General situation and utilization potential of wild plant resources in Changbai Mountain Reserve

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Abstract. According to the field investigation of Changbai Mountain Nature Reserve, the wild plant resources in this region were investigated in detail. Combined with the investigation of wild plant resource types, the utilization potential of wild plant resources was analyzed and evaluated in order to provide reference for the development and utilization of wild plant resources in Changbai Mountain. The results showed that the vascular plants in Changbai Mountain Nature Reserve consist of 6 classes, 47 orders, 124 families, 515 genera and 1550 species. There were about 1244 species of plants that could be used as resources, among which, medicinal plant resources ranked first, a total of 1083 species, accounting for 87.06%. From the perspective of market value of resources, 1244 species of wild vascular plants in the reserve were graded, and 276 species of resource plants with high value and great significance, which were rated as 4 and 5 points, were screened out. According to the evaluation level of resource utilization potential, There were 48 species of first level, 87 species of second level, 103 species of third level, 32 species of fourth level and 6 species of fifth level. Finally, some suggestions on the protection, development and utilization of wild resources in Changbai Mountain Nature Reserve were provided.

1. Introduction
Changbai Mountain Nature Reserve, located in the southeast of Jilin Province, with a forest coverage rate of 87.9%, belongs to the temperate continental mountain climate influenced by monsoon. It is a natural complex nature reserve with forest ecosystem as the main protection object. Due to the influence of geographical environment and climatic conditions, the wild plants in this region are rich and diverse. However, the wild plants in Changbai Mountain Nature Reserve have not been studied completely and systematically so that most of them have not been fully exploited and utilized. Therefore, the utilization potential of wild plant resources was systematically analyzed and evaluated in order to provide reference for the development and utilization of wild plant resources in Changbai Mountain.

2. Materials and methods
2.1. General situation of Changbai Mountain Nature Reserve
Changbai Mountain Nature Reserve, located in the southeast of Jilin Province, with a forest coverage rate of 87.9%, belongs to the temperate continental mountain climate influenced by monsoon. The
winter is long and cold. The summer is short and mild. The spring is windy and dry. The autumn is foggy and cool.

2.2. Survey location and method
The evaluation of plant resources is based on extensive and comprehensive survey of resources, and “the index sum method” was used to score each plant according to its own actual situation and relevant value, and finally the total score of each index was summed to obtain the available estimate, thus the evaluation grade of each plant was determined [6].

According to the actual situation within the scope of the survey and the summarized data, combined with references and actual survey data [7-8], value size, value breadth, abundance, frequency, plant size, adaptability and utilization level were established as evaluation indexes, as shown in table 1. Each index was divided into five levels, corresponding to 1-5 points respectively.

2.3. Evaluation methodology

| Serial number | index          | Grade                          | Remarks                                      |
|---------------|----------------|--------------------------------|----------------------------------------------|
| 1             | Value size     | A (1 point) B (2 points) C (3 points) D (4 points) E (5 points) | Depending on the market value of the resources |
| 2             | Value breadth  | 1-2 kinds 3-4 kinds 5-6 kinds 7-8 kinds 9 or more | Depending on the use of the resources |
| 3             | Abundance      | very few scarce medium more massive | Depending on the number of plants in the survey area |
| 4             | Frequency      | very rare rare commonly frequently very frequently | Depending on the frequency of plants in the survey area |
| 5             | Plant size     | tiny (small herbs) less (common herbs) medium (large herbs, liana, small shrubs) larger (shrubs or small trees) huge (arbor) | Depending on the aboveground biomass |
| 6             | Adaptability   | Extremely strict requirement Strict requirement narrow ecological range General adaptability Diverse habitats, Wider ecological range Adapting to harsh habitats, extremely wide habitat | Depending on the habitat requirements or ecological range |
| 7             | Utilization level | Overused Fully utilized General utilization Less utilized Not being utilized | Depending on the utilization status |

