An Introduction to Wetland Classification and Ecology

by J. Derek Johnson (Derek presented this paper as a session at the Volunteer Steward Conference)

Historically, wetlands have been perceived as lands having little value, as wastelands, a nuisance, or an obstacle to development. Their perceived value depended on their potential for conversion to more "productive" uses. Approximately 21% of Alberta is covered by wetlands. This translates to about 13,740,000 ha; 11% of the total wetland area of Canada.

WETLAND CLASSIFICATION

Over time, the classification of wetlands has created a profusion of terms. These terms have often been used interchangeably and this has resulted in considerable confusion about wetlands amongst the general public.

What is a wetland? A wetland is defined as land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation, and various kinds of biological activity which are adapted to a wet environment. This seems like a rather convoluted way to say that a wetland is land that is wet. An older definition defined a wetland as an area of land where the water table is at or above the level of the mineral soil for the entire year. This is generally a workable definition except in the case of some marshes. Wetlands include: mineral wetlands, areas of mineral soil which are influenced by excess water but which, for climatic, soil, or biotic reasons produce little or no peat (the decaying remains of plants), and organic wetlands or peatlands characterized by an accumulation of more than 40 cm of peat above the mineral soil. The 40 cm limit was chosen because at this thickness the vast majority of wetland plants are rooted solely in peat. The majority of this discussion on classification will focus on peatlands.

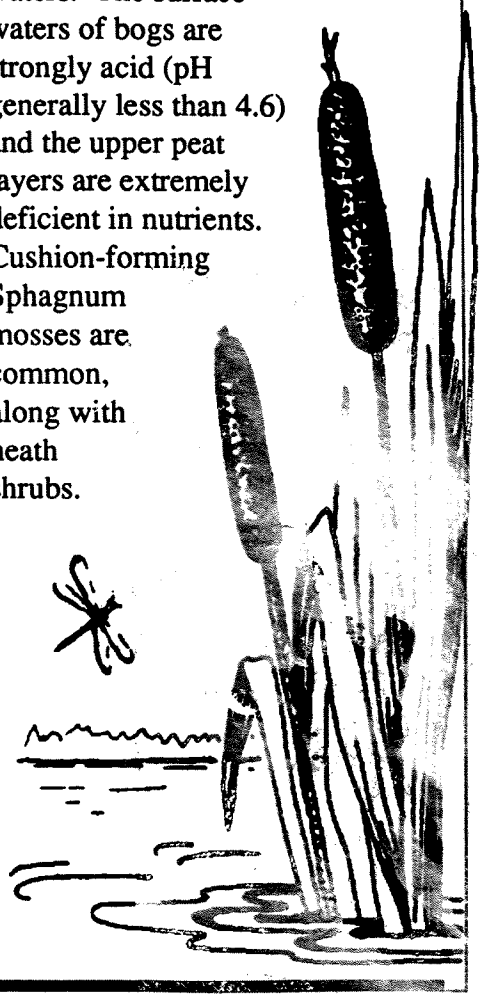
The Canadian Wetland Classification System contains three hierarchical levels:
(1) class;
(2) form; and
(3) type.

This is analogous to the family, genus, and species used in plant and animal classification systems. Five wetland classes are recognized on the basis of overall genetic origin. Seventy wetland forms are differentiated on the basis of surface morphology, surface pattern, water type, and morphology of the underlying mineral soil. Sixteen wetland types are classified according to vegetation physiognomy.

The five wetland classes in the Canadian classification system are: bog, fen, swamp, marsh, and shallow open water less than 2m deep. I won't be saying anything more about shallow open water as this class is relatively self-explanatory.

BOGS are peat-covered wetlands in which the vegetation shows the effects of a high water table and a general lack of nutrients.

The bog surface is virtually isolated from mineralized soil waters. The surface waters of bogs are strongly acid (pH generally less than 4.6) and the upper peat layers are extremely deficient in nutrients. Cushion-forming Sphagnum mosses are common, along with heath shrubs.



