



Study on Forest Types and Forest Fire Prevention Status and Countermeasures in Mount Tai Scenic Area

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Abstract: Mount Tai is rich in vegetation, lush trees and abundant water resources. The environmental support system of Mount Tai and its surrounding areas has played an irreplaceable role in water conservation, wildlife protection and environmental regulation. At present, the total forest area of Mount Tai has exceeded 10000 hectares, the forest coverage rate has reached more than 82%, the vegetation coverage rate has reached more than 94%, and there are more than 3200 species. The ecological environment has been greatly improved. There are 1412 species of higher plants, 446 species of lower plants, 1136 species of vascular plants, belonging to 133 families and 550 genera, including more than 800 species of wild plants and more than 300 species of cultivated plants. The abundant species of animals and plants and their interaction with environmental factors form a stable natural ecosystem of Mount Tai. Forest fire is the most dangerous enemy and also the most terrible disaster of the forest. The fire could bring destructive damage to the forest, not only burning the forest, but also reducing the reproductive capacity of the forest, causing soil barrenness and destroying the water conservation of the forest, and even leading to complete imbalance of the ecological environment. With the rapid development of economy, the state pays more and more attention to the development of forestry, and has made remarkable progress in the work of forest fire prevention. Forest fire has a great impact on forestry, so better forest fire prevention is the basic work to prevent forest fire, which is of great significance to the protection of forest resources and forest workers. This paper summarizes the forest species in Mount Tai Scenic Area, analyzes the current situation of forest fire prevention, and discusses the Countermeasures for forest fire prevention at present.

Keywords: Forest Types, Forest Fire Prevention, Mount Tai, Vegetation, Ecological Environment

1. Introduction

Mount Tai is located in Tai'an City, Shandong Province, with a total area of 426 square kilometers. It is located in the warm temperate climate zone, with a large number of coniferous forests and broad-leaved forests. The grass, shrub and humus layer under the forest grow vigorously and have become the habitat of many animals and plants. Mount Tai belongs to the flora of North China. Due to the influence of the Yellow Sea and the Bohai Sea, it has abundant rainfall and is a transition zone of dry and wet alternation. The main peak of Mount Tai is about 1545 meters above sea level. There are more than 20 ancient buildings and more than 2200 steles on

the mountain. It is one of the first batch of national scenic spots in China [1-3].

In the 1930s and 1940s, the vegetation of Mount Tai was sparse and the forest coverage rate was less than 5%. The trees were mainly distributed on both sides of the Mountaineering Road and around the scenic spots, resulting in serious water and soil loss, very bad ecological environment, and frequent landslides and other disasters. In order to protect the ecological environment, the forest management department of Mount Tai has carried out large-scale afforestation activities since the 1950s, in order to restore the vegetation of Mount

Tai as soon as possible and play its important ecological function. After decades of efforts, the barren hills and barren hills in the past have been covered with trees [4].

In recent years, the total forest area of Mount Tai has exceeded 10000 hectares, the forest coverage rate has reached more than 82%, the vegetation coverage rate has reached more than 94%, and there are more than 3200 species. The ecological environment has been greatly improved. Since then, there has been no landslide in Mount Tai, and soil erosion has become less and less. The vegetation of Mount Tai is divided into forest, shrub, shrub meadow, meadow and other types. The research shows that the plants of Mount Tai grow luxuriantly. There are 1412 species of 645 genera of 174 families of higher plants and 446 species of lower plants. There are 1136 species of vascular plants, belonging to 550 genera of 133 families, including more than 800 species of wild plants and more than 300 species of cultivated plants; More than 240 species of vertebrates; More than 900 species of insects have been identified. The abundant species of animals and plants and their interaction with environmental factors form a stable natural ecosystem of Mount Tai [5].

2. Forest Species in Mount Tai

Mount Tai is rich in forestry, lush in trees, abundant in water, and complex in terrain. It is an excellent natural place for all kinds of animals to forage and inhabit. The environmental support system of Mount Tai and its surrounding areas has played a key role in water conservation, wildlife protection and regulating the surrounding environment. The unspoiled Mount Tai forest ecosystem has become a paradise for wild animals. Taking birds as an example, due to the improvement of ecological environment conditions, it can provide birds with suitable climate and rich food. Some species that were originally migratory birds do not migrate in winter [6-8].

