PEAT AND PEATLANDS

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Contents

Summary

Due to differences between fields of study and uses, there is no universal definition of peat and peatland. The content of organic matter in peat and the degree of decomposition of organic debris are the major indexes when defining peat, whereas depth of peat layer is

considered as a fundamental basis for peatland definition. Peat distribution has particular characteristics including unbalanced distribution between the southern and northern hemispheres, the latter containing more than 90% of the total area of world mires.

The basic factors controlling peat formation and development are water and temperature (which depend upon climatic conditions), geological, geomorphological, and hydrological factors. Combined conditions of climatic factors control the decomposition and transformation of plant debris, and hence influence the accumulation rate of peat. Geological and geomorphological factors control the spatial locations of peat formation and development.

Experts have advanced many kinds of classification systems for peat and peatland from the perspectives of their own studies, such as the peat classification system of L. von Post, and the peatland classification system of C. A. Weber.

The environment in which peat accumulates controls its primary composition. Organic matter is the most important constituent. Peat is a semi-colloid and macromolecule system, with unique physical and chemical properties, such as a high CEC, high water holding capacity, large specific area, low bulk density, etc. The compositions and the unique properties of peat determine the main uses, which include utilization as an energy source, a growing medium, a raw material for industry, and uses in environmental protection, balneology, etc.

Peatlands are extremely important from the point of view of biodiversity conservation, as they support very large numbers of plant and animal species, some of them being confined to this habitat. Peatlands are also of great scientific importance for their record of paleo-environmental information. Buried peat layers are able to provide a great deal of information about previous climates and vegetation. Peatlands are also extremely important as carbon sinks, and have great significance in terms of global climate change. For these reasons, there has been much research on environmental impacts of peatland exploitation, destruction and regeneration.

1. Concepts of Peat and Peatland

Due to the differences in uses and research fields, and isolation in the past between different groups of specialists, there have been various definitions of peat and peatland. To date there is still no complete agreement on such definitions and this has made the compilation of reliable statistics more difficult.

1.1. Peat

Peat consists of organic matter (organic debris and humus), mineral matter, and water. For all the definitions of peat, the divergences lie primarily in two aspects. Firstly there is the minimum content of organic matter in relation to total weight of dry matter. Secondly there is the decomposition degree of the organic debris. Some scholars consider the content of organic matter in peat must be higher than 50%, while some say 30%, and others favor a figure as low as 20%. Most experts think the minimum content of organic matter in peat should be 30%, because incorporation of external matter, such as clay, sand

and the eruptive matter of volcanoes, may reduce the percentage during the peat formation process. The extent of decomposition of organic debris in peat ranges from a barely decomposed layer of spongy deadwood and leaves, to lignite, which contains no recognizable plant material. So peat formation and maturation is commonly thought of as the primary process in the development of lignite.

1.2. Peatland

Peatland is the term given to an area in which peat has accumulated. If peat continues to develop and accumulate, the area is called live peatland or peat bog. If the peatland has been covered by mud or sand, the deposit is known as buried peat. If the peatland has been drained, so that development of peat has ceased, the peatland is called dead peatland. So there are two kinds of peatland: live peatland (peat bog) and dead peatland (drained or buried peatland).

The depth of a peat layer is often taken as a fundamental criterion in defining peatland. The necessary minimum depths of peat layer has differed between various workers and fields of study and utilization. C. A. Weber (a German peat scientist) considers that peatland must have at least a 20 cm peat layer after draining. E. Granlund (Sweden) considers 40 cm is the minimum depth for peatland under natural conditions. At the Second Congress on Peat Resources in the former Soviet Union, the minimum depths were set 30 cm for a peat layer under natural condition and 20 cm for a peat layer under drained conditions. The United Kingdom sets the minimum depths at 15 cm in forests, but elsewhere it was set at 60 cm. Denmark ruled that peatland must have a 33 cm peat layer under natural conditions, while Australia states that peatland must have a minimum depth of 50 cm. If peat is exploited as a fuel or a raw material, there are more detailed terms for the depth of peat layer, its structure, and its reserve.