3. Results and Analysis

3.1. Status of plant resources in Changbai Mountain Reserve
There are 1550 species of vascular plants in Changbai Mountain Nature Reserve, belonging to 6 classes, 47 orders, 124 families and 515 genera. Among them, ferns have 81 species, 13 varieties and 1 forma belonging to 3 classes, 7 orders, 23 families and 43 genera. Gymnosperms have 11 species and 2 varieties belonging to 1 class, 2 orders, 3 families and 7 genera. Angiosperms have 1237 species, 37 varieties, 39 formas and 2 subspecies belonging to 38 orders, 98 families and 465 genera.
3.2. Plant resource types in Changbai Mountain Reserve

Combined with Internet search and “List of medicinal plants in China”, a total of 1244 species of resource plants were selected from Changbai Mountain National Nature Reserve after preliminary investigation and statistics. Among all kinds of resource plants, medicinal plant resources ranked first, with a total of 1083 species, accounting for 87.06%.

- Medicinal plant resources
  Changbai Mountain Reserve is rich in medicinal plant resources. According to the statistics, there are 1083 medicinal vascular plants in the reserve. Among them, there are 1063 species of Chinese herbal plants, accounting for 85.45% of resource plants in Changbai Mountain. 20 species of plant resources are used for pesticides. 60% of the varieties of traditional Chinese herbal medicine are distributed in the reserve.

- Ornamental plant resources
  There are 744 species of ornamental plants in the reserve, including 9 species of ferns, 11 species of gymnosperms, 598 species of dicotyledonous plants and 124 species of monocotyledonous plants. The total amount accounts for 59.81% of resource plants in Changbai Mountain Reserve.

- Timber plant resources
  The reserve is rich in timber plants. Currently there are 63 species of timber plants, including 52 species of dicotyledonous plants and 11 species of monocotyledonous plants. Timber plants account for 5.06% of resource plants in Changbai Mountain. Juglans mandshurica, Fraxinus mandshurica and Phellodendron amurense are the three typical broadleaf tree species in northeast China.

- Edible plant resources
  Edible plant resources can be divided into starch plant, edible plant and forage plant. Among them, there are 20 species of starch plants, accounting for 1.61% of resource plants in the reserve. There are 234 species of edible plants, accounting for 18.81% of resource plants in the reserve. In addition, there are 236 species of forage plant resources, accounting for 18.97% of resource plants in the reserve.

- Industrial plant resources
  According to the use of plant resources in the region, industrial plant resources can be divided into 7 categories, which are fiber plant, tanning plant, perfume plant, oil plant, pigment plant, nectariferous and pollen plant, resin plant and gum plant.

  There are 83 species of fiber plants in the reserve, such as Acorus calamus, Iris dichotoma, Iris ensata.

  The reserve is rich in tanning plants. There are 139 species of tanning plants, such as Dryopteris crассirhизoma, Abies nephrolepis and Larix olgensis.

  There are 128 species of perfume plants in the reserve, such as Ledum palustre, Sorbaria сorbifolia, Sorbus pohuashanensis and Melilotus officinalis.

  There are 148 species of oil plants in the reserve, such as Corylus mandshurica, Corylus heterophylla and Ulmus macrocarpa.

  Natural plant pigment resources are very rich in the reserve, about 83 species, such as Physali alkekengi, Siphonostegia chinensis and Xanthium sibiricum.

  There are 273 species of nectariferous and pollen plants in the reserve, accounting for 21.95% of resource plants in the reserve.

  There are 28 species of resin and gum plants, such as actinidia, Rhamnus davurica, Abies holophylla, Larix olgensis, Pinus koraiensis, Pinus sylvestriformis, Picea jezoensis, Picea koraiensis and so on.

3.3. Evaluation of utilization potential of plant resources

From the perspective of resource market value, 1244 species of wild vascular plants in the reserve were graded, and 276 species of valuable and significant resource plants with 4 and 5 points were screened out. According to the 7 evaluation indicators in the evaluation criteria of resource utilization potential, the plant resources were scored, and then the sum of 7 scores was calculated. According to the score result, they were divided into 5 grades. Table 2 is shown the details.
Table 2. Classification criteria and development potential of vascular resource plants in the reserve

| Grade | Available estimate | Plant species | Proportion% | Development potential assessment |
|-------|--------------------|---------------|-------------|---------------------------------|
| One   | ≤17                | 48            | 17.40       | Very small                      |
| Two   | 18-20              | 87            | 35.52       | less                            |
| Three | 21-25              | 103           | 37.32       | medium                          |
| Four  | 26-29              | 32            | 11.59       | more                            |
| Five  | ≥30                | 6             | 2.17        | Extremely large                 |

