Ecosystem Health and Forest Ecosystem Management

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Abstract. Forest ecosystem management and ecosystem health are two related but different concepts. This paper expounds the origin, development, evaluation and research progress of ecosystem health, the difference between forest ecosystem management and traditional forest management science, and discusses the relationship between forest ecosystem management and ecosystem health, and holds that: 1) the health of forest ecosystem should be the goal pursued by forest ecosystem management; 2) Ecosystem health theory provides the theoretical foundation for specific measures of forest ecosystem management; 3) Forest ecosystem management measures also provide necessary means to maintain the health of forest ecosystem. In order to realize sustainable forest management, the goal of forest management should be changed from the traditional priority of utilization to the direction of emphasizing the health of forest ecosystem, which is the necessary prerequisite for sustainable development of ecological, economic and social benefits of forests.

Keywords: Ecosystem Health, Ecosystem Management, Sustainable Forest Management

1. Introduction
Forest is the main body of terrestrial ecosystem. It is the natural resource bank, biological gene bank and energy storage bank, which plays a decisive role in improving the ecological environment of the earth and maintaining the ecological balance. Therefore, forests are also of great strategic significance for the sustainable development of human economy, especially for developing countries to get rid of poverty. Since 1990s, with the in-depth study on the role of forest in global climate change, as well as its role in protecting biodiversity and maintaining atmospheric adult balance, people put forward more urgent requirements for sustainable development of forest. Forest scientists all over the world have studied the theory of sustainable forest management from different angles. For example, Guo Jinping [1], based on analyzing the diversity of forest functions and their mutual contradiction and unity, expounded the basic concepts and principles of limited forest regeneration and the variability of forest regeneration, and discussed the basic factors affecting forest sustainable management and the ways to realize it, and put forward the basic principles of forest sustainable management. Internationally, WWF, International Forest Management Committee, International Tropical Timber Organization, International Forestry Research Center and other related organizations have put forward corresponding indicators and principles of sustainable forest management. Although its definition is not uniform, the understanding of its connotation has basically reached a consensus, that is, sustainable forest...
management should "keep forest productivity and regeneration for a long time without unacceptable damage, as well as species and ecological diversity of forest ecosystem". It requires the overall improvement of productivity, vitality, biodiversity and regeneration capacity of forest ecosystem to ensure rich forest resources and healthy environment and meet the needs of present and future generations. Many countries in the world have studied and formulated forestry action plans according to this new theory. In 1995, China also formulated China Agenda 21 Forestry Action Plan accordingly. Forestry is no longer regarded as a narrow and closed industry, but is regarded as an important and widely influential cause in the global population, environment and development pattern. Sustainable forest management has become a very important content.

2. Forest Ecosystem Health

2.1. Concept and Meaning of Ecosystem Health

Ecosystem health is a very complex concept. In 1941, Aldo Leopold first gave the definition of "Land health" and used "Land sickness" to describe the disorder of land function. It was not until 1989 that Ropport first gave the definition and connotation of ecosystem health. He believed that the definition of ecosystem health could be analogized from the definition of human health, and that ecosystem health meant that there was no sickness in the ecosystem. Since then, different scholars have given different definitions and connotations from different positions and professional backgrounds, but there is no widely accepted concept and definition before. Here are only two representatives who hold different views. Costanza and others define ecosystem health as follows: if an ecosystem is stable and sustainable, that is to say, it is active and can maintain its organizational structure and automatically recover from stress after a period of time, this ecosystem is healthy and not affected by stress syndrome; Alexander pointed out that "the health of forest ecosystem is a state in which forest ecosystem provides human needs and maintains its own complexity".

Combining the above two different views on ecosystem health, we can find the differences between these two views: the role and position of human interests in ecosystem health. The former view holds that human interest is only a by-product of this perfect structure and function, while the latter view holds that the health state of ecosystem must be in line with human interest. The author thinks that compared with the second view, the former is an objective description and evaluation of the ecosystem, while the latter has more subjective wishes, in which different people have different views of interests, which inevitably leads to the subjectivity of the evaluation criteria.

Therefore, ecosystem health can be understood as follows: the structure and function of an ecosystem are sustainable in time scale and the system should have resistance and resilience to natural and man-made interference, so we say that the ecosystem is healthy.

