

# The Current Situation and Protection of China Rare and Endangered Seed Plants

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**Abstract-**In this paper, the basic concept of the protected plants and classification are briefly introduced, and analyzed the status quo of rare endangered seed plants in China (see the appendix). Also discussed the protection of endangered plant shortcomings and given several advices: 1. Protection mechanism is not perfect, lack of local and pertinence, government agencies need to increase capital investment and the strengthening of effective management; 2. Botanical Garden is not rational and Lack of relevant personnel, need to take a more rational deploy; 3. Endangered seed plants need sustainable development and utilization, protection by exploiting its own value; 4. Publicity has to have local characteristics to change the wrong conception of people, universal relevant laws and regulations.

**Key words-** Rare Endangered Seed Plants; Protection; Living Situation

## I. INTRODUCTION

Since the Industrial Revolution, human has exploited and utilized the plant resource rapaciously, which caused the forestry area decrease sharply, vegetation was severely destroyed and the ecological environment deteriorated grievously. Many plants have been endangered, even become extinct. Correlated data show that by the end of the 20<sup>th</sup> century there are 50000 to 60000 kinds of plants subjected to varying degrees of survival threat. In other words, there are one out of five kinds of plants are threatened to live. In almost 30000 kinds of higher plants in China, there are at least more than 3000 species endangered [1], among which seed plants accounted for over 96%. Seed plants are the main resource of food human being relies for survival, they also provide human with all kinds of cellulose and medicine. They are widely used in human production activities, industry, agriculture, and medicine. It will be a huge loss to organism gene pool if the seed plants die out. Also it will affect human production activities and jeopardize ecological balance of nature, which will lead to a series of vicious chain reaction. Therefore, it's an important task for human being to conserve and utilize endangered seed plants sustainably.

### A. The Status Quo of Endangered Seed Plants in China

#### 1) The Basic Concepts and Categories of The Protected Plants

When referring to plant protection, we need to distinguish rare endangered plants from protected plants.

##### a) Rare Endangered Plants

Rare endangered plants refer to the plants which are equipped with particular important value in economy, science research, culture and education, but in limited distribution and in small quantity. They are classified by the international universal standard, i.e. according to the endangered status of plants, distribution area and species quantity to make the classification. Referring to the definition of the levels of threatened plants in Red Data Book of IUCN (International Union for Conservation of Nature) and combing with the actual conditions in China, we formulated the classification definition of rare endangered plants and hierarchical protection standard, i.e. adopting the three levels of "endangered", "rare" and "vulnerable". Endangered species refer to the species are threatened to die out at any time in the entire or prominent distribution areas, for example *Ostrya rehderina*, etc. Rare species refer to monotypic family, monotypic genera or the representative oligotypic species which are unique to China and won't become extinct at once. But there are few groups in their distribution area or will disappear quite soon because they exist in very limited areas; or although they are distributed in large areas, there are very few species like ginkgo etc. Vulnerable species refer to the species that are prone to become endangered in their entire distribution area or the import parts of the distribution area in the foreseeable future due to man-made or natural causes[2]. The first batch of Directory of rare endangered plants in China was released in 1984 by the Environmental Protection Committee under the State Council.

##### b) Protected Plants

The protected plants refer to the plants under state law protection. When classifying the plant protection hierarchy, the first consideration should be the economic and scientific research value of the plant, then is the endangered level. It was enacted by the related administrative department, released after the ratification of the State Council and came into being along with the supporting information of the State Council administrative laws and regulations. According to the different values they possess, the protected plants in China are divided into three protection levels, namely the first national protection plants, the second national protection plants, and the third national protection. The first batch of Directory of the national key protected wild

plants was officially released in 1999 by the State Council.

### 2) *Directory of Rare Endangered Plants in China and Analysis of Causes of Being Endangered*

The former Environment Protection Leading Group under the State Council co-chaired a meeting that experts and scientific and technical workers from each relevant department with Institute of Botany of Chinese Academy of Sciences in 1982. In the meeting, after repeated review and opinions solicitation, 384 kinds of plants (including 13 kinds of pteridophyte, 63 kinds of gymnospermae, and 312 kinds of angiosperm) were selected as the first batch of rare endangered plants in China, and were released in the form of directory in 1984. Among them, there were 116 kinds of endangered seed plants, 115 kinds of rare seed plants, 154 kinds of vulnerable seed plants, 8 kinds of first national protection species, 159 kinds of second national protection species, and 222 kinds of second national protection species. For details, see Appendix I. It is worthy of being mentioned that an article published in Agriculture of Henan (Vol.3, 1995) pointed out that at that time there had been more than 200 kinds of plants dying out including *Nyssa yunnanensis* which included in the Directory. Therefore, the situation is not optimistic. Due to limited personal ability and out-dated data, I don't judge the accuracy of the description in the Directory.