The restoration of forest vegetation in Mount Tai has also brought about great ecological benefits. The value evaluation shows that the forest ecosystem in Mount Tai Scenic Area alone creates hundreds of millions of RMB of ecological value each year, mainly including water conservation, soil protection, carbon dioxide absorption, greenhouse effect reduction and carbon neutralization.

Table 1. Main forest species in Mount Tai.

Type	Forest Species
Coniferous forest	Pinus tabulaeformis forest, red pine forest, black pine forest, Huashan pine forest, larch forest, Platycladus orientalis forest, Korean pine forest and camphor pine forest
Broad-leaved forest	Oak, Quercus variabilis, Robinia pseudoacacia, alder Liaodong, alder, Acer Yuanbao, Populus tomentosa, Populus canadensis, Populus maple and various fruit trees
Bamboo forest	Light bamboo forest and moso bamboo forest

There are nearly 3000 species of animals and plants in Mount Tai, including forest, shrub, shrub, meadow, wetland and other ecosystems. Mount Tai is located in the warm temperate monsoon climate zone and the central area of the warm temperate zone in China. The vegetation belongs to the warm temperate deciduous broad-leaved forest area and is a flora dominated by the temperate deciduous broad-leaved forest. The natural secondary forest of Pinus tabulaeformis distributed in houshiwu, taisongshan and other places and the ancient sidewall forest in Lingyan are typical representatives of the natural coniferous forest in the warm temperate zone of China, and also the representative type of vegetation in this area [9].

2.1. Coniferous Forest

The forest coverage rate of Mount Tai is more than 82%, which is the main type of vegetation in Mount Tai (Table 1). Taking coniferous forest as an example, there are many kinds of coniferous forest, including Pinus tabulaeformis forest, red pine forest, black pine forest, Huashan pine forest, larch forest, Platycladus orientalis forest, Pinus koraiensis forest and Pinus sylvestris forest.

2.1.1. Pinus Tabulaeformis Forest

Pinus tabulaeformis forest is distributed in the whole area of Mount Tai. Most of them are early plantations. There are few natural Pinus tabulaeformis forests, which only exist in the two places of shuangsongshan and houshiwu, with an altitude

of 1000 to 1400 meters, an area of about 700 mu, and a tree age of 100 to 300 years, up to 500 years. The height of the trees is usually 6 to 12 meters, the DBH is 30 cm to 80 cm, the trunk is curved, and the crown is spread in all directions.

2.1.2. Red Pine Forest and Black Pine Forest

Red pine forest and black pine forest are sporadically distributed in a few sections of the forest areas of Mount Tai below 700 meters above sea level. They are small artificial red pine forest and black pine forest.

2.1.3. Huashan Pine Forest

Huashan pine was first introduced in 1950s. It was planted at an altitude of 300-1500 meters, covering an area of about 3000 mu. The lower shrubs mainly include Lespedeza, Spiraea trifid, forsythia and so on. The herbaceous plants mainly include tangsongcao, wusuli fengmaoju, boxing ginseng, three veined Malan, Sargassum, Elymus lanceolata, and low sedge.

2.1.4. Larch Forest

Larch forest is composed of artificially introduced North China Larch and Japanese larch, mainly distributed in Sancha, Daiding north slope, etc. The Larix forest in Sancha enters the middle age with uniform distribution and orderly forest appearance. The tree height is 6-8 meters and the DBH is 6-10 cm. The Shrubs under the forest mainly include Forsythia suspensa, Spiraea trifid, Spiraea Huabei and Vitis amurensis; The herbaceous plants mainly include three veined magnolia,

Yuzhu, low-lying *Carex*, and lanceolate *Carex*.

2.1.5. Side Berlin Forest

Side Berlin is mainly distributed on both sides of the winding road from Hongmen to Zhongtianmen and Lingyan temple, which are basically artificial forests. The tree age is more than 200 years, the tree height is 7 meters to 8 meters, and the DBH is 30 cm to 50 cm. The section from dongxiqiao to hutiange is the most concentrated and prosperous. In the area from huimaling to Chaoyang cave, the growth of *Platycladus orientalis* is weakening. At the lower part of the mountain, the trees of the side Berlin in Haoli Mountain, science mountain, Jinshan mountain, jingshiyu, Lingyan temple and other places with a lower elevation are mostly about 30 years old and grow well.

