CHINESE GEOGRAPHICAL SCIENCE
Volume 1, Number 1, pp. 54—61, 1991
Science Press, Beijing, China

THE ECOLOGICAL FEATURES AND ECOLOGICAL CONSTRUCTIONS OF A MIRE IN CHINA

Huang Xichou (黄锡畴)

(Changchun Institute of Geography, Academia Sinica, Changchun 130021, PRC)

ABSTRACT: A mire as an ecosystem, usually is considered as an aquatic ecosystem,or a terrestrial ecosystem. The author thinks that mire is a special ecosystem between these two ecosystems, and proposes the new concept that a mire is a natural ecosystem with transitional nature of semi—water and semi—land formed by water and land interaction. The paper discusses the nature of the mire ecosystem, the exploitation and utilization and ecological construction of a mire.

KEY WORDS: mire ecosystem,nature of semi—water and semi— land, ecological constructions

In general, a mire is considered an area where there is permanent standing water or temporary standing water; the soil is generally saturated;it grows hydrophytes and mire vegetation. There is peat deposition or although no peat, there is a gley horizon. Some special animal communities and microorganisms dwell and breed in the area. A mire is the general term for this kind of natural ecosystem.

Because a mire is widely dispersed,it differs greatly in different regions and the causes of formation are varied. Different disciplines have different angles and methods of studying a mire. Also, different researchers usually focus on local mires and emphasize their respective features so that the definition of a mire takes on diverse characteristics and interdisciplinary aspects.

Among all the definitions of a mire, the best one can be derived from studying the hydrology, botany, peat geology and landscape. Actually, a mire ecosystem has its own internal characteristics which differentiate it from other natural ecosystems. Clarifying all those characteristics is conducive not only to establishing a mire theory, but also to clearing the way for mire exploitation, utilization, and ecological constructions.

I. A MIRE IS A SPECIAL ECOSYSTEM

A mire is neither a real water body, nor real land. It is a natural body which has a transitional nature between water and land. The author has pointed out that "the semi–water and semi–land ecological environment of a mire determines its special biological, physical and chemical functions and geographical distribution" [1] . Recently, the author proposed a new concept of "A mire which is formed by the interaction of water and land is a natural ecosystem with transitional characteristics of both water and land" (Fig.1).

1. Water and Land Interaction

The distribution of a mire ecosystem is widespread and unbalanced. Although the types of mires are varied,any kind of mire,in origin and formation,occurs and exists in the zone joined by water and land. Because of the interconnection of liquid–facies and solid–facies materials, a special transitional zone of neither water nor land emerges in the area of water–land interconnection. A mire is the special ecosystem which occurs and exists in this transitional zone. Its characteristics are interlocked and highly orderly.

In the macro view of the biosphere, the zone of water–land interaction and interlock exists in various forms, and thus various mire types areas. On a global scale, mires can occur and exist in the seashore belt or sections joined by sea and land. In river–mouth areas where rivers enter seas, it forms coastal salt marshes, reed–swamps,mangrove swamps, etc.

On the continent,every zone where water and land join together can form marshes, such as the palus of rivers, lakes and reservoirs. In the arid areas because of the discharge of underground water, marginal areas of alluvial and diluvial fans can form marshes. This is also a type of water–land interaction. In the blanket bog which developed in the mountains of Northwest Europe, because of the extreme Atlantic humid climate condition, moss vegetation absorbs atmospheric precipitation and other forms of water so that a special "water body" is formed. Long periods of vertical interaction between this kind of water body and the soils of the earth form a blanket bog. This is the other kind of water–land interaction.

In a connecting belt of water and lands frequent erosion and deposition create unstable features,thus giving ecosystem a fragile and unstable nature.

2. The Process of Mire Formation from Water and Land

A mire is formed comprehensively by various natural factors and has a variety of types. But as for mire formation processes on the earth, they can be summed up as terrification and paludification. Using the original characteristics of a water body, terrification can be divided into rivers and lakes, etc. Using the original characteristics of