2.2. Factors Affecting Ecosystem Health

Although the concept of ecosystem health is still controversial, there is a high degree of unity among the factors that affect ecosystem health, that is, disturbance and stress are the main factors that affect ecosystem health. Under the condition of stress and disturbance, the ecosystem will affect its health and cause health risks. However, not all stresses affect the sustainability and stability of ecosystems. In fact, many ecosystems depend on certain stresses to maintain them. These stresses have become an integral part of the natural ecosystem and can be called forward stresses. However, in a general sense, stress often refers to the reverse stress that causes negative effects on the ecosystem. Different ecosystems have different responses to stress, and individuals, populations, communities and ecosystem levels in the same ecosystem have different responses to stress. Under stress, the ecosystem will change at the level of energy, material circulation, community structure and general system. Ren Hai, Jianguo Wu and others think that under the external factors that the ecosystem can bear, the response process of the ecosystem to disturbance has three stages, the initial reaction, then the resistance stage and finally the recovery stage. There are four kinds of ecosystem responses to stress, one is extinction, the other is degradation (succession deviates from track), the third is recovery (that is,
it returns to its original state and its similar state), and the fourth is entering a new state. Interference causes the characteristics of a community or ecosystem to exceed its normal fluctuation range. The interference system includes interference type, frequency, intensity and time.

2.3. Characteristics of Healthy Forest Ecosystem

There are different standards about the characteristics of a healthy forest ecosystem because the concept of ecosystem health has not been unified. In addition, because ecosystem health is a relative concept, that is to say, there is no absolutely healthy forest as a standard to evaluate the health status of other forest ecosystems. Chen Gao, Deng Hongbing and others \[12\] think that a healthy forest ecosystem has the following characteristics: 1) stay away from ecosystem distress syndrome; 2) The ability to respond to disaster changes and/or recover from disaster changes at the landscape level; 3) They are self-sustaining, and their physical environment and biological resources can support the nutrition network of forest production at least in some succession stages, and can ensure the functional balance between the supply and demand of the essential resources (water, nutrients, light and growth space) of vegetation; 4) Diversity of succession stage, stand structure and all ecosystem processes that provide habitats for many native species; 5) Management practices and ecosystem processes will not harm neighboring ecosystems; 6) Maintain a good forest service function and a healthy human society (because there are almost no ecosystems in the world that are not subject to human intervention and management). This conceptual framework covers all ecosystem characteristics of forest ecosystem, such as structure, function, dynamic process, ecological service and complex ecosystem. Based on this standard, a large number of specific assessment methods and approaches have been produced.

2.4. Ecosystem Health Assessment

To evaluate the health status of an ecosystem accurately and objectively, we must formulate corresponding standards according to the concept of ecosystem health, and derive various health states around this standard. An absolutely healthy ecosystem does not exist, but health is a relative state, which indicates the state in which the ecosystem is located. Chen Gao-Gao \[13\] thinks that the index selection of ecosystem health should follow the following principles: considering the comprehensive whole of ecosystem, the spatial scale is appropriate, the index selection is concise and standardized, and it should be easy to operate, so as to correctly reflect the health status of ecosystem and provide the current situation and changing trend of ecosystem; Reflect the quality and sustainability of ecosystem services provided by ecosystems to human society; And reflect the reasons of ecosystem change and provide basis and explanation for decision-making.

Schaeffer et al. \[14\] discussed the measurement of ecosystem health for the first time. Wang Xiaoyi et al. \[15\] think that the health of agro-ecosystem can be evaluated from the aspects of diagnosis of ecosystem maladjustment syndrome, evaluation of buffering capacity and sustainability of ecosystem, ecological risk assessment, etc. Ren Hai et al. \[11\] summarized the standard of ecosystem health, and thought that as an assessment of ecosystem health, the most important aspects were vitality, resilience, organization and maintenance of ecosystem service functions. In addition, Mark Ming Kong Hongmei \[7\] thinks that environmental quality monitoring from landscape scale is also an essential step. The macro-technical means, such as remote sensing, geographic information system and landscape ecology principle, are closely matched with ground research, and the functional process of landscape structure is understood through the change of landscape structure. The best way to evaluate ecosystem health is a comprehensive study combining micro and macro. The evaluation methods are mainly summarized as: principal component analysis \[16\], analytic hierarchy process \[17\], knowledge granularity method \[18\], indicator species evaluation method \[19\], artificial neural network method \[20,21\], healthy distance method \[22\], grey relational analysis method \[23\], index evaluation method \[24\], Cluster analysis method \[25\] and comprehensive index evaluation method \[26\], etc.

