# AN OUTLINE OF THE WETLAND REGIONS OF CANADA

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## ABSTRACT

*Sixteen wetland regions were identified on the basis of wetland development throughout Canada. Wetland districts were identified in some regions, according to distribution and relative abundance of certain kinds of wetlands. A map of wetland distribution in Canada was compiled. This report is based largely on the work of the National Wetlands Working Group, and was prepared as a part of a comprehensive report on the wetlands of Canada.*

## RÉSUMÉ

*Au Canada, seize régions de terres mouillées ont été identifiées d'après l'extension des terres mouillées. Dans certaines de ces régions, des districts ont été délimités selon la répartition et l'abondance relative de certains types de terres mouillées. Une carte de la répartition a été établie. Ce rapport est fondé en grande partie sur les travaux du groupe de travail national sur les terres mouillées et fait partie d'un rapport détaillé et complet sur les terres mouillées du Canada.*

## INTRODUCTION

The National Wetlands Working Group began assembling a comprehensive report on the wetlands of Canada. As a first step in this direction, the wetland regions were to be determined and characterized. Such regions, based on ecological principles, would serve as a framework for the more detailed discussion of Canada's wetlands.

In previous attempts (Zoltai et al 1973, Zoltai and Tarnocai 1976, Zoltai 1976) the concept of wetland regions was presented, but not elaborated. When the initial map was examined by the Wetlands Working Group, the number, character and boundaries of the various wetland regions were found to be inadequate. This has been corrected by a series of draft maps and descriptions. The comments by the Wetlands Working Group led to new ideas, namely the recognition of wetland districts, and the representation of wetland distribution. The present paper is an integration of the information provided by the Wetlands Working Group into a cohesive report.

## DISTRIBUTION

Wetlands, as used in this paper, are defined as areas where wet soils are prevalent, having a water table near or above the mineral soil (Zoltai et al 1973) for the most part of the thawed season, supporting a hydrophylic vegetation. Wetlands include peatlands formed by the accumulation of remains of hydrophylic vegetation. They also include areas that are influenced by excess water, but where, for climatic, edaphic, or biotic reasons, peat is not produced or preserved. Shallow open water, generally less than 2 m deep, dominated by emergent vegetation is also included. This type of wetland is especially important in semi-arid areas where the depressions, called potholes or sloughs, may fill up with water in the spring, but are usually partially dry by the end of summer. The definition does not include areas that may become temporarily flooded, but remain relatively well drained for most of the growing season.

The extent or distribution of wetlands in Canada was not determined with any degree of precision. Various estimates are available of the area of peatlands; these vary from a low of $5.9 \times 10^6$ ha (Coupal 1972) to a maximum of $130 \times 10^6$ ha (Radforth 1961). Other estimates are $9.6 \times 10^6$ ha of peatlands (Tibbetts 1968) and $121 \times 10^6$ ha of organic soils capable of being cultivated (Leahey 1961). The wide ranges of these estimates reflect the different criteria used to obtain them and show a lack of general basic information.

For the present study, data were collected from different sources, such as published reports (Ketcheson and Jeglum 1972, Korpijaakko 1975), maps of Canada Soil Survey and Canada Land Inventory in the developed areas and surficial deposit maps of the Geological Survey of Canada in the north. This information covered about half of Canada south of the arctic regions. For the rest of Canada, estimates were obtained from knowledgeable resource managers. The resulting map (Figure 1) is still only an estimate, although it is probably more accurate than previous estimates. On this basis, the total area of wetlands in Canada is about 170 x $10^6$ ha, or 18% of Canada's land surface. Peatlands are the most common wetlands. It is estimated that about 90% of the wetlands are covered by peat over 50 cm in thickness.

## WETLAND REGIONS

Regional differences in the development of wetlands are readily apparent in Canada. Some of these differences relate to the development of certain kinds of wetlands, while others relate to the distribution or abundance of wetlands. Although distribution is often influenced by physiography, the developmental trends and the establishment of specific kinds of wetlands can be attributed to climate-related regionalization.