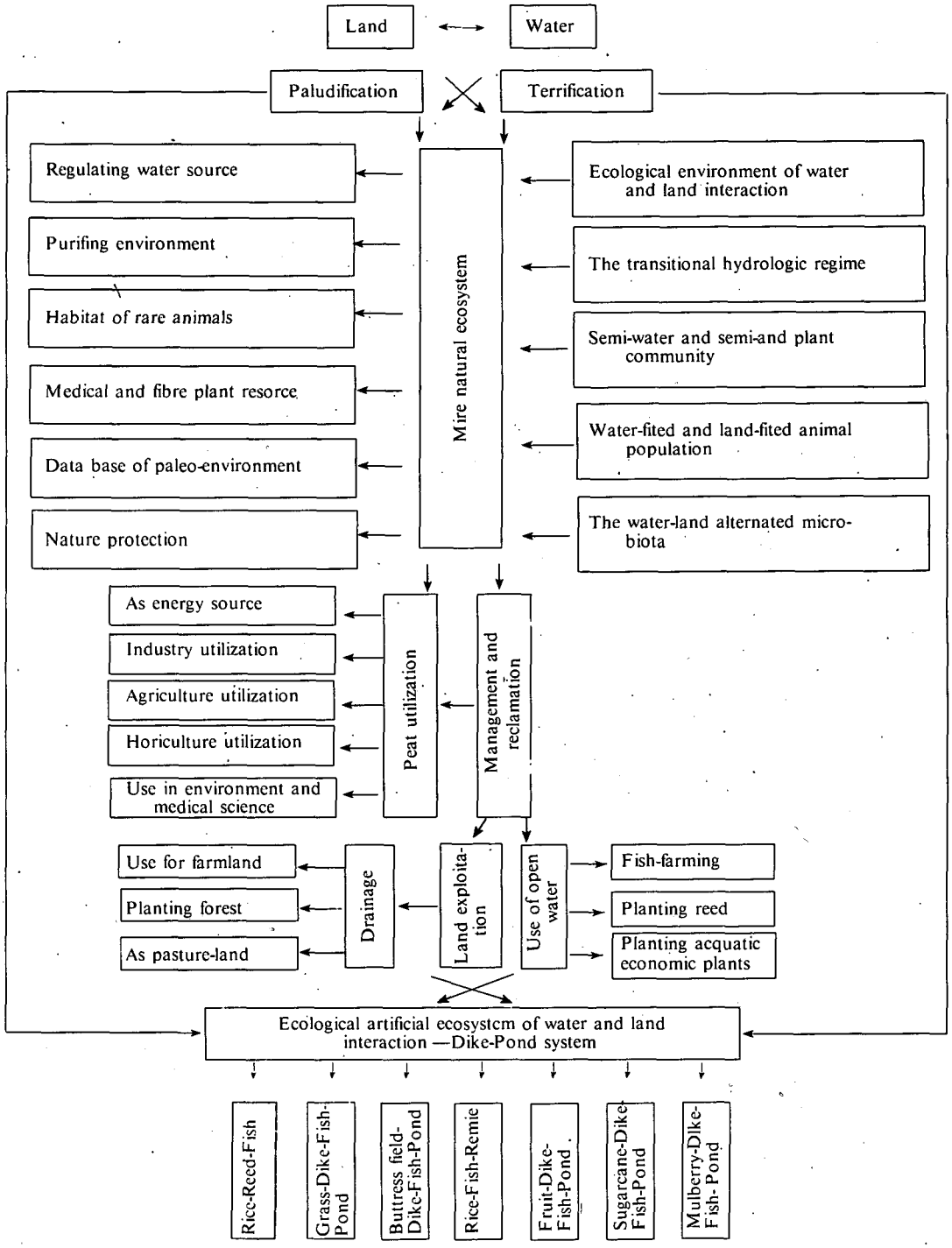

Fig. 1 The nature and function of a mire ecosystem

land,paludification can be divided into land and forests,etc. In general,a mire ecosystem can be derived either from a water body or from land. This interaction of water and land does not occur in any other kind of ecosystem.

3.Compatible Characteristics of Mire Distribution and Development

The same as forests, steppes,tundra and other biogeocoenosis, mires are a component part of the biosphere. A mire as a natural complex, its distribution is governed by the natural differentiation, so that the distribution conforms to the zonality and the overlap intrazonal law.

This accounts for the fact that a mire ecosystem has either the zonality feature of a terrestrial ecosystem such as a forest, steppe,tundra,etc., or the intrazonal feature of an aquatic ecosystem such as lakes. It abides by laws governing the distribution of both water and land.

Based on the law of natural differentiation and from the point of view of "time–space unity", the author points out and discusses the multi–pattern theory of mire development [1–5] . Because the origin and formation of a mire depends upon water–land interaction, the development of a mire cannot obey one fixed pattern. This demonstrates the multi–pattern theory of mire development.