Trees may be present or absent; if present, they form open-canopied forests of low, stunted trees. Sphagnum mosses are the primary peat formers. Bogs receive their nutrients only from rain water; the living vegetation is not nourished by mineral-enriched groundwater. Calcium (Ca) and magnesium (Mg) levels in the groundwater are extremely low.

FENS are peatlands characterized by a high water table, but with a very slow internal drainage by seepage down very low gradient slopes. The slowly moving water table is enriched by nutrients (particularly Ca and Mg) from upslope materials and thus fens are more minerotrophic than bogs. The pH of the groundwater is generally in the range of 5.5 - 7.0. The vegetation in fens reflects the water quality and quantity available, resulting in three basic types: graminoid fens without trees and shrubs, shrub fens, and treed fens. Sedges and the so-called "brown mosses" are the primary peat formers in fens.

SWAMPS are wetlands where standing or gently moving waters occur seasonally or persist for long periods, leaving the subsurface continuously waterlogged. The water table may drop seasonally below the rooting zone of vegetation, creating aerated conditions at the surface. Swamp waters are circumneutral to moderately acid, and show little deficiency in oxygen or mineral nutrients.

Swamps are nutritionally intermediate between bogs and fens. Their substrate consists of mixtures of mineral and organic materials, or woody, well-decomposed peat. The vegetation may consist of dense coniferous or deciduous forest, or tall shrub thickets. Most peat-forming mosses are absent, or present only in a subordinate role. Woody species are the primary peat formers in swamps, ~~and~~ but in many swamps, peat formation is minimal.

MARSHES are wetlands that are periodically inundated by standing or slowly moving water and hence are rich in nutrients. Marshes are mainly wet, mineral soil areas; peat formation is often minimal. Marshes are subject to a gravitational water table, but water remains within the rooting zone of plants for most of the growing season. Waters are usually circumneutral to slightly alkaline. Marshes are characterized by an emergent vegetation of reeds, rushes, sedges, or grasses. The surface water levels of marshes my fluctuate seasonally with the vegetation showing a distinct zonation according to water depth, frequency of drawdowns, or salinity.

The type and distribution of wetlands that will occur in an area is influenced by: climate (through precipitation), morphology of the land surface (through its influence on the distribution of surplus water), surface water, groundwater, vegetation, and soils. Wetlands reflect the nutrient status of the waters that feed them.

To be continued in the Fall issue of *The Steward!*

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(continued from Summer 1993)

Importance and Function of Wetlands

Hydrology

Wetlands help to control and store surface water, and so reduce the risk of flooding, soil loss and downstream sedimentation. By recharging and discharging groundwater, wetlands help to maintain water table levels. Wetlands also provide natural shoreline protection from wave action and erosion.

Ecology

Healthy wetlands are part of the overall biological diversity. They serve as a refugium for rare and endangered species. They provide food, shelter and breeding sites for many animals. Forty-five species of waterfowl, between 80 and 100 species of other birds, and 30 species of mammals use wetlands or wetland margins for all or part of their life cycle. This doesn't even begin to address the importance of wetlands to fish, amphibians, reptiles and invertebrates. The amount of organic carbon stored in peatlands is immense. Canada has 30 percent of the world's peat reserves. In Alberta, there is an estimated 2.7×10^{11} m^3 of peat by volume or 2.67×10^9 tonnes of dry peat by weight. Wetlands provide nutrients to downstream-connected waters. Wetlands act to naturally retain toxic substances, such as heavy metals and pesticides, thereby improving soil and water quality.

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Agriculture

The native grasses and sedges found in wetlands are grazed or cut for hay. In dry years, they may provide the only available forage for livestock. Wetlands help to reduce topsoil erosion and improve soil moisture. They provide an on-farm water supply for livestock and domestic use. The growing of wild rice in natural wetlands is worth $7 million annually to the Canadian economy. Berries and market garden crops produced on "managed" (=drained) wetlands infuse $100 million into the Canadian economy annually.

Subsistence and Commercial Hunting, Trapping and Fishing

Hunting and trapping associated with wetlands is estimated to bring $50-70 million per year into the Canadian economy. The commercial freshwater fishery adds another $22 million and fish farming adds a further $2-3 million.