3. Forest Ecosystem Management
3.1. Concept of Forest Ecosystem Management

The core theory of traditional forest management theory, the idea of "Legalizing Forest", is the product of the combination of classical economics and forestry science, and it is the sustainable thought of forest management with wood as the main product. This theory has dominated the whole forest management activities in the past nearly 200 years, and its single management objectives and objects will inevitably lead to serious consequences such as unbalanced forest ecological structure and destroyed ecological functions. With the irrational management and destruction of forests, the threat to human living environment has gradually increased, and people have put forward ecosystem management and deepened their understanding of it. In the 1920s, American scholar Leopold proposed that land should be managed as a "complete organism", and his view has begun to take a reasonable core of forest ecosystem management. From 1935, ecologist A.G. Tansley put forward the concept of "ecosystem" in 1935 and it was widely adopted in the world until the 1970s. The term ecosystem management began to appear in the publications of some environmental organizations, however, In 1988, American scholars Agee and Johnson published the first monograph on ecosystem management and gave a clear definition of ecosystem management. Since then, American Forest Service(1992), FEMAT(1993), American Forestry Society(1993), American Eastern Forest Health Assessment Research Group(1993), American Forestry and Paper Association(1993), American Environmental Protection Agency(1995), ecological society of America(1996) and other organizations have given their own definitions, and Chinese scholars also Under the premise of fully understanding the integrity and complexity of the ecosystem, the management activities that are constantly adjusted according to the results of long-term monitoring of key ecological processes and important ecological factors are aimed at continuously obtaining the expected material products and ecological and social benefits.

The reason why there are so many definitions reflects the professional background and interest orientation of the definers to a certain extent, but it is not difficult to find something in common from these definitions. They all emphasize the integrity and sustainability of the ecosystem, emphasize that the ultimate purpose of ecosystem management is to serve human society, and emphasize the balance between human society and ecosystem.

3.2. Relationship between Forest Ecosystem Management and Traditional Forest Management

There are differences and connections between forest ecosystem management and traditional forest managers. Forest ecosystem management is born out of traditional forest managers, which is a kind of inheritance and development of traditional forest managers. Traditional forest managers mainly focus on timber production and aim at sustainable utilization of products and output. However, forest ecosystem management emphasizes maintaining the health and vitality of the whole ecosystem, paying attention to the effect at landscape level, and combining the overall stability of the ecosystem with the stability of economic and social systems in a specific and large area to form a reasonable ecological function zoning and planning. As shown in the following figure1.
4. Relationship between Forest Ecosystem Management and Forest Ecosystem Health

Forest Ecosystem Management and Forest Ecosystem Health are two concepts which are both different and related. First, their subjects are different. The subject of forest ecosystem management is the management of forest ecosystem by human society in order to meet its own needs, and forest ecosystem health is a state that emphasizes forest ecosystem itself. There is a close relationship between them. First, the health of forest ecosystem should be the goal of forest ecosystem management. The goal pursued by traditional forest managers is the sustainable utilization of forest products, which will inevitably lead to the degradation of forest ecosystem. The goal of forest ecosystem management to maintain the health and vitality of forest ecosystem is based on the overall operation and management of forest ecosystem, which is the inheritance and development of traditional forest managers. Secondly, the theory of forest ecosystem health provides theoretical basis for specific measures of forest ecosystem management. Only on the basis of comprehensive and systematic understanding and assessment of the health status of forest ecosystem can we better manage and manage the forest ecosystem and provide better services for human society. The feedback of real-time monitoring of forest ecosystem health status also provides basic data for the continuous adjustment of forest ecosystem management measures. Third, forest ecosystem management measures also provide necessary means to maintain the health of forest ecosystem. Forest ecosystem should not only provide sustainable services for human society, but also maintain its long-term health and vitality, which requires specific measures to manage and manage forest ecosystem, and only in this way can the sustainable development of forest ecosystem be achieved.

A healthy ecosystem must be stable and sustainable, that is, it has the ability to maintain its organizational structure, self-regulate and recover from stress in time. The sustainable management of forest requires maintaining the long-term health and continuous vitality of forest ecosystem, which can endure short-term pressure and adapt to long-term changes, and prevent ecological imbalance caused by interference (human and natural). Therefore, in order to realize sustainable forest management, the goal of forest management should be changed from the traditional priority of utilization to the emphasis on the health of forest ecosystem, and the forest resources should be managed and utilized within the carrying capacity of forest ecosystem, so that the health and vitality of forest ecosystem can be maintained for a long time and continuously, which is a necessary prerequisite for sustainable forest management to exert ecological, economic and social benefits continuously.

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