1.3. Terms on Peat and Peatland

A variety of different terms are used for peat and peatland in different countries. Peat terms include peat in UK, turf in Ireland, *torf* in Germany, *torn* in Sweden, *turban* in Italy and Spain, *torf* in Poland, and *veen* in the Netherlands. In addition to these, there are many local terms. Peatland terms also have several synonyms, such as peatland, moorland and blanket bog in UK, turf bog in Ireland, *torfmoor* in Germany, etc. The word peatland is generally used to describe a type of mire with a minimum depth of peat and organic matter content, and the terms moss, bog and fen, are types of peatland.

2. Reserves and Distribution of Global Peat

2.1 Global Peat Reserves

Due to variable depths of study of peat resources and peatland, different degrees of utilization, and the unreliable quality of some of the statistics, the global peatlands areas reported by different countries or experts tend to be different. In 1996, Lappalainen (a peat scientist from Finland) organized 68 peat experts to collaborate in the production of *Global Peat Resources*. In this monograph, they concluded that the global peatland area is about 3 985 000 km^2, a figure which is believed to be fairly accurate. The average thickness of the world peatlands has been estimated to be 1.3 to 1.4 m. The total volume of the global peat resource is therefore in the range from 5000 to 6000 billion m^3.

2.2 Distribution of Global Peat

As can be seen from Figure 1, the distribution of mires shows a certain pattern.

Firstly the distribution of the world's mires is very unbalanced. They are mainly distributed in North America, Asia and Europe, these continents comprising more than 90% of the total area of global peatlands. Africa, South America, Australia and Oceania hold less than 5%.