Peat Resource

- horticultural peat.
- fuel peat. Limited consideration in Alberta as petroleum products are still relatively cheap and there are concerns about rehabilitating peatlands once they have been mined out.
- peat for industrial absorbents.
- timber production/forestry.

Recreation and Tourism

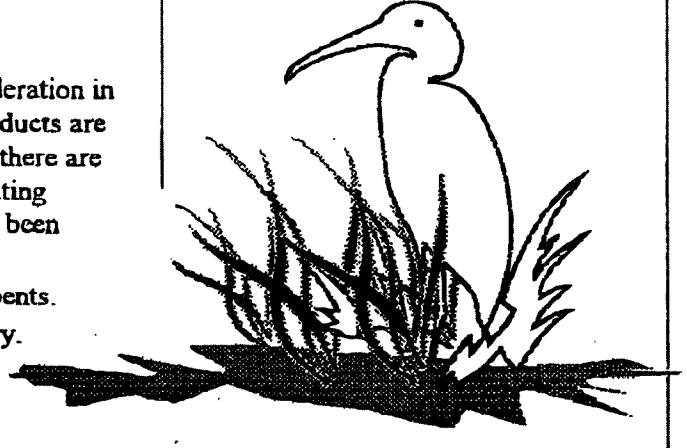
Both consumptive and non-consumptive uses of wetlands.

- hunting/fishing
- boating/canoeing
- cross-country skiing/skating
- birdwatching
- photography
- sightseeing
- nature appreciation in general

Scientific Research and Education

Wetlands provide excellent outdoor laboratories for learning about ecosystem structure and function. They are useful for demonstrating and studying ecological principles such as energy flow, biodiversity, nutrient cycling, and carrying capacity. And, since many wetlands have been highly modified by man, they provide excellent examples of environmental problems resulting from human disturbance.

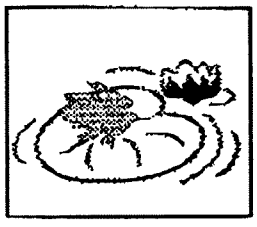
The economic returns derived from wetlands are estimated to be between $5-10 billion annually in Canada, $3 billion of which is from nonconsumptive recreational use.



Threats to Wetlands

Agriculture

Agriculture has accounted for 85 percent of the total known conversions of wetlands to other uses. The most serious wetland losses have been the marshes (sloughs) of central and southern Alberta. The boreal forest wetlands are still in relatively good shape, although they are facing increasing threats from hydroelectric developments, peat extraction, and forestry. Over 70 percent of the prairie wetlands have been converted to other uses; for the aspen parkland region the figure is over 60 percent. Eighty percent of the wetlands surrounding Calgary and Edmonton have been lost to agriculture and urban expansion since the time of settlement. Ninety percent of the wetlands in the prairie/



parkland area have been affected to some extent by agricultural activities. An estimated total of 1.2×10^6 ha of wetland have been converted to agriculture in the prairie/parkland region. One half of one percent of Alberta's wetlands are lost to agricultural drainage each year. Currently, less than 0.2 percent of all of Canada's wetlands lie within 40 km of our 23 largest metropolitan areas.

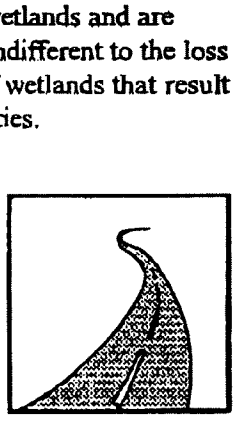
Drainage of wetlands is attractive to many agricultural producers. Subsidies and tax incentives for drainage have been available and there has been social pressure to drain wetlands. Such drainage is viewed as a way to bring more land into production. It improves the efficiency and timing of field operations. It reduces waterfowl damage to crops. It allows earlier access to land in the spring. It allows cultivation and seeding of all areas at the same time. And it prevents waterlogging of crops after summer storms. However, these advantages ignore the loss of habitat for wildlife or problems associated with increased soil salinity following drainage. Clearing of wetland margins decreases the wetland size and depth by restricting snow accumulation, and promotes eventual basin-filling by increased water erosion and siltation resulting from tillage of the margins.