Based on the analysis of plants in the Directory, we can easily draw the characteristics of seed plants prone to be endangered: 1. Plant groups with single morphological traits are prone to be endangered. Though they might take precedence over other species in some physiological functions, they lack of diversified physiological functions, and lack of the ability to make immediate response to external interference. For example, long beak *Ranunculus Alismataceae* live in a flexible ecological environment with alternation of the water and the land. This environment is rather unstable; the plants will suffer devastating disaster when encounter with drought or flood. 2. Particular plant groups, especially the peculiar genera are more easily being endangered, such as ginkgo, *Panzhihua Cycas*, Taiwan fir, etc. Most of them are relict species in transition. These ancient plants have poor ability because of genetic variation, so that they have higher requirements of living environment and cannot adapt themselves to the changing environment. They are in the declining stage in the system development process, and are bound to die out when they exhaust all the evolutionary potential eventually. 3. Some reproductive biology characteristics, such as reproduction mode, reproduction ability, pollination, seed growth characteristics, and seed distribution mode, are incompatible with the changing environment, and this lead to their tendency of easily being endangered. Most rare or endangered plants are encountered with reproductive disturbance to a certain extent, such as unsynchronized development of pistil and stamen, pollen abortion, pollen tube failing to reach embryo sac, and embryo sac abortion, etc.

The above three factors contribute to the internal cause for the plants being endangered, which can be summarized as poor survivability and adaptability. However, the species disappear so quickly mainly because human exploit and utilize the plant resource rapaciously. For a long time, because of population explosion, fast development of industry, expanded construction of cities and towns, predatory utility of plant resource like forest timber, medicinal plants, economic plants, ornamental plants, etc. the forest area has decreases sharply, the vegetation has been destroyed, and the ecological environment has deteriorated rapidly. Therefore, the plant species gradually got into such a plight as being threatened, vulnerable, and endangered.

### 3) *Distribution Situation of Rare Endangered Seed Plants*

China is a country with a vast territory and abundant resources. Its terrain landforms are complex, and the natural condition is diversified. From south to north, it covers five climatic zones, namely tropical zone, subtropical zone, warm temperate zone, temperate zone, and cool temperate zone. According to World Seed Plants Distribution Types[3] counted by Wu Zhengyi, China has all the major distribution types except Extratropical S. Hemisphere disjuncted or dispersed, Trop. Africa & Trop. America disjuncted and Holantarctic. Table I shows Zhuhua's[4] China Seed Plant Distribution Types, from which we can see the variety of China seed plants is remarkable. Although China is country with large quantity of plants, ranking third in the world, many plants' survival is threatened or being endangered. For example, *Ranunculus Alisma*, Wild Goose *Machilus*, and Guangyuan Holly has died out; raven cherry fruit, *Carpinus tientaiensis*, *Angiopteris fokiensis* are endangered.

TABLE I CHINA SEED PLANT DISTRIBUTION TYPES

| Areal-type                                    | No. of genus | %             |
|---|--------------|---------------|
| 1、Cosmopolitan                                | 104          | 3.34          |
| 2、Pantropic                                   | 362          | 11.61         |
| 3、Tropical Asia & Tropical America disjuncted | 62           | 1.99          |
| 4、Old World Tropic                            | 177          | 5.68          |
| 5、Tropical Asia to Tropical Australia         | 148          | 4.75          |
| 6、Tropical Asia to Tropical Africa            | 164          | 5.26          |
| 7、Tropical Asia                               | 611          | 19.60         |
| 8、North Temperate                             | 302          | 9.69          |
| 9、East Asia and North America disjuncted      | 124          | 3.98          |
| 10、Old World Temperate                        | 164          | 5.26          |
| 11、Temperate Asia                             | 55           | 1.76          |
| 12、Mediterranean, W Asia to C Asia            | 171          | 5.49          |
| 13、Central Asia                               | 116          | 3.72          |
| 14、East Asia                                  | 300          | 9.62          |
| 15、Endemic to China                           | 257          | 8.25          |
| <b>Total</b>                                  | <b>3117</b>  | <b>100.00</b> |