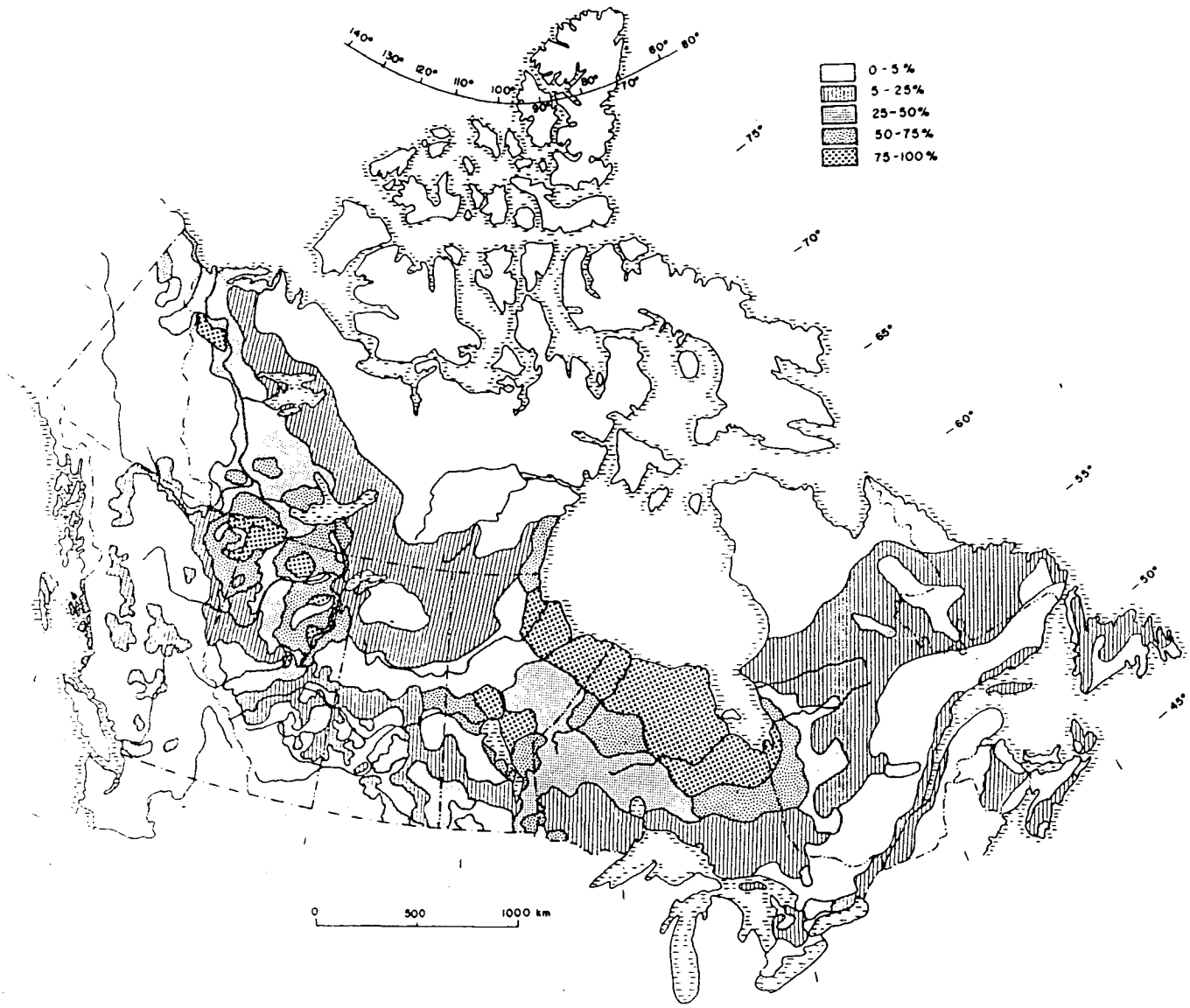


Figure 1. Classification of wetlands in Canada, Expressed as Percent (%) of Total Land Surface

Wetlands are dynamic ecosystems where an interaction of the biotic and abiotic environment produces specific physical and biological conditions. Various factors, such as water quantity and quality, peat formation, vegetation, organisms, etc., are continually interacting and reacting to changes brought about by other factors. These interactions take place through time under climatic conditions that may change, emphasizing the dynamic nature of wetlands, where different wetlands develop under different conditions. If the developing wetland is in equilibrium with its environment as modified by the wetland itself, very few changes will occur. On the other hand, if the developing wetland alters its own environment, or if the environment changes because of external natural or artificial causes, certain changes will take place in the development of the wetland. It follows that surface conditions reflect the present status which is but a slice in time of what may be a steady state or a transitional period. An understanding of wetland dynamics is therefore essential in a rational study and classification of wetlands.

