

Research Progress on the Endangered Mechanism and Conservation Strategies of the *Abies Chensiensis*

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Abstract: *Abies chensiensis* Tiegh. is an endangered coniferous plant endemic to China, mainly distributed in the Qinling Mountains, which is of great value for scientific research and ecological balance. In recent years, its living environment has been seriously threatened, including climate change, natural disasters and man-made destruction. Studying the ecological adaptability and population dynamics of *Abies chensiensis* is crucial for formulating effective conservation strategies. At present, the protection measures include the establishment of nature reserves, limiting logging and carrying out scientific research, but there are problems such as poor management and poor protection in the implementation. Future conservation strategies need to strengthen population genetic diversity research, protect habitats, and strengthen international cooperation. Through in-depth research and practical exploration, it can provide scientific basis and effective strategies for the long-term survival of *Abies chensiensis*.

Keywords: *Abies Chensiensis*; Endangered; Protection; Research

1. Introduction

Abies chensiensis Tiegh, a unique coniferous tree species in China, is also a national second level protected wild plant. It is of great significance for scientific research, plant geography, paleoclimate, and paleogeography. Mainly distributed in the Qinling Mountains. The growth height of the *Abies chensiensis* is generally between 1500 and 2500 meters, and its habitat is mainly distributed in areas such as high mountains,

canyons, and rock crevices. In these areas, water and temperature conditions are extremely harsh. The distribution range of *Abies chensiensis* is mainly concentrated in provinces such as Shaanxi, Gansu, Sichuan, Chongqing, Hubei, and Henan, and is one of the important vegetation types in northern China [1, 2].

In recent years, due to various reasons, its living environment has been seriously threatened. Studying the endangered status and reasons of the *Abies chensiensis* can also help us better understand its reproductive biology characteristics, genetic diversity, ecological adaptability, and population dynamics, discover the ecological adaptability and population dynamics of the *Abies chensiensis*, and provide more scientific and effective strategies for plant protection [3].

2. Analysis of the Endangered Status and Causes of *Abies Chensiensis*

2.1 Distribution and Habitat Status of *Abies Chensiensis*

Abies chensiensis is a precious tree species unique to China, mainly distributed in the hinterland of the Qinling Mountains, including Shaanxi, Gansu, Sichuan, and Hubei. The distribution range of *Abies chensiensis* is wide, with unique habitat characteristics and high requirements for climate and soil.

The distribution range of *Abies chensiensis* is mainly concentrated in the hinterland of the Qinling Mountains, where the climate conditions are complex and variable, with high rainfall and humidity, as well as lower temperatures and larger diurnal ranges. This climate condition is very important for the

growth and reproduction of the *Abies chensiensis*. In addition, the growth of the *Abies chensiensis* also requires relatively fertile soil, which usually has a high organic matter content and less gravel.

Due to its high requirements for climate and soil, the distribution range of *Abies chensiensis* is relatively small, mainly concentrated in the hinterland of the Qinling Mountains. Meanwhile, due to the continuous influence of human activities, the living environment of the *Abies chensiensis* has also been damaged to a certain extent. For example, excessive cultivation and logging have led to the deterioration of their living environment, further narrowing the distribution range of the *Abies chensiensis*.

Nevertheless, as an important ecological resource, the protection of *Abies chensiensis* still holds great significance. Firstly, the *Abies chensiensis* plays an important role in maintaining the ecological balance of the Qinling region. *Abies chensiensis* is one of the main vegetation types in the Qinling region, which is of great significance for maintaining biodiversity, water conservation, soil conservation, and other aspects of the region.

Secondly, as a precious plant resource, the *Abies chensiensis* has important scientific research value. The genetic diversity of the *Abies chensiensis* is abundant, which has important value for studying the systematic evolution and species formation of plants.

Therefore, in order to protect the *Abies chensiensis*, need to take a series of protective measures. Firstly, it is necessary to strengthen the protection of the living environment of the *Abies chensiensis* to prevent further deterioration of its living environment. Secondly, it is necessary to strengthen the reproductive research of the *Abies chensiensis*, improve its reproductive efficiency, and increase its population size. In addition, it is necessary to strengthen the awareness of protecting the *Abies chensiensis* and prevent illegal logging and destruction [4].