- There are 48 species of Grade One wild resource plants. Such wild resource plants are either over-exploited or rare in the survey area, containing many rare and protected plants. Therefore, their exploitation potential is extremely small and should be strictly protected. Some species with large numbers of resources can be considered suitable artificial cultivation and utilization. These resource plants mainly include *Prinsepia sinensis*, *Melilotus officinalis*, *Potentilla chinensis*, *Elsholtzia ciliata*, *Lathyrus davidii*, *Hypericum ascyron*, *Platycodon grandiflorus*, *Cimicifuga dahurica*, *Gnaphalium transschelii*, *Bupleurum chinense*, *Angelica gigas*, *Peucedanum praeruptorum*, *Panax ginseng* and so on.

- There are 87 species of Grade Two wild resource plants. These resource plants mainly include *Dianthus chinensis*, *Scutellaria scordifolia*, *Gueldenstaedtia verna*, *Aristol chinesis*, *Adenophora tetraphylla*, *Siphonostegia chinensis*, *Cypripedium macranthum*, *Humulus scandens*, *Acorus calamus*, *Agastache rugosa*, *Indigofera kirilowii*, *Angelica dahurica* and so on.

- There are 103 species of Grade Three wild resource plants. These wild resource plants have certain economic value and general utilization breadth. They are common in the survey area, so they have certain development potential. These resource plants mainly include *Actinidia kolomikta*, *Pinus sylvestris*, *Rhododendron aureum*, *Rhodiola cretina*, *Typha angustifolia* and so on.

- There are 103 species of Grade Three wild resource plants. These wild resource plants have certain economic value and general utilization breadth. They are common in the survey area, so they have certain development potential. These resource plants mainly include *Actinidia kolomikta*, *Malus baccata*, *Aconitum kusnezoffii*, *Pinus sylvestris*, *Rubus feddei*, *Rhododendron aureum*, *Rhodiola cretina*, *Crataegus maxima* and so on. In the high altitude area, the Shannon-Wiener diversity index, Pielou evenness index and Simpson dominance index of *Rhododendron chrysanthemum* community decreased with the decrease of disturbance intensity.

- There are 6 species of Grade Five wild resource plants. These wild resource plants have great economic value and utilization breadth. They are very common in the survey area, but not fully utilized, so they have great development potential. The six plants are *Acer mono*, *Juglans mandshurica*, *Sorbus pohuashanensis*, *Pinus koraiensis*, *Abies nephrolepis* and *Larix olgensis*.

4. Conclusion and Discussion

- There are abundant wild plant resources in Changbai Mountain Nature Reserve, which are characterized by large quantity, wide distribution and strong adaptability. Among the 276 main vascular resource plants, the proportion of the resource plants with extremely large, large and moderate development potential is 2.17%, 11.59% and 37.32% respectively, and a total of 51.08%. They will make an inestimable contribution to the sustainable development and utilization of wild plant resources and economic development in Changbai Mountain National Nature Reserve. Of course, artificial cultivation and utilization can be considered for the wild resource plants of Grade One or Two on the premise that the population and ecology are not damaged and degraded.

- The ecological benefit and economic benefit in the construction of ecological environment are not the opposite of contradiction, but the unity of contradiction. Many wild plants are often used for a variety of purposes, and a large number of resource plants have not been exploited yet. The research
and development of natural drugs and wild vegetables are still in a relatively backward stage, so the exploitation potential of wild plant resources in Changbai Mountain reserve is huge in this respect. The species and region of plant resources protected in the reserve are limited, which cannot meet the actual needs of plant resources protection at present, and many forms of plant resources protection are not optimistic.

- Therefore, how to protect the wild plant resources, fully develop the introduction, domestication and observation of wild plant species suitable for development and utilization, carry out research on propagation methods and adaptability to protect scattered and scarce resources and build raw material planting base so as to provide stable and high-quality products for the market, realize the sustainable utilization of resources and create more wealth for the local people and society of Changbai Mountain Reserve.

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