CANADIAN PEAT HARVESTING AND THE ENVIRONMENT

SUSTAINING wetlands

ISSUES PAPER, No. 1992 - 3

North American Wetlands Conservation Council (Canada)

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Cover : *A bog in the boreal zone, Northwest Territories during the autumn. Photo: S. Zoltai*

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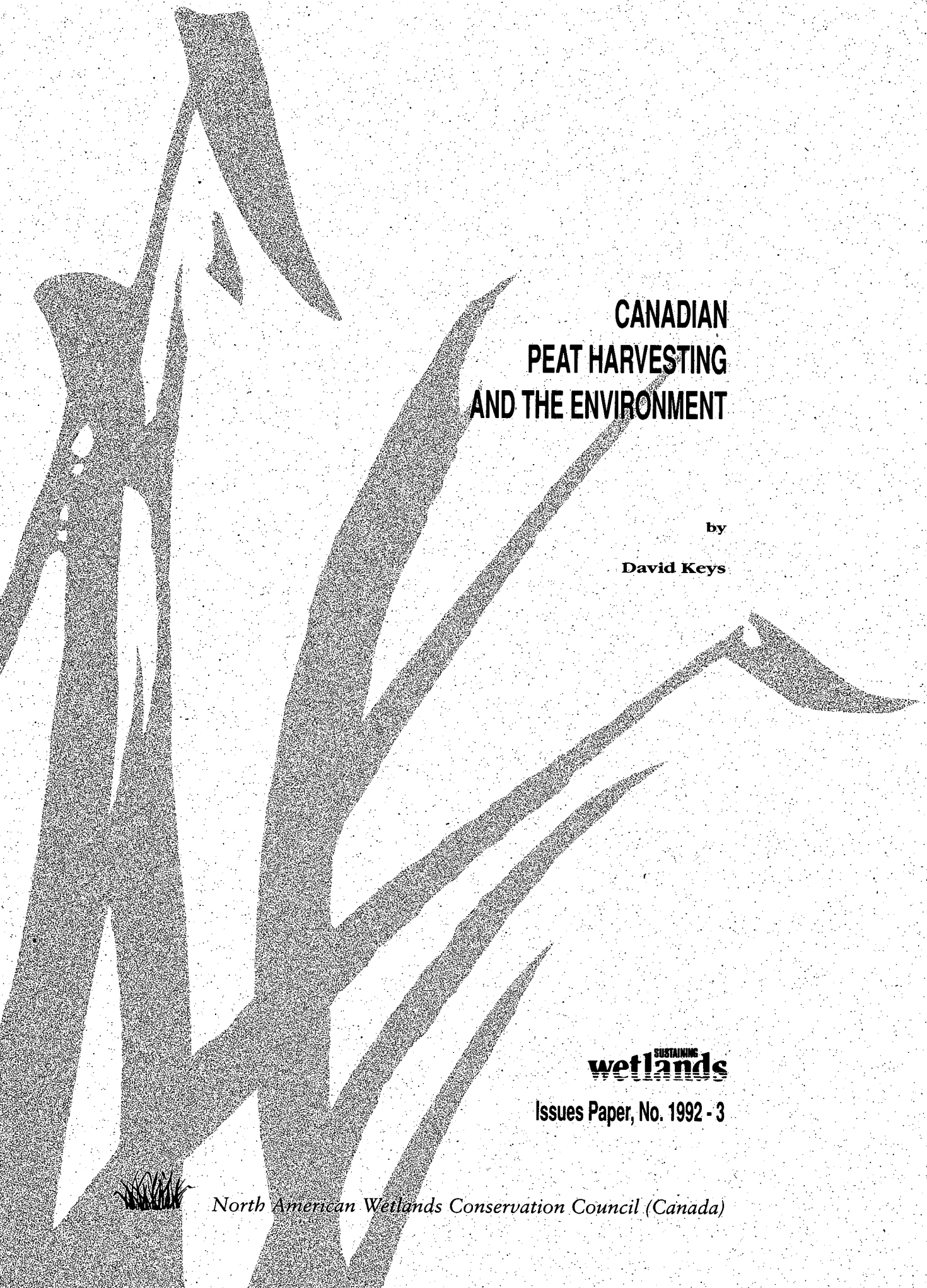

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by

David Keys

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Executive Summary

For generations, Canadians have used peat or peat moss for a variety of domestic applications. In the last fifty years in Canada the peat harvesting industry has emerged as a significant rural employer and user of peatland resources.

Peat, mainly derived from *Sphagnum* moss but also from reed and other sedge deposits across the nation, is marketed among many uses as a soil supplement to enhance gardening and as a soil base for greenhouse production. It is one of nature's truly green products. Peat in various sizes of compressed packages and bales has become a readily available product at our local hardware and garden centres. What would spring gardening be like without a few bales of peat moss to dig into our flowerbeds or to plant with some new shrubs or roses? However, consumers of peat moss want to know whether this important soil additive is being harvested and applied in ways that protect the overall resource and the environment.

In 1990, 749 000 metric tonnes, or about 20 000 000 bales of peat were sold by Canadian producers. This volume of peat harvested each year is small in comparison to the estimated 50 million tonnes or more of peat that accumulate naturally each year in Canada. On a volume basis, there are an estimated three trillion cubic metres of peat deposits in Canada. This indicates that far more peat accumulates naturally in the Canadian environment each year than is harvested. The total value of this market now exceeds $100 million annually. Our peat, regarded as among the best quality peat in the world, is sold to markets in the United States and Japan as well as across Canada. However, Canada has only a very small share of the world market accounting for less than one percent of global peat moss used.