Overall, the protection of the *Abies chensiensis* is an important ecological project that requires our joint efforts to ensure its survival and reproduction, while also contributing to China's ecological protection and scientific research.

2.2 Endangered Degree and Risk Level of *Abies Chensiensis*

The *Abies chensiensis* is a rare plant unique to China, with a high degree of endangerment and risk level, and its protection is urgent. The endangerment of the *Abies chensiensis* is mainly due to the combined effects of various factors, such as changes in gene flow between populations, human destruction, and intensified habitat fragmentation. These factors have led to a decrease in the adaptability of the offspring of the *Abies chensiensis* to the environment, a decrease in seed setting rate, and a low survival rate of seedlings. Therefore, it is necessary to strengthen the management of the distribution area of the *Abies chensiensis*, reduce human damage, and carry out on-site protection. At the same time, appropriate relocation protection should be carried out for understory seedlings to reduce the harm caused by distant decline [5].

In terms of on-site protection, Chinese governments at all levels and relevant departments attach great importance to precious tree species such as the *Abies chensiensis*, and have established protected areas or points in their respective distribution locations. However, despite this, the current situation of *Abies chensiensis* is still not optimistic. When Baishanzu fir was discovered, there were 7 large trees, but now only 3 remain. Due to a deviation in the public's understanding of national protected plants, believe that the protected plants must have special uses and values. The resource fir trees distributed in Ziyuan County, Guangxi have almost been cut down. The fir trees of Fanjing Mountain are quietly dying in large areas. These phenomena indicate that the living environment of the *Abies chensiensis* is no longer suitable for their survival [6].

Need to take active protection measures in response to the endangered status of the *Abies chensiensis*. Firstly, research on reproductive biology, ex situ conservation, and genetic diversity of the *Abies chensiensis* should be strengthened to provide a basis for formulating practical and feasible conservation measures. Secondly, meteorological observation stations should be established in the distribution areas of the *Abies chensiensis*, and meteorological data

should be recorded and tracked year-round to understand the impact of climate change on the growth of the *Abies chensiensis*. In addition, should also strengthen environmental education for the public and raise their awareness of the protection of rare plants such as the *Abies chensiensis* [7]. Overall, the endangered status of the *Abies chensiensis* is severe, and its protection is urgent. need to take active protection measures, strengthen research on reproductive biology, ex situ conservation, and genetic diversity of the *Abies chensiensis*, in order to understand the endangered mechanism of the *Abies chensiensis* and develop practical and feasible protection measures. At the same time, should also strengthen environmental education for the public and raise their awareness of the protection of rare plants such as the *Abies chensiensis*.

2.3 Analysis of the Reasons for the Endangerment of the *Abies Chensiensis*

The *Abies chensiensis* is a rare plant unique to China, and its endangerment can be mainly attributed to natural and human factors.

Natural factors mainly include climate change and natural disasters. Climate change is one of the main natural factors affecting the survival of the *Abies chensiensis*. Global warming, especially rising temperatures and changes in precipitation, has had a significant impact on the growth environment of the *Abies chensiensis*. As the temperature rises, the growth rate of *Abies chensiensis* slows down, the growth period shortens, and the survival rate of seedlings decreases, thereby affecting its population quantity and structure. In addition, natural disasters such as floods, droughts, hail, etc. have also had adverse effects on the living environment of the *Abies chensiensis* [6], which may lead to the loss or alteration of its habitat.

Human factors are another important reason for the endangerment of the *Abies chensiensis*. Human activities have caused serious damage to the living environment of the *Abies chensiensis*, including excessive logging, land development, and environmental pollution. Overlogging has led to the destruction of the habitat of the *Abies chensiensis*, resulting in a reduction in its

living space; Land development has worsened the living environment of the *Abies chensiensis*, which may lead to the loss of its habitat; Environmental pollution has led to a decline in the quality of the living environment for the *Abies chensiensis*, affecting its growth and development [8]. In addition, the endangerment of the *Abies chensiensis* is also related to its own biological characteristics. The *Abies chensiensis* has high environmental requirements, and its habitat is mainly distributed in special landforms such as high mountains and canyons, with specific requirements for climate, soil and other environmental conditions. However, with the impact of climate change and human activities, these special environmental conditions are gradually changing, and the living environment of the *Abies chensiensis* is deteriorating.