II. THE TRANSITIONAL ECOLOGICAL ENVIRONMENT

An ecosystem is the system which is formed by the biocommunity of vegetation,animals,microorganisms,etc.,and the inorganic environment which biocommunity life depends on. A mire ecosystem demonstrates an obvious transitional nature between an inorganic and a biocommunity environment.

1. The Transitional Hydrologic Regime

Water is the decisive condition and environmental factor for mire formation. Water is also one of the most important characteristics of a mire ecosystem. There is standing water on the ground in a mire, but not very deep; the water is in a stagnant status or faint flow status. Although there is a great deal of water in a mire, it is not a real water body. The water mainly comes from atmospheric precipitation,fluvial or flood discharge and underground water. The change of the water's source of supply,such as the increase or decrease of surface runoff and the up and down nature of underground water levels,can cause the expansion and reduction of water in the mire, which causes a change in the succession of the mire and the biocommunity. The up and down action of sea level can cause the growth, decline and succession of coastal marshes. Mire water can be considered as the transitional type of surface water and underground water in these environments.

The pattern of water in a mire is different from other water bodies such as lakes and rivers. Except for a part of the water stagnant on the surface and forming the surface wat-

er,much water in a mire is stored in peat and herb root layers. Since the peat and herb root layers have tremendous capability to store water,the mire is called a huge "bio—reservior". Water is stored in the mire in the form of gravitational, capillary, film, seepage and combined water.

There is a special form for the movement of mire water which is different from other water bodies. Movement takes place in the form of runoff due to overland flows and subsurface flows. Evaporation and vegetative transpiration are the main ways that mire water expands.

The amount of mire evaporation is related to the mire type. High evaporative capacity and small runoff are important characteristics of mire water balance.

There is a series of special charateristics of mire water quality. They are rich in organic content and suspended matter. The intense biochemical action makes the water muddy and yellow—brown in color. Because of the high content of organic acid,iron and manganese,the surface of mire water is usually red in color. The mineralization and hardness of mire water is low;the pH value is between 3.5—7.5; between an acid and neutral reaction,more form weak acid reactions [2] .

The amount of most of the chemical elements in mire water is higher than in natural water,but lower than in underground water. Because of the accumulation of organic matter in a mire,soluble organic compounds and trace elements are also increasing. The migration coefficient of same kind of element is bigger in mire water than in surface water or underground water. In different types of mires,the hydrochemical characteristics are different. Trace elements are higher in low moor than in high bog. In low moor, both the water and peat have a high content of dispersing elements. In the mire water of the Sanjiang Plain, most of the elements are higher than in other natural water bodies. Meanwhile,the migration capabilities of most elements are strong. That causes the elements in organic matter not to be dissolved and released so that the circulation period of chemical elements in the mire is longer. In a word,the characteristics of mire water represent the transitional feature of surface water and underground water.

2. Accumulated Organic Soil

Generally, there are only deposits in rivers, lakes,seas and other water bodies, but no real soil. In a mire ecosystem, under ecological conditions of plentiful water, after mire plants die, their residues in the anaerobic environment decompose slowly or don't decompose at all, this causes an accumulation of organic matter. The swampy soil formed in this way is different from that of any other land ecological environment.

The process can be summarized as a paludification and gleyed process.The greatest characteristic of the process is the great quantity of organic matter accumulated. The organic matter content of gley mire soil is generally 10—20%, but the organic matter content of peat moor can be as high as 50—90%.

III.THE WATER–LAND ALTERNATION BIOCOMMUNITY

A mire biocommunity includes mire plants, animals, and microorganisms and its composition is complicated. The semi–water and semi–land ecologic environment cause the plant community and animal community to have obvious water–land alternations and transitions. The typical component is classified as "amphibious like" [6].

1. Semi–water and Semi–land Plant Community

The composition and structure of a mire plant community is varied and complicated. It is a complex community of different plants of various origins. Its variety and complexity are also due to the great range of ecologic conditions. The mire plant community includes trees, bushes, shrubs, perennial grass, bryophyte and lichen,etc. Thus plants form different types of mire vegetation. Mire vegetation is not only a main component part of the ecosystem,but also comprehensively reflects the ecologic environment and is an indicator of the ecosystem. Vegetation can be used as the basis for classifying mire types,such as forest mires, treeless mires and moss bogs. According to the nutritional status of mire vegetation,mires can be divided into oligotrophic, eutrophic and mesotrophic. All the above show the important significance of vegetation to a mire ecosystem.