I collected some relative data[5] and summarized the variety comparison of rare endangered floral element in 14 provinces or regions(see Table II). Academia holds a general opinion that when encountered with the same intensive ambient interference as in the circumpolar latitude, tropical plant groups will suffer a lot more losses (Jablonski 1986b). From Table II we can see that the provinces rank ahead of other provinces are in subtropical zone where species are more various and community structures are more complex. But affected by global warming and human factors, these species show lower resistance against threats, therefore, more endangered species are produced. Moreover, in terms of distributional range of endangered species, most endangered species are distributed in narrow area form or in an island shape, and the regions are in a tendency to reduce.[16]

TABLE II VARIETY COMPARISON OF RARE ENDANGERED FLORAL ELEMENT IN 14 PROVINCES OR REGIONS

| Regions  | No.of family | No.of genus | No.of species | Integrative coefficient | order |
|----------|--------------|-------------|---------------|-------------------------|-------|
| Fujian   | 33           | 46          | 52            | 0.9886                  | 4     |
| Zhejiang | 32           | 51          | 56            | 1.1908                  | 3     |
| Jiangsu  | 12           | 16          | 17            | -1.6185                 | 11    |
| Anhui    | 30           | 44          | 52            | 0.8075                  | 5     |
| Jiangxi  | 38           | 63          | 74            | 2.2358                  | 2     |
| Hunan    | 40           | 65          | 76            | 2.4260                  | 1     |
| Hubei    | 30           | 44          | 49            | 0.7315                  | 6     |
| Shanxi   | 29           | 41          | 44            | 0.4786                  | 7     |
| Henan    | 27           | 37          | 41            | 0.2947                  | 8     |
| Shandong | 8            | 8           | 8             | -2.2394                 | 14    |
| Hebei    | 11           | 13          | 14            | -2.1504                 | 12    |
| Shanxi   | 11           | 13          | 14            | -2.1504                 | 12    |
| Mongolia | 19           | 25          | 26            | -0.8456                 | 10    |
| NE.China | 19           | 26          | 30            | -0.7158                 | 9     |

## B. Primary Exploration on Protection Mechanism of Endangered Seed Plants

### 1) Laws and Policies of Endangered Seed Plants Protection

Since the first modern international convention related to wildlife protection--Convention on Preservation of Fauna and Flora in the Natural Environment came out in 1933, there have been over 40 signed conventions related to species protection. Moreover, countries throughout the world, like America, Britain, France, Japan, India, Indonesia, Switzerland, Hungary, Romania, Germany, Denmark, Finland, Iceland, Norway, Sweden, Brazil, Colombia, South Africa, Australia, New Zealand, Korea, have formulated laws and regulations of wildlife protection tailored to their national conditions. All the measures play a positive role in wildlife protection.

Chinese government attaches great importance to the protection and management of wild plants. Article 9 in The Constitution of the People's Republic of China stipulates that the state ensures the rational use of natural resources and protects rare animals and plants. Appropriation or damaging of natural resources by any organization or individual by whatever means is prohibited. On this ground, National People's Congress promulgated Environment Law (1979), Forest Law (1985). The State Council promulgated Provisional Regulation of Management of Scenic Spots (1985), Regulation of Wild Medicinal Materials Protection (1987), Regulations of Natural Reserves (1994), Regulations of the People's Republic of China on Wild Plants Protection (1996). These laws and regulations clearly define the protection and management of wild plants, provide a legal basis for the protection of wild plants, and ensures the establishment and implementation of China's wild plants protection mechanism.