2.1.6. Red Pine Forest and Camphor Pine Forest

In Sancha, there are introduced small red pine forest and camphor pine forest. The red pine forest is about 20 years old, with an average tree height of 5.1 meters and a DBH of 8.9 cm. The age of Zhangzi pine forest is about 13 years, with an average height of 4.2 meters and a DBH of 7 cm.

2.2. Broad-Leaved Forest

The broad-leaved forest is composed of deciduous broad-leaved trees in the warm temperate zone, mainly including *Quercus*, *Quercus variabilis*, *Robinia pseudoacacia*, alder Liaodong, alder, *Acer Yuanbao*, *Populus tomentosa*, *Populus canadensis*, *Populus maple* and various fruit trees.

2.2.1. Oak Forest

Quercus Quercus forest is mainly distributed in panhuangling, Zhulin temple, Foye temple, Yaoxiang and other places. It is a secondary forest and artificial forest. The oak forest on the south slope of the central part of Zhulin temple and zhaojunling is a 28 year old budding forest, with an average tree height of 18 meters and a DBH of 16.8 cm. The Shrubs under the forest are mainly brambles and *Lespedeza*. The herbaceous plants mainly include wild grass, gooseberry, *Artemisia annua*, *Bidens*, endive, low moss and so on. The 16-year-old oak forest in zhaojunling has an average tree height of 8.2 meters and a DBH of 8.7 cm. The Shrubs under the forest are mainly brambles and flowering *Lespedeza*. The herbaceous plants are mainly yellow backed grass, wild ancient grass, *Bidens* and low sedge.

2.2.2. Quercus Variabilis Forest

Quercus variabilis forest is mainly distributed in the sunny slope from sanyangguan to shuangbaishu, and in the middle and lower part of xiaoluohan cliff and jianganyu. It is mostly budding forest. The *Quercus variabilis* forest on the west slope of sanyangguan has an average tree height of 8 meters, a DBH of 9.1 cm, and a canopy density of 0.5. The Shrubs under the forest include fine stem *Lespedeza*, dawuri *Lespedeza*, bramble and jujube. The herbaceous plants include orange grass, yellow back grass, *Carex* grass, *Zoysia japonica*, sand ginseng with willow leaves, low sedge and so on. The oak forest on the east side of the martyrs' temple has a tree age of 60 years. It is the

oldest oak forest in Shandong Province. The average tree height is 12.2 meters and the DBH is 29.7 cm. Under the forest, there are scattered and flowered branches and poles. The herbaceous plants include kanmai Niang, *Setaria*, *Cornus*, lavender, *Bidens*, endive, and *Solanum nigrum*.

2.2.3. Locust Forest

Robinia pseudoacacia forest is one of the main afforestation trees in Mount Tai after the founding of the people's Republic of China. It is widely distributed in river valleys and hillsides below 1000 meters above sea level, with a large area in matiyu, laoniuzhai and getiaogou. Most of them are pure forests, with luxuriant growth, canopy density of 0.8 to 0.9, average tree height of 8 to 9 meters, DBH of 8 cm to 15 cm, and regeneration seedlings of various ages. There are few shrubs under the forest. The herbaceous plants on the shady slope are some wet loving plants, including bayberry, longbud grass, *Pinellia ternata*, *Commelina*, *Polygonum Polygonum*, bulbous, etc; The herbaceous plants under the forest on the sunny slope include stinky grass, yellow back grass, sparsely flowered green grass, orange grass, gooseberry grass, low sedge and so on.

2.2.4. Red Poplar Forest

The red poplar forest is mainly distributed in Sancha, Daiding and other places. It is composed of artificially introduced red poplar and alder. It is a young forest with a canopy density of 0.6 to 0.8. Shrubs under the forest include *Lespedeza*, Tuzhuang *Spiraea*, etc; The herbaceous plants include tangsongcao, *valerian officinalis*, ginseng, *sanguisorbia officinalis*, Wusuli fengmaoju, low moss and so on.