Mire vegetation can be divided into three ecological groups: (1) the plant which only can be seen on the mire; (2) the plant which can grow both in the mire and in mineral soils of the same area; (3)the plant which can be seen in the mire in some regions,but in other regions, it can be seen both in the mire and in mineral soils. This indicates the alternative characteristic of the mire plant community. But emerged plants are the typical plant of a mire ecosystem,because they grow in shallow water or saturated soil. Their backbones sink in the water and their leaves stand above the water surface, exposed in the air they have features of terrestrial plants and aquatic plants and fit into semi–water and semi–land habitat. The emerged plants are also called"amphibious plants". In a word,mire plants have a series of ecological features: well developed aeration tissue; shallow roots; breed by way of unfixed roots.

2. Water–adaptable and Land–adaptable Animal Community

Mire animals are the most active and important component of mire ecosystems and sensitive to the ecological environment. The composition of mire animal community is varied and complicated animal community. In different types of mires, the zonal formation and composition of the animal community and ecological characteristics are greatly different.

The animal community of a mire includes mammals, birds, amphibians, reptiles, fish and invertebrate. Using the ecologic habit,it can be divided into five groups, i.e.: the animals feed and breed in the mire; the animals generally feed in the mire except in breeding

season; the animls feed and breed either in the mire or in other ecosystems,but prefer to live in non–mire ecosystems; the animals stay shortly in the mire in the migration season [6].

After the study in Zoigê Plateau, a mire animal community can be divided into three ecological types,i.e.: the settled type;the semi–settled type and the invaded type. Amphibious animals and wading birds adapt to semi–water and semi–land mire ecosystem over a long period of time. They have the ecological features of a long beak,long legs and a long neck.

IV. MANAGEMENT, UTILIZATION AND ECOLOGICAL CONSTRUCTIONS

At present, the problems of food, population and the environment are more and more serious in the world. Because mire ecosystems contain plenty of natural resources such as water, living things, peat and land,they present a great productive potential. For this reason the value of mires are paid more and more attention to.

1. Multi–Way Reclamation and Utilization

The types and the complexities of mire ecosystems determine the various ways in which mires can be reclaimed and utilized. Obviously,in different types of mires,the goals and ways of development and utilization are different. So the manner of development and utilization should be based on the mire type and utilization goal.

After drainage, mires can be transformed into farmland, forest stands and pastures. The peat in mires can be excavated as fuel, fertilizer or raw materials and used in industries and agriculture. The swamp can be used for fishing, planting reeds and economic acquatic plants.

In the Sanjiang Plain Region,large areas of mire have been reclaimed as farmland. The Great Northern Wilderness has become the Great Northern Barn and is now one of the main commodity grain bases. Because of the lack of comprehensive understanding of a mire,the expansive drainage caused an exploitation. In addition, because of exploitation and construction,the cultivated mire in dry years became flooded again. It not only wasted the material resources and manpower,but also lowered the economic benefit,and even made the ecological environment worse.

2. Ecological Constructions

Many marshes and wetlands in the "region of lakes and swamps" in southern China have been transformed into "regions of fish and rice". Good productive economic and ecologic benefits have been realized. For example,based on an environment of water and land,productive areas of "mulberry–dike–fish–ponds" and "sugarcane–dike–fish–ponds" were created in the Zhujiang Delta. That is a successful example of the rec-

lamation of marshes and wetlands.

Based on the mulberry–dike–fish–ponds and sugarcane–dike–fish–ponds, Prof.Zhong Gongpu advances a new concept called the "dike–pond system". This system is a special artificial water and land ecosystem which combines terrace system characteristics with those of a water system. This system which fully utilizes resources is a three–dimensional cultivating and raising environment, containing water and terrance areas. It has good economic, ecologic and social benefits [7].

The principles and practices of a "dike–pond system" have already been applied to the construction of swamps and wetlands in many areas of China. For example,there are "dike–pond systems" in various forms in the Zhujiang River Delta, Taihu basin,Dongtinghu basin, Jianghan Plain and Lixia River basin, etc.

Recently, there have been some productive variations created, such as rice–reed–fish and rice–fish–marten systems. Experiments show that these forms are the correct way to utilize a wetland. Thus, not only can marsh areas be developed but also their original eco–balance can be recovered.Of course,the social,economic and environmental benefits are also clear.

Generally,the dike–pond system is a new ecosystem created by humans and nature based on the principle of an applied ecosystem. We think that a natural ecosystem of semi–water and semi–land,formed by interaction of water and land, can be constructed into an artificial ecosystem under similar conditions e.g. the dike–pond system.It conforms to ecological and economic principles. At the same time,it is a correct method of constructing a good mire environment.

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