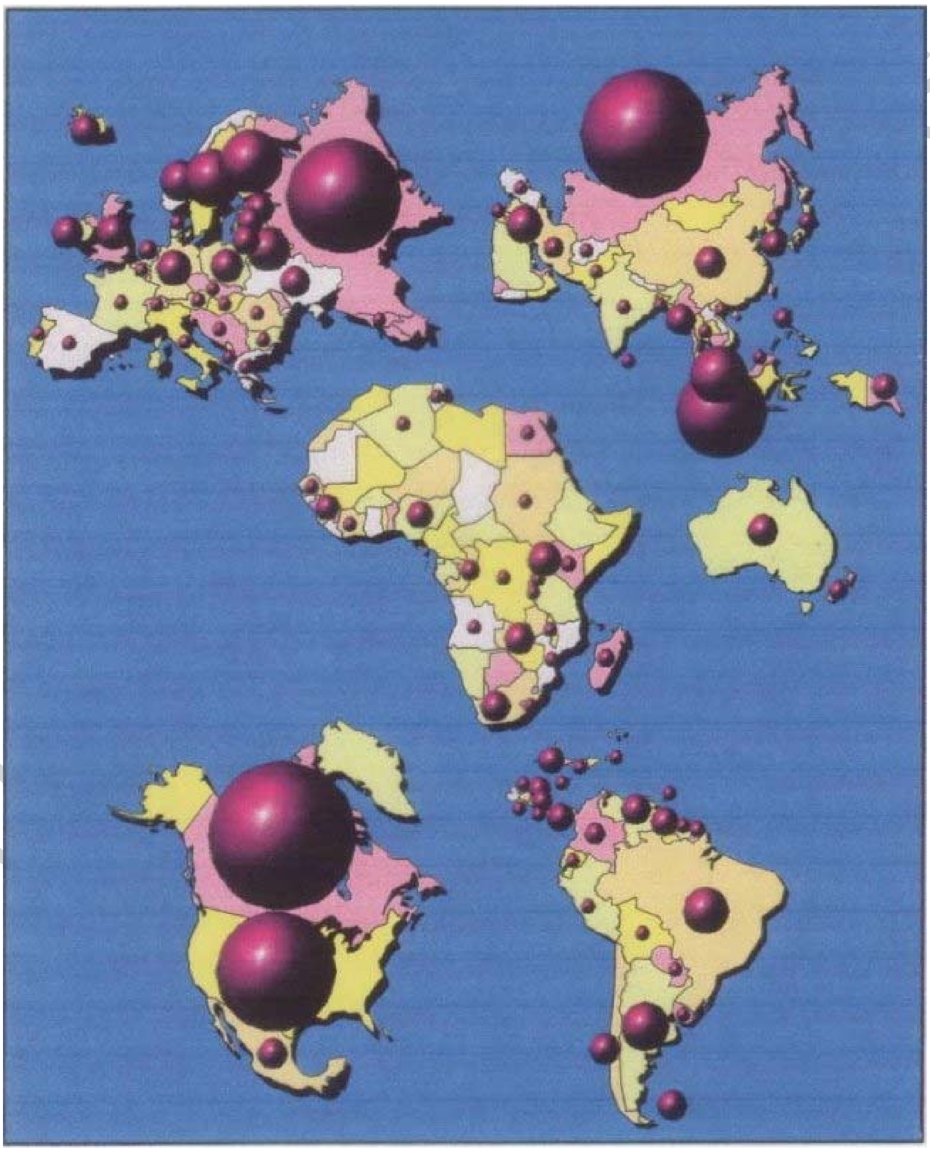

Figure 1. Distribution of the world's peatlands

Secondly there is a clear zonality to the distribution of the world's mires (see *The Global Distribution of Peat*). They are mainly distributed in two zones: between 45^{o}N and 75^{o}N, and round the equator (in the tropical rainforest zone). In the northern hemisphere peatlands predominantly occupy regions that are cool and wet. To the north, their extent and growth is limited by depth and duration of snow and ice cover, and to the south they are limited by high summer temperatures and long seasons with little rainfall. The zonality of distribution of mires in the southern hemisphere is not as obvious as that in the northern hemisphere because the land area is very much smaller and mountain ranges aligned north-south break up the zonality which would otherwise by primarily east-west.

Thirdly there is some regularity in the distribution of mires along the meridians, or, to be more precise, a concentration in regions bordering the Pacific and Atlantic oceans. This is partly attributable to the higher humidity and smaller range of variation of temperature in regions with an oceanic climate. Around the Pacific, in Asia and North America, many coastal areas have developed deep oligotrophic mires. Mountains near the coasts prevent moisture-laden sea winds progressing inland. In western Europe, however, the development of mires is rather different. With relatively few mountains oriented north–south, the humid west winds can extend eastwards as far as the Yenisei River. So, deep oligotrophic mires are distributed all over central and northern Europe. The rain bearing winds on the east coast of North America do not extend far into the interior, and the distribution of mires is not as wide as it is in western Europe, but it is still wider than that on the western side of North America.

Finally there are marked differences in the coverage, or density, of peatlands in the different continents. The cover is highest in North America, where peatland lies mainly between 47^{o}N and 70^{o}N. Mires in Europe are mainly distributed in the north and north-west, and are most prevalent between 57^{o}N and 72^{o}N. Mires in Asia are mainly distributed in western Siberia, on the eastern coastal areas and islands, and the archipelagoes in Southeast Asia, such as those of Indonesia, the Malay Peninsula, Kalimantan, etc. Mires in South America are mainly distribute in the middle and lower reaches of the Amazon River, and the southern coastland of Chile. Mires in Africa are sporadically distributed in some areas, but they are very small due to the mostly hot dry climate.

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Bibliography

Asplund D. (1996). Energy use of peat. In *Global Peat Resources* (ed. E. Lappalainen). Jyskä, Finland: International Peat Society. pp. 319–25. [This paper deals with energy production with fuel peat and the combustion and power plant technologies.].

Chai Xiu (1990). *Peat Geography* (in Chinese), pp. 1–2, and pp. 22–27, and pp. 136–154. Beijing: Scientific Press. [This work deals with peat characteristics, physical and chemical properties of peat, peat-forming conditions, and peat distribution.]

Dai Guoliang and Ma Xuehui, trans. (1989). *Basic Characteristics and Measuring Methods of Peat* (in Chinese; the original version is in Russian), 48-84. Beijing: Scientific Press. [This work deals with the modern concepts on the properties, compositions and structure of peat, and classification methods.]