2.2.5. Yuanbao Maple Forest

Yuanbao maple forest is mainly distributed in sanyangguan, both sides of the winding road of the middle Mountaineering Road, Yaoxiang and other places. Autumn leaves are yellow or red.

2.2.6. Poplar Forest

The poplar forest is mainly composed of *Populus tomentosa*, which is distributed in the low slopes and valleys of various forest areas, such as Dongkexue mountain and Xiaoluohan cliff.

2.2.7. Maple and Poplar Forest

Maple and Poplar Forests are scattered in the gullies of various forest areas. There are many water and moisture resistant plants under the forest, such as *Commelina communis*, *Polygonum hydroponicum*, *Polygonum Nepalis*, *Myrica rubra*, *Carex* winged fruit, and gooseberry.

2.2.8. Fruit Tree Forest

The traditional fruit trees in Mount Tai include apple tree, chestnut tree, hawthorn tree, walnut tree, jujube tree, apricot tree, peach tree, pear tree, persimmon tree, etc., which are distributed in the alluvial fan platform at the foot of the mountain and the alluvial plain in front of the mountain, with an area of about 30000 mu. The undergrowth vegetation mainly includes intercropping crops and low moss.

2.3. Bamboo Forest

It is mainly composed of light bamboo forest and *Phyllostachys pubescens* forest. Light bamboo forest is distributed in Dajinkou, Ouchi, Zhulin temple, Luohanya, Sancha and other places, all of which grow in small pieces. The Danzhu forest garden in Dajinkou has a cultivation history of more than 100 years. The light bamboo forest at the site of Zhulin Temple grows on the sunny slope about 400 meters above sea level, with an average of 2767 trees per mu, a height of 5.9 meters and a diameter at breast height of 3 cm. There are no shrubs under the forest, and the herbaceous plants are sparse, mainly white Britain, *Solanum nigrum*, *Polygonum oxyphyllum*, *Bidens*, and *Commelina communis*. Moso bamboo forest was introduced in Mount Tai in the 1960s. There are small pieces of bamboo forest near the bamboo forest temple, and the growth is good.

3. Present Situation of Forest Fire Prevention in Mount Tai

Forest fire is the most dangerous enemy and the most terrible disaster of the forest. The fire will bring destructive damage to the forest, not only burning the forest, but also reducing the reproductive capacity of the forest, causing soil barrenness and destroying the water conservation of the forest, and even leading to complete imbalance of the ecological environment [10].

3.1. Classification of Forest Fires

According to the central location of the forest fire, the spreading speed, the affected parts and the degree, the forest fire can be roughly divided into three categories: surface fire, crown fire and underground fire. Based on the size of the affected forest area, forest fires are divided into the following four categories: (1) Forest fire: the affected forest area is less than 1 hectare or other forest land fires (including wildfires); (2) General forest fire: the affected forest area is more than 1 hectare but less than 100 hectares; (3) Major forest fire: the affected forest area is more than 100 hectares but less than 1000 hectares; (4) Extraordinarily large forest fire: the affected forest area is more than 1000 hectares.

3.2. Causes of Forest Fires

There are two main causes of forest fire: man-made fire and natural fire. Man-made fire includes: (1) Productive fire sources: fire for agriculture, forestry and animal husbandry production, fire for forestry and sideline production, fire for industrial and mining transportation production, etc; (2) Nonproductive fire sources: such as outdoor cooking smoke, cooking, paper burning, heating, etc; (3) Intentional arson: burning hay, setting off firecrackers and fireworks. Among the fires caused by man-made fire sources, the forest fires caused by reclamation and burning and smoking are the most. In the forest fires in China, the fires caused by cooking smoke, burning wasteland and burning paper on the grave account for the absolute number.

Natural fire includes lightning fire, spontaneous combustion, etc. Forest fires caused by natural fires account for about 1% of the total forest fires in China [11].

3.3. Current Fire Prevention Methods

Lookout monitoring is to observe the occurrence of forest fire, determine the location of fire and report the fire through the lookout. Its advantages are large coverage and good effect. The disadvantage is that it is impossible to set up observation platforms in remote forest areas. The observation effect is limited by the terrain and terrain, and the coverage is small. There are dead corners and gaps that cannot be observed. It is impossible to observe the large area of fire, residual fire and underground fire with heavy smoke. It is impossible to observe on the tower in lightning weather; It is very dependent on the experience of the lookout, with low accuracy and large error.