In summary, the reasons for the endangerment of the *Abies chensiensis* are multifaceted, including natural and human factors. In order to protect the *Abies chensiensis*, need to take a series of protective measures, including establishing natural reserves, restricting human activities, and improving its living environment. At the same time, it is necessary to strengthen research on its habitat and ecological characteristics in order to better understand and protect this important biodiversity resource.

3. Research Progress on Endangered Conservation Strategies of *Abies Chensiensis*

3.1 Germplasm Protection and Genetic Resource Evaluation of *Abies Chensiensis*

The endangered crisis of the *Abies chensiensis*, as a rare plant unique to China, has attracted widespread attention. In order to better protect and utilize the precious genetic resource of *Abies chensiensis*, China has conducted in-depth research on its germplasm protection and genetic resource evaluation.

Firstly, conducted a detailed investigation and evaluation of the germplasm resources of the *Abies chensiensis*. Through research on the distribution, growth environment, genetic diversity, and other aspects of the *Abies*

chensiensis, have gained a more comprehensive understanding of its germplasm resources. Meanwhile, through the evaluation of the genetic resources of the *Abies chensiensis* have gained a more accurate assessment of its utilization potential and value, providing a scientific basis for the protection and utilization of the *Abies chensiensis*.

Secondly, conducted in-depth research on the conservation strategies of the *Abies chensiensis*. In response to the endangered crisis of the *Abies chensiensis*, have proposed a series of conservation strategies, including on-site protection, ex situ protection, and germplasm protection. Among them, on-site protection is the most effective way to protect the *Abies chensiensis*. By protecting its habitat, it can effectively prevent the destruction and loss of its habitat. Relocation protection involves transplanting the *Abies chensiensis* to other suitable growth environments to prevent its extinction due to habitat loss. Germplasm protection refers to the protection and utilization of the genetic resources of the *Abies chensiensis* to ensure their sustainable existence [9].

Finally, also conducted an in-depth analysis of the protection status of the *Abies chensiensis*. Through research on the distribution, growth environment, population size, and other aspects of the *Abies chensiensis*, have found that the protection status of the *Abies chensiensis* is not optimistic. Due to the continuous expansion of human activities, the habitat of the *Abies chensiensis* is gradually being lost, and its population is also decreasing. Therefore, must take more effective measures to strengthen the protection of the *Abies chensiensis*, in order to ensure the sustainable existence of this precious genetic resource.

Overall, the protection and utilization of the *Abies chensiensis* is a systematic and complex task that requires in-depth research from multiple aspects such as genetic resource assessment, conservation strategy research, and analysis of conservation status. Only in this way can better protect and utilize the precious genetic resources of the *Abies chensiensis*, ensure the sustainable existence of its population, and contribute to the protection of biodiversity in China.

3.2 Habitat Protection and Restoration of *Abies Chensiensis*

Abies chensiensis is a precious tree species unique to China, with important ecological functions and scientific value. However, due to various reasons, the quantity and distribution area of the *Abies chensiensis* have been greatly affected and are in danger of extinction. Researchers have proposed a series of protection and restoration strategies to address this issue, providing important practical references for the survival environment of the *Abies chensiensis*.

Firstly, researchers emphasized the protection of the *Abies chensiensis* habitat. believe that habitat is the foundation for protecting biodiversity, and therefore effective measures must be taken to protect the habitat of the *Abies chensiensis*. Specific measures include establishing nature reserves, strictly controlling human activities, and preventing habitat destruction. At the same time, also proposed some specific habitat protection strategies, such as setting protection signs, strengthening patrols, and preventing illegal hunting and destruction.

Secondly, researchers have proposed restoration strategies for the *Abies chensiensis* believe that only when the habitat of the *Abies chensiensis* is effectively protected can its population survive and reproduce. Therefore, proposed some specific recovery strategies, such as artificial reproduction to increase the population size; Restore habitats and improve their living environment. At the same time, also proposed some specific restoration strategies, such as artificial afforestation to increase vegetation coverage; Carry out soil improvement to enhance soil fertility [4].