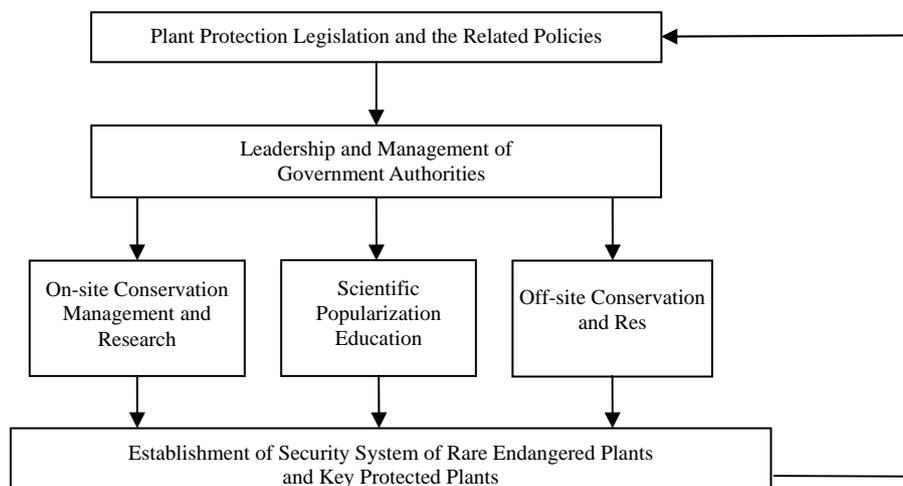


Fig. 1 Schematic diagram of rare endangered plants security mechanism

The establishment of China's wild plants protection mechanisms is still in its infancy. Though it wins initial success, we need to take an objective view to find there are some shortcomings in these mechanisms. Firstly, we need to establish a sound law system in international level, national level and prefecture level to effectively protect plants variety. So far there have been more than 600 local laws and regulations related to environmental resource protection, but there have been few laws and regulations on wild plants protection. There are almost no laws and regulations on rare endangered seed plants. The available local laws and regulations fail to legislate according to the local wild plants protection characteristics, lacking of local color but duplicating the provisions formulated by the state. These laws and regulations cannot integrate local actual situations to make tailored stipulations. While in America, many states make plants protection stipulations tailored to its own local condition, and legislate to decide the species that are protected by the state laws. Secondly, when enforcing the laws, we only deal with the most typical cases and lack of day-to-day enforcement. The management system is incomplete, and daily management work is not normalized, standardized, or legalized. It's in a chaotic and passive perfunctory state. Lastly, wild plant resource protection & management funds are not integrated into the financial budget of governments at all levels. Government budgetary spending on wild plant resource protection & management is rather limited, without a stable fund source to guarantee. Therefore, it is hard to carry out infrastructure construction, research facilities, administrative enforcement, propaganda and education efficiently, which cannot meet the requirements of wild plant resource protection & management.

In this regard, it is recommended that to integrate the wild plant resource protection & management into national economic and social development plan. Wild plant resource protection & management funds should be integrated into the financial budget of governments at all levels. Also we need to establish forest ecological benefit compensation mechanism and use these plant resources rationally to widen the source of fund. In addition, local governments should make investigations on plant resource actively, and formulate laws and regulations tailored to the actual local situations. In addition, we need to take in more talents equipped with professional skills in the field of plant resource protection.

## 2) *Countermeasures for Protection*

The countermeasures for protection of rare endangered seed plants in China can be divided into three classes: on-site conservation, off-site conservation, and popular science propaganda, among which on-site conservation is most effective. Since China established the first natural reserve-Dinghu Mountain Reserve in 1956, China has established 1146 natural reserves by the end of 1999, covering 8.8% land area. They not only reserve plant species but also protect the ecological environment the plants need to survive, so as to prevent the plant species from continuous deteriorating. However, there's nothing we can do to help the rare endangered plants that their adaptabilities decline or their living environment destroyed by natural disaster or anthropic factors. So we resort to off-site conservation, which establishing botanical gardens is the major measure. At present, there are more than 160 botanical gardens in China, and they collect and cultivate over 23000 kinds of Chinese flora plants, which accounts for 65% species throughout China. Among them, there are 13000 kinds of plants are wildly distributed in China, 389 kinds of plants listed in the first batch of protected plants in state level, and 332 kinds of rare endangered plants off-site conserved, which occupies 85.3% of the sum total. The two countermeasures are very effective but only fix the symptoms instead of the root cause. The most important way for rare endangered plants protection is popular science propaganda. Only fostering protection consciousness in people's mind can solve the problem fundamentally.