At present, the mainstream monitoring mode adopted in China is the video monitoring system, which is a simple extension of the traditional urban monitoring. The collected video images are collected by microwave, and the centralized monitoring is completed manually. However, manual monitoring is easy to cause fatigue of the naked eye, and the fire in the video is not easy to be detected, resulting in missing reports. There are many video lines in the monitoring center, and the manual monitoring cannot be monitored one by one, which is easy to cause missing reports. Therefore, the biggest disadvantage of traditional video surveillance is the very high rate of false alarm [12].

4. Suggestions on Forest Fire Prevention Measures

With the rapid development of economy, the state pays increasingly attention to the development of forestry, and has made remarkable progress in the work of forest fire prevention. Forest fire has a great impact on forestry, so better forest fire prevention is the basic work to prevent forest fire, which is of great significance to the protection of forest resources and forest workers [13-15].

Mount Tai Scenic Area in Tai'an City, Shandong Province has creatively carried out forest fire prevention and forest pest prevention and control, established a set of high-efficient and replicable three-dimensional comprehensive prevention and control corridors of "Tianluo, ground network, human sentry and water shield", and adopted a number of measures to solve the problem of forest fire prevention.

Build satellite remote sensing monitoring system and electronic fence control system to realize automatic fire monitoring and early warning and real-time control of people and vehicles entering the mountain; More than 700 intelligent checkpoints and more than 10 unmanned aerial vehicles have been set up. The "smart Mount Tai" integrated command and dispatching platform for forest fire prevention and fire fighting and the pine wood nematode disease epidemic prevention and control supervision platform have been

independently developed to realize the comprehensive inspection and prevention of forest resources, the automatic image intelligent identification of dead trees, the automatic publicity and reminder of people entering the mountain, and the automatic positioning and alarm of illegal fire use in the forest area. The satellite telemetry, high-altitude aerial survey, infrared monitoring an integrated monitoring and early-warning system without blind areas based on information retrieval and manual verification.

An isolation network will be built around Mount Tai. More than 2000 publicity signs will be hung along the way. The management method of physical closure and intersection control will be adopted for the whole line. An integrated fire prevention and insect prevention inspection station will be built. The measures of real name registration, inspection and prohibition of kindling, scanning of fire codes, and daily clearing of personnel entering the mountain will be implemented. The entry and exit of production operations will be strictly controlled. The publicity of Mount Tai positions for fire prevention and epidemic prevention will be built. The inspection and control of illegal personnel entering the mountain in nonopen areas, the inspection and control of vehicles and building materials entering the mountain Seamless barrier layout for the whole process of pine wood nematode control.

Firmly establish the concept of "fire prevention is the prevention of people", set up more than 60 new checkpoints and more than 20 management and protection rooms at important intersections around Mount Tai, mobilize all cadres and forest protection personnel to carry out grid three-dimensional inspection and patrol, and form a forest fire prevention and pest prevention and control no dead angle patrol system of "point blocking, grid patrol and whole area linkage". Build a Mount Tai water fire extinguishing system with the reservoir as the core, the water supply network as the framework, the high-pressure series water pump as the vein, and the fire network covering the whole mountain. Form a full coverage "water shield" guarantee system of watering and humidification in high fire risk period, water protection in case of fire, forest irrigation in dry season, and water intake in place for disease and disease control.

The staffs in the scenic area have arranged and deployed forest fire prevention work in advance, fully implemented the forest fire prevention responsibility system, formed a strict prevention and control network system, and established a strict forest fire prevention responsibility system. They will intensify publicity and education to raise the awareness of fire prevention among the people. Through the installation of voice intelligent bayonets at the entrance of the forest area, the hanging of propaganda banners, the distribution of clear paper, the dispatch of propaganda vehicles and other forms, the forest fire prevention publicity and education are carried out to create a strong atmosphere for the whole society to pay attention to and participate in forest fire prevention. Strengthen fire source control and eliminate fire safety

hazards. In the fire prevention period, the combustibles in the forest area shall be comprehensively cleaned up and the illegal use of fire shall be severely punished.

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