Regional studies in Europe and Asia showed that broad geographic regions have characteristic wetlands. In Europe, nine zones were identified (Bellamy 1972), three in Finland, with several subzones (Ruuhijärvi 1970), ten in the USSR (Matveev et al 1968), with seven in West Siberia (Neishtadt 1977). In Canada similar regionalization of wetland development was observed, generally along a north-south temperature gradient and an east-west precipitation gradient. Sixteen regions were recognized, divided among six zones (Figure 2).

The wetland regions are based on the developmental trends of wetlands within the regions. Abundance is not a determining factor, although it may be one of the characteristics of the region. Subdivisions of the regions may be necessary if a part of the region is somewhat different from the other parts of the region, but the differences are not great enough to recognize it as a different region. Such wetland districts resemble the wetland regions, but are different in the distribution of peatlands, or in the relative abundance of various wetlands. A few wetland districts are identified on the map (Figure 2).

Broad vegetation regions, based mainly on dryland vegetation, resemble the wetland regions in a general sense. This prompted Stanek (1977) to delineate the muskeg regions of Canada on the basis of major forest regions. In general, however, the vegetation of wetlands resembles the upland vegetation of more northerly regions. Thus the hardwood swamps of the Eastern Temperate Wetland Region, dominated by maple (*Acer*), resemble the upland vegetation in the Low Boreal Wetland Region. The closed-canopy spruce (*Picea*) forests growing on bogs in the Low Boreal Wetland Region resemble the upland vegetation in the High Boreal Wetland Region. The open spruce-lichen woodlands characteristic of perennially frozen peatlands in the High Boreal Wetland Region appear in the uplands of the High Subarctic Wetland Region. This phenomenon may be explained by the observation that most wetlands occur in depressions that tend to be cooler than the nearby uplands. Furthermore, the soils are waterlogged, and much of the available heat is used to evaporate the water, rather than warming the soil (Williams 1968).

A brief characterization of the wetland regions of Canada follows.

HIGH ARCTIC Wetland Region ($A_H$ on Figure 2)

The characteristic wetlands are basin fens and seepage fens. The climate is cold, with cold, short summers and very cold winters. The precipitation is very low (Table 1).

Peat development is minimal, the common maximum thickness is about 50 cm. In some areas cryoturbation is sufficiently intense to prevent the establishment of plants, resulting in nearly barren, frost-patterned ground, without any peat development.

Permafrost underlies all wetlands. The maximum development of the thawed active layer is less than 40 cm.

MID-ARCTIC Wetland Region ($A_M$ on Figure 2)

The characteristic wetlands are flat fens and basin fens with small, elevated peat mounds. Low-center polygons occur locally, but high-center lowland polygons are rare. The climate is cold and arid (Table 1).

Permafrost underlies all wetlands. The active layer on the peat mounds under the better-drained peat is about 30 cm, and on the wet fens it is about 40 cm. The thickness of peat is less than 150 cm on the peat mounds, and usually less than 50 cm on the fens.