### a) *Aspects need to be Improved Regarding Botanical Gardens in China*

First of all, the distribution of botanical gardens in China is unbalanced. The distribution of existed botanical gardens is too concentrated, while there're no or few botanicals distributing in areas where plant species are most diversified, the living environments are special or are unique to China. There're almost no botanical gardens in Qinghai-Tibet Plateau and Southwest region. So many cold-resistant and heat-resistant plants are not appropriately protected. Secondly, some off-site conserved plants grow unhealthily due to technology limitation. Moreover, botanical gardens only attach importance to transplanting, without conducting comprehensive and systematic researches on physiological ecology of off-site conserved plants. They don't appropriately deal with the relationship between protection and exploitation & utilization, so the protection effectiveness is greatly reduced. In addition, plant species diversity information and monitoring network hasn't been established among the botanical gardens. Relevant information exchange isn't smooth, which causes many unnecessary repetitive studies. Lastly, the fund and professionals investment is too limited. The off-site conservation of rare endangered plants includes infrastructure construction and maintenance, which will cost a large amount of money. Lack of professionals reduces the efficiency of implementation of the measures, so that work cannot be done smoothly which will exert a negative impact on rare endangered plants protection.

### b) *Rational Exploitation and Utilization of Rare Endangered Seed Plants*

According to preliminary statistics, there are more than 3000 kinds of important wild economic plants in China, 440 kinds of fiber plants, 150 kinds of starch plants, 260 kinds of protein and amino acid plants, 370 kinds of oil plants, 290 kinds of aromatic oil plants, 5000 kinds of medical plants, 300 kinds of commercial tree species, some balsamic acid plants, rubber-like plants, vegetable tanning plants, and 500 kinds of plants with the effect of insecticide. So there's huge exploitation potential in plant resources. As for endangered seed plants we need to enhance their reputation, taking their ornamental characteristics and garden utilization into consideration. We should attribute a beautiful meaning to the seed plants and expand the influence of the endangered seed plants in gardening circles, so as to achieve the comprehensive purpose of protection, development and

utilization. At present there are some rare endangered seed plants such as *Podocarpus fleuryi* and *Tsoongiodendron odorum* Chun are put into use in landscape forest and urban gardens in Qingyuan City, from which we can gain a lot of enlightenment for the development and utilization of the endangered seed plants. In addition, cultivating lots of high-quality cultivated ginseng through domestication of wild ginseng not only meets people's daily need, but also protects the wild ginseng indirectly. These success cases tell us that if handled properly, protection and utilization can be harmonious.

### c) *Enhance Publicity*

As known, the appearance of rare endangered seed plants is mostly due to the human factors. To further proceed with the protection of rare endangered seed plants, and promote the harmonious coexistence of nature and human beings, the key is to work hard to change people's inappropriate ideas and inspire people to realize the importance of protecting endangered plants.

The publicity should be targeted as well. We should make good use of the local power where rare endangered plants exist. And a library should be established. The spread of the rare endangered plants should be made to the local residents at regular intervals so they know about it better. Also, the publicity of the laws of plant protection should be increased to prevent people from illegal behaviors like destroying the plants.

### C. *The Significance of Protecting Rare Endangered Seed Plants*

Rare endangered seed plants are precious materials in plant genetics and breeding. One species is one gene pool. And many of the rare endangered seed plants are of great economic value, like the wild rice. Compared with the wild rice, the modern cultivated rice lose about one third of the allele and a half of the genotype, which contains a lot of good genes, like the anti-disease genes, anti-insect genes, anti-wild grass genes and anti-stress genes, and efficient nutrition genes as well as high yield and high quality genes. And through the hybrid modification of wild rice, great achievements have been made in both social and economic values. An area of 0.12 billion mu of hybrid rice are planted each year in China, half the area of the rice planted while its yield takes up 60% of the total output. The increased rice can feed a population of 60 million people. And there are others of medicinal value like *eucommia ulmoides* and ginseng, etc.

Besides, endangered seed plants are of great culture value, most of which in the nature protection are considered as the miniature of the nature. And during the appreciation of them, people cultivate their tastes. Also, endangered seed plants, especially the relic plants are a helpful basis for studying the origin and evolution of plants. And the ecological values are far greater as the disappearance of one plant will lead to that of a dozen of companion species. It is of great importance and significance to protect the endangered seed plants both in the ecological balance and diversity.

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