In addition, researchers have proposed some other conservation strategies, such as conducting scientific research to understand the ecological needs and behavioral habits of the *Abies chensiensis*; Conduct public education to enhance public awareness of the protection of *Abies chensiensis*; Engage in international cooperation to strengthen the protection of *Abies chensiensis*.

Overall, the protection and restoration of the *Abies chensiensis* is a systematic project that requires efforts from multiple aspects. Only when all protection strategies can be effectively implemented can the living

environment of the *Abies chensiensis* be truly improved, and its population can be truly protected.

3.3 Ecological Management and Protection Measures of *Abies Chensiensis*

The *Abies chensiensis* is a rare plant unique to China, and the study of its ecological management and protection measures is of great significance for protecting the ecological environment of the *Abies chensiensis*.

Firstly, the ecological management and protection measures of the *Abies chensiensis* should start from its ecological habits. The *Abies chensiensis* is mainly distributed in the Qinling Mountains, and its growth environment requires humidity, coolness, and abundant rainfall. Therefore, in ecological management and protection, attention should be paid to protecting its growth environment and avoiding its deterioration [10]. For example, the *Abies chensiensis* nature reserve can be established to protect its growth environment and prevent human activities from damaging its ecological environment.

Secondly, the ecological management and protection measures of the *Abies chensiensis* should start from its protected objects. The protected objects of *Abies chensiensis* are its population size and living environment. Therefore, in ecological management and protection, attention should be paid to protecting the population size and living environment of the *Abies chensiensis*. For example, a population survey of the *Abies chensiensis* can be conducted to understand its population size and distribution, and corresponding protection measures can be formulated. At the same time, it is also possible to protect their living environment by improving their living environment and enhancing their quality of life [11].

Once again, the ecological management and protection measures of the *Abies chensiensis* should start from its protection methods. The protection methods of *Abies chensiensis* mainly include on-site protection, ex situ protection, and germplasm protection. Among them, on-site protection is the most effective way to directly protect its growth environment and prevent the deterioration of its ecological environment. At the same time, the *Abies chensiensis* can also be

transplanted to other areas for protection through relocation protection, in order to expand its distribution range. In addition, germplasm protection can also be used to preserve the seeds of the *Abies chensiensis* to prevent its extinction [12].

In general, the ecological management and protection measures of the *Abies chensiensis* should start from its ecological habits, protection objects, protection methods, and other aspects to protect the ecological environment of the *Abies chensiensis* and prevent its extinction.

4. Conclusion and Discussion

4.1 Current Situation and Issues of Endangered Conservation Strategies for the *Abies Chensiensis*

The *Abies chensiensis* is a unique plant resource in the Qinling Mountains, and the complexity of its growth environment and unique ecological value have attracted much attention to its protection. Currently, China has taken a series of protection measures, such as establishing nature reserves and limiting logging, and has achieved certain results. However, these measures also face some problems in the actual implementation process and need further improvement.

Firstly, there are some issues with the current status of protection strategies for the *Abies chensiensis*. Although a nature reserve has been established, the survival environment of the *Abies chensiensis* is still threatened due to inadequate protection measures. For example, logging activities still exist in some areas, which seriously affects the growth of the *Abies chensiensis*. In addition, due to the complex growth environment of the *Abies chensiensis*, the distribution of its population also has a certain degree of randomness, which makes protection work more difficult. Secondly, the issues with protection strategies mainly manifest in the following aspects. Firstly, the implementation of protective measures is insufficient. Although nature reserves have been established, poor management has led to the destruction of the living environment of the *Abies chensiensis* in some areas. Secondly, the implementation effect of protection strategies is poor. The population of fir in some regions of the Qinling Mountains has not experienced

effective growth, which may be related to the implementation of protective measures. In addition, due to the involvement of multiple departments in the protection of the *Abies chensiensis*, coordination is difficult, which also affects the implementation of the protection work.

In response to these issues, China needs to further improve the protection strategies of the *Abies chensiensis*. Firstly, it is necessary to increase protection efforts and strengthen monitoring and management of the living environment of the *Abies chensiensis*. Secondly, it is necessary to improve the implementation of protection strategies and enhance their effectiveness. In addition, it is necessary to strengthen inter departmental coordination and form a joint force to jointly protect the *Abies chensiensis*.