LOW ARCTIC Wetland Region ($A_L$ on Figure 2)

The characteristic wetlands are lowland polygons, both the low-center and high-center varieties (Zoltai and Tarnocai 1975). The large expanses of tundra, covered with tussock-

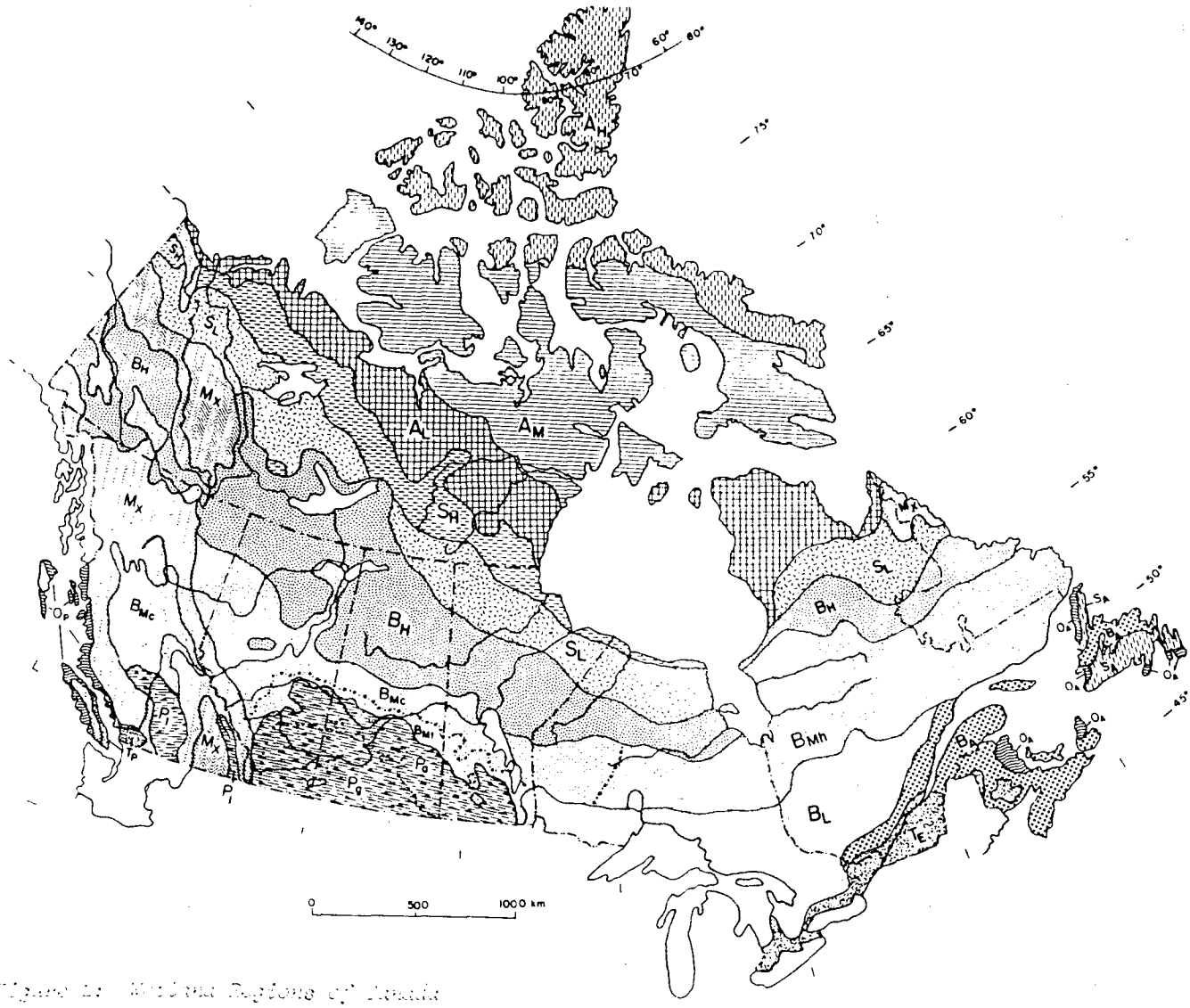


Figure 2: Wetland Regions of Canada

$A_H$ - High Arctic; $A_M$ - Mid-Arctic; $A_L$ - Low Arctic; $S_H$ - High Subarctic; $S_L$ - Low Subarctic; $S_A$ - Atlantic Subarctic; $B_H$ - High Boreal; $B_M$ - Mid-Boreal; $B_A$ - Atlantic Boreal; $B_L$ - Low Boreal; P - Prairies; $P_I$ - Intermountain Prairies; $T_E$ - Eastern Temperate; $T_P$ - Pacific Temperate; $O_A$ - Atlantic Oceanic; $O_P$ - Pacific Oceanic; $M_X$ - Mountain Complex. Wetland Districts are identified by lower-case subscript (see text). District boundaries are shown by heavily dotted lines.

forming graminoid species such as *Eriophorum vaginatum* and *Carex bigelowii* are not considered to be wetlands, as they are not waterlogged throughout the year. This view is in agreement with the definition of tundra bogs in Siberia (Boch 1974). Other wetlands, such as floodplain and delta fens, and tidal marshes may occur in hydrologically suitable areas. The climate is characterized by cool summers and low precipitation (Table 1).