Gore A. J. P. (1983). *Mires: Swamp, Bog, Fen, and Moor—Regional Studies*. Amsterdam: Elsevier Scientific.

Kari Mutka (1996). Environmental use of peat. In *Global Peat Resources* (ed. E. Lappalainen). Jyskä, Finland: International Peat Society. pp. 335–338. [This paper discusses the role played by peat in environmental protection and other applications.]

Lappalainen E. (1996.) *Global Peat Resources*. Jyskä, Finland: International Peat Society. Appendix 4. [This work provides extensive data concerning peatland areas and peat resources, and their use in the world.]

Lishtvan I. I. (1996). *Chemical and Thermal Processing of Peat*. *Global Peat Resources* (ed. E. Lappalainen). Jyskä, Finland: International Peat Society. pp. 347–354. [This paper discusses the principal trends in peat utilization, and chemical and thermal processing of peat.]

Ma Xuehui and Liu Huanguang (1991). *China's Mire* (in Chinese), pp.14-33. Beijing: Scientific Press. [This work provides the forming conditions, distribution, exploitation, and utilization of mires in China.]

Riita Korhonen (1996). Peat in balneology and health care. In *Global Peat Resources* (ed. E. Lappalainen). Jyskä, Finland: International Peat Society. pp. 347–54.

Sakakuchi (1983). *Peatland Geography—Research on Environmental Changes* (in Chinese; the original version is in Japanese; Liu Zheming et al. trans,) pp. 1-16. Beijing: Scientific Press. [This work provides the concepts of peat and peatland, peat characteristics, peat distribution and peat utilization in the world; it also deals with the relations between peat formation, and the natural environment.]

Schmilewski Gerald K. (1996). Horticultural use of peat. In *Global Peat Resources* (ed. E. Lappalainen). Jyskä, Finland: International Peat Society. pp. 327–334. [This work deals with the reasons why peat is used as a growing medium, the main users of peat in horticulture in the world, and applications in horticulture.]

Timo Nyrönen (1996). Peat production. In *Global Peat Resources* (ed. E. Lappalainen). Jyskä, Finland: International Peat Society. pp. 315–318.

XiaYumei, Wang Peifang, Li Qusheng, and Jiang Guiwen (1993). The preliminary study of climate change of the warm period of the Holocene in the northeast of China. *Research on the Past Life-Supporting Environment Change of China* (in Chinese), pp. 296-315. Beijing: Ocean Press. [This paper establishes the climate change sequence of the warm period of the Holocene in the northeast of China by spore-pollen analysis and dating (to the fourteenth century) of three peat profiles.]

Biographical Sketches

Professor Ma Xuehui was born in 1938. In 1960, she obtained her Bachelor's Degree in geography at Northeast Normal University. In the 1960s, she undertook research on mires and peat. During this period, she took part in investigations, experimentation, and research on mires (peats) in the Sanjiang Plain, the Zoige Plateau, the Xin'anlin Mountains, the Changbaishan Mountains, Xinjiang Province, and other southern provinces in China. In the 1970s, she took part in wilderness resource investigation in the Sanjiang Plain of China. In the 1980s, she undertook key projects in national science and technology. She took part in natural resource investigation and comprehensive exploiting, and experimental research in the Sanjiang Plain. In recent years, she has undertaken research on carbon cycling, micro gas emission, and influencing factors in the peatlands of the Sanjiang Plain. She has published 60 scientific papers on peat and wetlands in Chinese, as well as international journals. She co-edited several books in Chinese, such as *Mires in China*, and *Mires in the Zoige Plateau*, etc. In 1992, she was appointed Associate Professor, then Professor by the Changchun Institute of Geography, Chinese Academy of Sciences. She is a member of the Chinese Coal Society and the Jilin Peat Society, and managing director of the Editorial Research Society of the *Natural Scientific Journal* of the Chinese Academy of Science.

Dr. Hu Jinming was born in 1973. He obtained his Bachelor's degree in Geography in 1995 at Anhui Normal University, Wuhu City, China, and his Master's degree in Physical Geography in 1998, at Changchun Institute of Geography. He is now studying in the Department of Urban and Environmental

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