Overall, the protection of the *Abies chensiensis* is a complex system engineering that requires multiple efforts and cooperation. Currently, although some achievements have been made, there are still some problems that need further improvement. Only in this way can ensure the long-term survival and reproduction of the unique plant resource of *Abies chensiensis*.

4.2 Development Trends and Prospects of Endangered Conservation Strategies for the *Abies Chensiensis*

The endangered conservation strategies of the *Abies chensiensis* will become more scientific and effective with the development of science and technology. In the past few decades, China's protection of the *Abies chensiensis* has mainly relied on establishing natural reserves and adopting on-site protection measures, but these measures face many challenges in practical implementation. Therefore, need to draw on advanced international experience and combine the characteristics of *Abies chensiensis* to develop more scientific and effective protection strategies based on existing protection strategies.

Firstly, should strengthen the research on genetic diversity of the *Abies chensiensis* population. The genetic diversity of the *Abies chensiensis* is of great significance for its survival and adaptability. By studying the genetic diversity of the *Abies chensiensis*, can better understand its genetic

characteristics and provide scientific basis for formulating more reasonable protection strategies. In addition, genetic diversity research can also help us better understand the evolutionary process of the *Abies chensiensis* and provide reference for future genetic improvement [13, 14].

Secondly, need to strengthen the protection of the *Abies chensiensis* habitat. The *Abies chensiensis* is mainly distributed in the high-altitude areas of the highest mountains in some areas, and its habitat is relatively fragile. Therefore, need to take measures to protect these habitats and prevent further damage. This includes restricting human activities, preventing excessive development, and strengthening ecological restoration work [15].

In addition, should also conduct research on the relocation protection of the *Abies chensiensis*. Due to the narrow distribution range and scarce quantity of the *Abies chensiensis*, its natural reproduction ability is poor, therefore, ex situ conservation has become an important way of protection. By relocating and protecting the *Abies chensiensis*, can effectively expand its population size, improve its reproductive ability, and thus increase its chances of survival.

In the future, also need to strengthen cooperation with the international community and draw on advanced protection concepts and technologies from the international community. For example, can collaborate with international organizations such as the International Union for Conservation of Nature (IUCN) to jointly carry out the conservation work of the *Abies chensiensis*. At the same time, can also learn from the research and technological development of wildlife conservation in developed Western countries, providing new ideas and methods for the protection of the *Abies chensiensis*.

In short, with the development of science and technology, the protection strategies of the *Abies chensiensis* will become more scientific and effective. Should start from multiple aspects such as strengthening research on population genetic diversity, protecting habitats, conducting ex situ conservation, and strengthening international cooperation to provide strong support for the

protection of the *Abies chensiensis*. Look forward to effective protection of the *Abies chensiensis* in the near future and its continued reproduction on Earth.

4.3 Suggestions and Prospects for Future Research

The protection of *Abies chensiensis* has always been an important issue in China's forestry field. As an important forest resource, the ecological function and biodiversity value of fir cannot be ignored. However, due to the influence of natural and human factors, the survival environment of the *Abies chensiensis* is facing serious threats, and its endangered status is not optimistic. Therefore, research on the protection of *Abies chensiensis* not only helps to raise public awareness of fir protection, but also helps to develop more effective protection strategies. Firstly, theoretically, can further explore the protective mechanism of the *Abies chensiensis*. At present, research on the protection of fir in the Qinling Mountains mainly focuses on ecology, conservation biology, and other fields, while there is still a lack of in-depth research on the protection mechanism of fir. For example, can study the ecological adaptability of the *Abies chensiensis* to understand its growth status in different environments and provide a basis for formulating protection strategies. At the same time, can also study the conservation biology of the *Abies chensiensis* to understand its biological characteristics such as reproduction and growth, and provide scientific basis for the implementation of conservation work.

