	Blumea	Entire plant
<i>Satyrium nepalense</i> var. <i>ciliatum</i> (Lindl.) Hook. f.	Orchidaceae	Satyrium	Entire plant
<i>Bistorta sinomontana</i> (Sam.) Miyam.	Polygonaceae	Bistorta	Entire plant

(to be continued)



Continued table 7

Species	Family	Genus	Medicinal part
<i>Rheum nobile</i> Hook. f. & Thomson	Polygonaceae	Rheum	Underground stem
<i>Rheum acuminatum</i> Hook. f. & Thomson ex Hook.	Polygonaceae	Rheum	Underground stem
<i>Bistorta vivipara</i> (L.) Gray	Polygonaceae	Bistorta	Underground stem
<i>Pedicularis longiflora</i> Rudolph	Orobanchaceae	Pedicularis	Flower
<i>Gentianopsis paludosa</i> (Hook. f.) Ma	Gentianaceae	Gentianopsis	Entire plant
<i>Gentiana crassicaulis</i> Duthie ex Burkill	Gentianaceae	Gentiana	Underground stem
<i>Ranunculus tanguticus</i> (Maxim.) Ovcz.	Ranunculaceae	Ranunculus	Entire plant
<i>Delphinium caeruleum</i> Jacquem. ex Cambess.	Ranunculaceae	Delphinium	Entire plant
<i>Fragaria orientalis</i> Losinsk.	Rosaceae	Fragaria	Entire plant
<i>Acanthocalyx alba</i> (Hand.-Mazz.) M. J. Cannon	Caprifoliaceae	Acanthocalyx	Entire plant
<i>Houttuynia cordata</i> Thunb.	Saururaceae	Houttuynia	Entire plant
<i>Bupleurum chinense</i> Franch.	Apiaceae	Bupleurum	Fruit
<i>Allium prattii</i> C. H. Wright	Amaryllidaceae	Allium	Entire plant
<i>Polygonatum cirrhifolium</i> (Wall.) Royle	Asparagaceae	Polygonatum	Underground stem
<i>Lancea tibetica</i> Hook. f. & Thomson	Mazaceae	Lancea	Entire plant
<i>Sambucus adnata</i> Wall. ex DC.	Adoxaceae	Sambucus	Entire plant
<i>Hedera nepalensis</i> var. <i>sinensis</i> (Tobler) Rehder	Araliaceae	Hedera	Entire plant
<i>Sinopodophyllum hexandrum</i> (Royle) T. S. Ying	Berberidaceae	Sinopodophyllum	Underground stem
<i>Meconopsis horridula</i> Hook. f. & Thomson	Papaveraceae	Meconopsis	Entire plant
<i>Meconopsis racemosa</i> Maxim.	Papaveraceae	Meconopsis	Entire plant
<i>Zanthoxylum armatum</i> DC.	Rutaceae	Zanthoxylum	Fruit
<i>Cynoglossum amabile</i> Stapf & Drummond	Boraginaceae	Cynoglossum	Entire plant

4 Discussion

The Sertra mountain system, the remnants of the Nyingtangula Mountains, is connected to the east Himalayas developing northwards. Due to its unique geographical environment, it has produced a large number of valuable plant resources. We collected 282 species of plants belonging to 81 families and 199 genera. In terms of plant species, angiosperms dominate the region because of their strong adaptability to the environment, while gymnosperms

are rarely distributed. In terms of plant families, the main families are Asteraceae, Ranunculaceae and Rosaceae. the main genera are the suspensory genus *Rubus*, *Primula*, *Artemisia* genus *Pedicularis* and the old stork genus *Geranium*. The reason for this may be related to their superior reproductive structure and adaptability to the environment. In terms of plant life types, there are mainly herbs and shrubs, and perennial herbs are the most widely distributed, probably because they are often densely clumped, and can adapt well to unfavourable conditions such as short growing



period, frequent thawing and cold temperature. In addition, plant resources with medicinal value are also abundant in the Sertra Mountains.

5 Conclusion

Although Sejila Mountain in southeastern Tibet is rich in plant resources, its development, utilization and protection are far from adequate. Geographical influence, high-altitude environment and inconvenient transportation have posed great challenges to the field resource survey and hindered the protection of plant diversity. Local farmers and herdsmen have been excavating vigorously, and found that the excavation of Tibetan medicinal plants can bring high profits, while ignoring the protection of many endangered plants. The increasingly fragile ecosystem has caused serious damage to the diversity of plant resources. Therefore, it is necessary to strengthen the development and utilization of plant resources, taking into account the protection of resources and the environment in order to achieve the goal of sustainable development. On this basis, the following suggestions are made. Firstly, scientific research of plant resources in Mt. Sejila should be strengthened by increasing scientific research funds, strengthening support for scientific research workers, actively cooperating with local government departments, finding the home, conducting more basic research on plant resources, deeply developing Tibetan medicine resources, and comprehensively evaluating the development and utilization value of plant resources. Secondly, in the process of restoring Tibetan herbal medicine resources, we should explore Tibetan herbal medicine resources in a planned way, grasp the species of endangered plants in time strengthen the awareness of local residents on the protection of herbal resources, protect biodiversity, and take necessary management

measures to effectively protect herbal resources and ecological environment.

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