Permafrost underlies all wetlands. The active layer on the wet fens may reach 80 cm, but is usually only 40 cm on the better-drained high-center polygons. The common maximum thickness of peat on high-center polygons is about 2 m, but only about 50 cm on the polygonal fens.

HIGH SUBARCTIC Wetland Region ($S_H$ on Figure 2)

The characteristic wetlands are polygonal peat plateaus with local basin fens and shore fens. In the area along Hudson Bay, which has

*Table 1: Average Temperature and Precipitation Ranges in the Wetland Regions of Canada*[1]

| Wetland Region | Mean daily January temp. (°C) | Mean daily July temp. (°C) | Mean annual total precip. (cm) | Mean depth of snow, Feb. 28 (cm) |
|---|---|---|---|---|
| $A_H$ | -30 - -40 | 3 - 6 | 8 - 20 | 15 - 45 |
| $A_M$ | -30 - -35 | 4 - 10 | 10 - 20 | 20 - 50 |
| $A_L$ | -28 - -32 | 10 - 13 | 20 - 25 | 40 - 50 |
| $S_H$ | -26 - -30 | 10 - 16 | 25 - 35 | 40 - 50 |
| $S_L$ | -23 - -30 | 14 - 17 | 30 - 50 | 50 - 60 |
| $S_A$ | - 7 - -12 | 13 - 16 | 100 - 105 | 20 - 50 |
| $B_H$ | -18 - -23 | 14 - 18 | 30 - 80 | 45 - 65 |
| $B_{Mh}$ | -18 - -23 | 13 - 18 | 65 - 100 | 50 - 100 |
| $B_{Mc}$ | -15 - -23 | 16 - 18 | 40 - 65 | 30 - 50 |
| $B_L$ | - 7 - -18 | 18 - 21 | 60 - 105 | 40 - 100 |
| $B_A$ | 0 - -18 | 16 - 18 | 90 - 130 | 40 - 75 |
| $T_E$ | - 4 - - 7 | 20 - 22 | 80 - 100 | 0 - 30 |
| $T_P$ | 2 - - 1 | 18 - 19 | 100 - 150 | 0 |
| $O_A$ | - 8 - -10 | 10 - 13 | 100 - 130 | 20 - 50 |
| $O_P$ | 4 - - 1 | 13 - 16 | 230 - 255 | 0 |
| $P_a$ | -12 - -18 | 17 - 20 | 30 - 45 | 15 - 30 |
| $P_g$ | -12 - -18 | 18 - 20 | 30 - 40 | 10 - 20 |
| $P_I$ | - 4 - - 8 | 18 - 20 | 40 - 50 | 30 |

[1] Source: Anon. 1962. The climate of Canada. In: The Canada Year Book, 1959-1960, Dom. Bur. Statistics.

Anon. 1973. The National Atlas of Canada, Dep. Energy, Mines, Res., Surv. Mapping Br.

recently emerged from the Bay, polygon development is lacking. In the fens, small, incipient palsas are a common and conspicuous feature in this part of the region. Here, in the coastal zone, extensive fens are found dominated by *Carex*. In hydrologically suitable areas delta fens and floodplain fens develop. Tidal marshes occur along Hudson Bay, generally below the lowest relict beach. The climate is characterized by cool summers and low precipitation (Table 1).

Permafrost underlies all wetlands, except some shore fens located within a few metres of a lake. The active layer on the fens may be as much as 1 m thick, but only about 40 cm on the polygonal peat plateaus. The common maximum peat thickness is about 3 m.