Secondly, in practice, can further explore the protection strategies of the *Abies chensiensis*. At present, the protection strategies for the *Abies chensiensis* mainly focus on on-site protection and relocation protection. However, there are still some issues with these strategies in practical operation. For example, effective relocation protection is an urgent issue for some *Abies chensiensis* trees that grow in harsh environments. Therefore, can conduct in-depth research on the protection strategies of the *Abies chensiensis* from a practical perspective, in order to propose more effective protection strategies. In the future, can conduct in-depth research

on the conservation issues of the *Abies chensiensis* from the following aspects: firstly, to study the genetic diversity of the *Abies chensiensis*, in order to understand its adaptability in different environments and provide scientific basis for the formulation of conservation strategies; The second is to evaluate the protection effect of the *Abies chensiensis*, in order to understand whether the existing protection strategies are effective and provide reference for the adjustment of protection strategies; The third is to study the interrelationships between the *Abies chensiensis* and other organisms, in order to understand its position and role in the ecosystem, and provide comprehensive consideration for the formulation of conservation strategies.

Overall, the protection of the *Abies chensiensis* requires in-depth research from both theoretical and practical perspectives. Only in this way can propose more effective protection strategies to protect the important forest resource of *Abies chensiensis*.

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References

- [1] Zhao Qianyi, Zhang Shuangyu, Guo Shujie, et al. Research progress on Qinling fir. *Green Technology*, 2022, 24 (07): 63-66.
- [2] Li Pingli. Application value and tree species protection of Qinling fir in Meixian County. *Modern Agricultural Technology*, 2020, (04): 144+147.
- [3] Jia Hongru, Chen Yun, Zhang Xu, et al. The causes of death of Qinling fir in Xiaoqinling Nature Reserve. *Journal of Ecology*, 2016, 36 (07): 1936-1945.
- [4] Zhang Ying. Research on on-site conservation of Qinling fir in Xiaoqinling National Nature Reserve, Henan Province. *Anhui Agricultural Science*, 2013, 41 (13): 5900+5913.
- [5] Xu Chanjuan, He Ying, Wang Yufan, et al. A Preliminary Discussion on the Reproductive Ecological Characteristics of Qinling *Abies*. *Modern Horticulture*, 2012, (22): 190.
- [6] Li Weimin, Li Sifeng, Li Bin. A study on

- the structural characteristics of the endangered plant Qinling fir community in the Qinling Mountains. *Shaanxi Forestry Technology*, 2012, (05): 1-6.
- [7] Yang Yanping, Yang Yaping. Research on the technique of supplementary light seedling cultivation for endangered plant *Abies qinling*. *Chinese Wildlife Resources*, 2012, 31 (04): 76-77.
- [8] Li Weimin, Li Sifeng, Li Bin. Using SSR molecular markers to analyze the genetic diversity of natural populations of fir in the Qinling Mountains. *Acta Botanica Sinica*, 2012, 47 (04): 413-421.
- [9] Yang Kaibao, Sun Baosheng, Sun Yanfang, et al. Research on the Seedling Cultivation Technology of Qinling *Abies* by Twig Cutting. *Journal of Central South University of Forestry and Technology*, 2011, 31 (11): 75-78.
- [10] Shi Xiaohua, Liu Yi, Peng Jialong, et al. A comparative analysis of the age structure and dynamics of the populations of Qinling fir and Bashan fir. *Journal of Northeast Forestry University*, 2009, 37 (01): 10-14.
- [11] Zhu Xiuhong, Liu Guangwu, Ru Guangxin, et al. The quantitative characteristics and dynamics of the endangered plant Qinling fir community. *Journal of Ecology*, 2007, (12): 1942-1946.
- [12] Zhu Xiuhong, Liu Guangwu, Ru Guangxin, et al. Study on species diversity and stability of the Qinling fir community in the Shirensan Nature Reserve. *Journal of Nanjing Forestry University (Natural Science Edition)*, 2007, (05): 57-61.
- [13] Shi Xiaohua, Xu Xiaobo, Zhang Wenhui. A study on the ecological niches of the main populations in the Qinling fir community. *Plant Research*, 2007, (03): 345-349.
- [14] Zhang Wenhui, Xu Xiaobo, Zhou Jianyun. Reproductive ecological characteristics of endangered plant *Abies qinling*. *Journal of Ecology*, 2006, (08): 2417-2424.
- [15] Zhang Wenhui, Xu Xiaobo, Zhou Jianyun, et al. The population dynamics of endangered plant *Abies qinling*. *Journal of Applied Ecology*, 2005, (10): 1799-1804.