The costs and benefits of wetland drainage and retention are distributed unevenly among landowners and society as a whole.

The direct costs of wetland retention fall primarily on the landowner, while the benefits of wetland retention are societal in nature. Programs offered by government departments and various nongovernment organizations often appear to conflict in purpose with respect to wetlands. Some government programs promote drainage, and others support wetland preservation. Farming activity continues to move to less productive marginal lands, including wetlands, with little or no cost-benefit analysis being done to support the practice. Governments continue to subsidize uneconomical drainage programs with negative environmental consequences. Albertans are generally unaware of the many benefits of wetlands and are often unaware or indifferent to the loss and degradation of wetlands that result from human activities.

Urban Expansion

Nine percent of all wetland conversions in Alberta have been as a result of urban expansion, to provide land for building or to eliminate places for mosquitoes to breed.



Road Construction

Road construction results in a direct loss of wetlands through infilling, but it also results in indirect loss of wetlands through the alteration of natural drainage patterns.

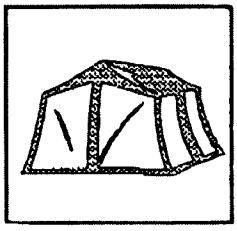
Oil And Gas Activity

Seismic lines, access roads and wellsites are infrastructures of the oil and gas industry.

Forest Land Drainage

Forested land is drained for commercial peat harvesting and improved timber production.

In total, 47 000 tonnes of peat are harvested annually in Alberta, worth almost $7 million in an industry that exceeds $47 million in revenue annually in Canada. Approximately 4 million ha or about 30 percent of Alberta's wetlands are considered potentially drainable for forestry purposes. Only about 1000 ha have been drained for this purpose so far. It is unlikely that this activity will increase much in the near future because the returns from forest land drainage do not currently justify the costs.



Recreational Developments

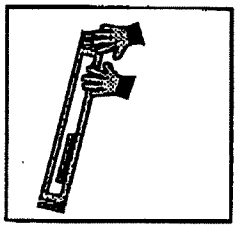
Recreation can be an incompatible land use in some wetlands. The construction of condominiums, marinas, and bathing beaches often destroys the very features that drew people to the area in the first place.

Pollution

Wetlands are often degraded by water contamination, siltation, channelization, or transformation into landfill sites.

Water Level Management

Hydroelectric developments, dams, weirs, and transmission lines all affect wetlands negatively.



Wetland Survey Methods

The vegetation in wetlands can be sampled in the same way as upland vegetation, except that if plot sampling is conducted, the plots generally have to be smaller than in upland sites so that the subtle differences in vegetation composition over very slight rises in elevation are not obscured.

Sampling of the peat profile is often done using a Macaulay sampler. This device is pushed into the peat by hand and gives a 4-cm diameter semicircular core about 50 cm long with each extraction. Samples from these peat cores are analyzed chemically to determine the nutrient status of the peat. The micro-fossils and pollen found in the peat are studied to characterize the peatland in terms of its past and present vegetation composition. This analysis makes it possible to determine how these peatlands have changed over time.

Peatlands create their own environment. Upon reaching a critical thickness, accumulated peat can bring about a drastic change in the chemistry and nutrient levels of the peat. Such changes allow the invasion of different peat-forming vegetation, changing the complexion of the peatland. The total age of the peatland and the approximate rate of peat accumulation are determined through radiocarbon dating.

Indicators of Ecological Health in Wetland Habitats

Species richness and diversity are two of the best indicators of ecological health in wetland habitats. Declines in these components indicate deteriorating conditions in the wetland. The invasion of non-native species is also an indicator of declining wetland health. The presence or absence of certain "keystone" species provides a quick indication of ecological health. In the case of wetlands, changes in the cover and/or abundance of the aquatic macrophytes, insectivorous plants, shallowly rooted species, and mosses provide the most readily observable indications of changes in wetland health.

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