LOW SUBARCTIC Wetland Region ($S_L$ on Figure 2)

The common wetlands are peat plateaus, and patterned (ribbed, or strings) and flat fens. Palsas are frequent in the areas generally east of Nelson River in Manitoba, but are far more restricted farther west. The climate is charac-

terized by cold winters, but moderately cool summers. The precipitation is low in the west, but considerably higher east of Nelson River (Table 1).

Permafrost occurs only under peat plateaus and palsas, but not under fens. The active layer is about 60 cm at its maximum development. The common maximum thickness of peat is about 4 m.

ATLANTIC SUBARCTIC Wetland Region ($S_A$ on Fig. 2)

Characteristic of this region are slope bogs, small basin bogs, and/or exposed elevations patterned for veneer. Extensive complexes of slope bog and slope fen occur on mountain slopes. The climate is characterized by cool winters and summers, and by high precipitation (Table 1). Frequent windstorms result in reduced snow cover in winter.

The common maximum thickness of peat in bogs is 2-3 m. In patterned fen veneers, the peat thickness varies from a few centimetres to 2 m. Permafrost is absent.

HIGH BOREAL Wetland Region ($B_H$ on Figure 2)

The characteristic wetlands are ribbed and netted fens, small, wooded peat plateaus and palsas with collapse scars, and flat bogs and fens. In suitable areas shore fens, delta fens, and floodplain fens may develop. Tidal marshes occur near Hudson Bay. The climate is characterized by cold winters and moderately cool summers. Precipitation is low in the west, but increases in the eastern part of the region (Table 1).

Permafrost occurs only in the peat plateaus and palsas. While the permafrost is thin (commonly 2-3 m) in the southern fringe of the region, its thickness commonly exceeds 3 m elsewhere. The active layer is about 1 m thick. The common maximum thickness of the peat is about 5 m.

MID-BOREAL Wetland Region ($B_M$ on Figure 2)

The characteristic wetlands are treed bogs and fens in broad flats and in confined basins. Raised bogs are common in the humid east, but not in the subhumid west. Floating fens and thicket swamps may border lakes and ponds. Sufficient regional differences are apparent to recognize several wetland districts. The climate varies from cold winters and warm summers in the west to mild winters and cool summers in the east. Precipitation is high in the east near the ocean, gradually decreasing to the west (Table 1). Permafrost is absent.

Humid Mid-Boreal Wetland District ($B_{Mh}$ on Figure 2)

Domed, flat and basin bogs are common, but fens are relatively scarce, except along ponds where marshes may also occur. Thicket swamps and spruce swamps may be locally common. Common peat depth on the bogs and fens is about 6 m.

Continental Mid-Boreal Wetland District ($B_{Mc}$ on Figure 2)

Flat bogs and basin bogs and fens are common, often associated with fens. Occasionally, somewhat elevated, flat-topped bog plateaus occur in larger fens, often separated by patterned fens. Locally, marshes can be found along lakeshores. The common maximum peat thickness is about 5 m.

Transitional Mid-Boreal Wetland District ($B_{Mt}$ on Figure 2)

This district is transitional between the Prairie to the south and the Boreal region. Basin fens and bogs, thicket swamps and marshes occupy the depressions in about equal proportions. Flat fens and floating fens occur along drainages and lakeshores. Peat accumulation is in the order of 3 m on bogs, but less in fens, and minimal in swamps and marshes.

LOW BOREAL Wetland Region ($B_L$ on Figure 2)

The characteristic wetlands are treed bowl bogs that are often surrounded by conifer swamps. Hardwood swamps have a limited occurrence, occupying depressions with good air drainage. The climate is characterized by cold winters and warm summers, with relatively high precipitation, especially in the eastern part of the region (Table 1).

The common maximum thickness of peat in bogs and fens is about 5-7 m. In swamps the peat is well humified and seldom exceeds 50 cm in thickness, except where the swamp occurs on the fringe of a bog or fen.

ATLANTIC BOREAL Wetland Region ($B_A$ on Figure 2)

The characteristic wetlands are domed, raised bogs, most with an eccentric pool pattern and associated fens. Small slope fens occur throughout the region. Large tidal and freshwater marshes occur along the seashore in areas of low relief. The climate is characterized by relatively mild winters, cool summers, and high amounts of precipitation (Table 1).

The common maximum thickness of peat is 8 m, with some bogs exceeding 10 m, but it rarely exceeds 2 m in slope fens. Peat accumulation is usually less than 50 cm in the marshes.

EASTERN TEMPERATE Wetland Region ($T_E$ on Fig. 2)

The characteristic wetlands are hardwood swamps and coniferous bogs in basins of flats. Shore marshes and fens near ponds and along drainageways may occur. The climate is characterized by mild winters and warm summers, with relatively high amounts of precipitation (Table 1).

Peat is no longer forming under hardwood swamp condition, as the well decomposed surface peat was deposited during an earlier stage, perhaps under different climatic conditions. The thickness of peat is therefore variable, depending on the degree of oxidation. A common maximum thickness is 2 m.

PACIFIC TEMPERATE Wetland Region ($T_P$ on Fig. 2)

The characteristic wetlands are coniferous swamps, flat and domed bogs, and flat fens. Floodplains and deltaic areas may contain extensive marshes. Locally tidal marshes may be found, especially in deltaic areas. The climate is humid and mild, with high rainfall, mild winters and warm summers.

The thickness of peat in the swamps is generally less than 1 m. The common maximum thickness of peat in the bogs is about 5 m. In the fens the peat seldom exceeds 1.5 m in thickness.

ATLANTIC OCEANIC Wetland Region ($O_A$ on Fig. 2)

The characteristic wetlands are blanket bogs and plateau raised bogs. Small slope fens and slope bogs are often associated with the plateau raised bogs. The climate is characterized by cold winters and cool summers, with high amounts of precipitation (Table 1).

The peat thickness is less than 3 m in blanket bogs, but generally thicker in the plateau bogs, often reaching 5 m in thickness.

PACIFIC OCEANIC Wetland Region ($O_P$ on Fig. 2)

The characteristic wetlands are slope bogs and raised bogs, with local flat fens. The climate is characterized by very high amounts of precipitation, most of it falling as rain. The winters are mild, but the summers are cool (Table 1).

The thickness of peat is usually less than 1 m in the fens, consisting of somewhat decomposed sedge peat. The common maximum thickness of peat is 3 m on slope bogs, and 5 m on raised bogs.

PRAIRIE Wetland Region (P on Figure 2)

Characteristic wetlands are marshes, usually in association with semi-permanent ponds. The climate is semi-arid, with cold winters and hot summers (Table 1). Two wetland districts were recognized on the basis of wetland development.

Aspen Parkland Prairie Wetland District ($P_a$ on Figure 2)

Semi-permanent ponds and freshwater marshes usually support an encircling shrubby or treed border. Small depressions are often occupied by meadows and shrub carrs. Saline marshes may border larger lakes. There is a limited development of well humified peat, usually less than 50 cm thick.

Grassland Prairie Wetland District ($P_g$ on Figure 2)

Wet meadows and fresh to saline marshes occupy depressions containing semi-permanent shallow lakes. Peat development is absent.

INTERMOUNTAIN PRAIRIE Wetland Region ($P_I$ on Figure 2)

Characteristic wetlands are saline and freshwater marshes, usually bordering ephemeral or semi-permanent ponds. Peat development is absent. The climate is semi-arid, with hot summers and mild winters (Table 1).

MOUNTAIN COMPLEX ($M_X$ on Figure 2)

Wetlands in mountainous areas occur only in the valleys and lower slopes. The kind of wetland developing at each location will depend on the latitude and elevation of the location. Thus, in an area, bogs typical of the boreal region may occur in the lowest valleys, but at higher elevation the wetlands will resemble those found in subarctic or arctic areas. Because of such complex vertical zonation, the wetlands of mountainous areas are not described here.

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# PROCEEDINGS OF A WORKSHOP ON CANADIAN WETLANDS

A meeting of the National Wetlands Working Group, Saskatoon, Saskatchewan 11-13 June 1979

# COMPTE-RENDU D'UN ATELIER SUR LES TERRES HUMIDES DU CANADA

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