The need to protect natural resources and to ensure wise, sustainable use of the environment is greater today than perhaps at any point in our history. Like other natural resource sectors, the harvesting of peat moss around the world has attracted the interest of concerned environmental groups in government and the public.

In early 1991, the Canadian Sphagnum Peat Moss Association (CSPMA), the New Brunswick Department of Natural Resources and Energy, and the Secretariat to the North American Wetlands Conservation Council (Canada), representing the combined interests of industry, government and researchers, initiated the production of this report. It focuses on the status of peat harvesting and environmental issues concerning the use of peat and peat moss.

At present, less than 16 000 ha of Canada's 111 million ha of peatlands are being used for peat or peat moss harvesting. The majority of companies involved in this industry, through their association the CSPMA, has articulated a policy for environmentally-sensitive peatland use and for site restoration or reclamation after use. The industry, in association with government and non-government interests, environmental groups, and universities is developing a national peatland research strategy to promote awareness of peatland restoration technology and information. On-going research indicates that new and many existing sites will revert to functioning peatlands with proper site management during and after use. Other older sites can also be reclaimed to valued agricultural, forestry, or wildlife habitat uses.

It is very evident that Canadian peat moss harvesting is not contributing to a decline in peatland functions or values on a national or global scale. There is room for further growth of the industry in a cooperative, consultative manner with regulators and environmental interests to ensure a balance between the needs of the environment and sustainable development.

CANADIAN PEATLAND FACTS

- Peatlands, covering over 111 million ha of Canada's land and freshwater area (about 12 percent of the surface area of the nation), comprise 90 percent of the 127 million ha of the wetlands across Canada.

- The volume of peat on Canadian wetlands is an estimated three trillion cubic metres, a major portion of the global peat resource.

- Most peatlands occur in the boreal zone of Canada and are generally unaffected by agricultural, urban, ports/harbours, and industrial impacts.

- Only a specific range of peatland forms have peat and/or peat moss which is suitable for use in horticultural and other current applications.

- Peatlands support a complex mixture of ecological functions such as habitats for wildlife and other biological resources.

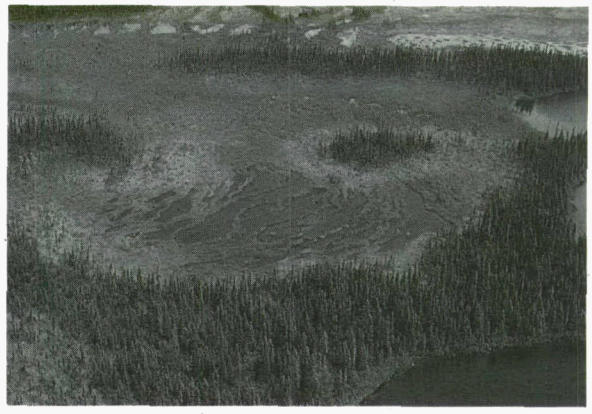


Photo: D. Wells

String fen peatlands in Newfoundland.

- Horticultural peat and peat moss are valuable, environmentally friendly products used by millions of residents of North America for gardening, greenhouse and a variety of other applications. Peat moss is also now entering the marketplace in a range of other household and hygiene products.

- Over 50 million tonnes of peat are estimated to accumulate in the natural environment each year in Canada, while current applications utilize, on average, from 700 000 to 800 000 tonnes annually.

- Less than 0.02 percent (16 000 ha) of Canada's peatland area is currently being used for horticultural peat harvesting and related applications. At present, almost no peat in Canada is used for fuel purposes.

- Total revenues for horticultural peat in 1990 exceeded CDN$ 90 million and provided employment for thousands of residents in rural areas of the nation.

- An integrated national inventory of peatland distribution and sites of regional or national significance does not exist in Canada, although detailed peatland data bases in portions of Canada are now in place, notably parts of the Prairie provinces, central and southern Ontario, southern Quebec, the Island of Newfoundland, and all three Maritime provinces.

Preface

"Canadians need and will continue to need peat and peatlands. We cannot and should not halt use altogether, though wise management and intensive use on selected sites must be encouraged."

So said my colleague Barry Warner of the University of Waterloo in correspondence about this proposed paper when it was being developed. Of course Barry is right. Unfortunately, Canadians are surprisingly unaware of our peatlands and the opportunities Canada is blessed with in having so many peatlands present in this nation.

Hence, this paper is about peatlands in Canada. It addresses what they are, how our peatland resources are being used (in particular for horticultural peat uses and for other peat moss applications), and what the environmental issues are that must be addressed by Canadians. The paper also examines what is being done to ensure the sustainable, wise use of our peatlands.

David Keys

Introduction

There has been increased recognition of the value of wetland ecosystems in recent years. Wetland loss due to agriculture, urbanization, industrial development, water management projects, and a variety of related activities has made wetland conservation an issue in many jurisdictions. Modification or loss of wetland ecosystems has been extensive in some regions. For example, over 70 percent of the wetlands in the southern portions of the central Prairies, southern Ontario and the Fraser Lowland in British Columbia have been converted to other land uses. However, wetland disturbance has been minimal in lightly populated areas of Canada such as the boreal zone.

Canada's peat-dominated ecosystems are a major component of the nation's total wetland resource base. In this paper, the term "peatland" is used to refer to the peat-dominated areas within the total wetland resource of Canada. Peatland resources are utilized for many purposes including agriculture, forestry, peat extraction, and wildlife habitat. Partially decomposed peat suitable for horticultural applications and peat moss are harvested in several regions of Canada. However, most of the wetlands in southern Canada that the general population is likely to be familiar with are not suitable for this purpose. Thick accumulations of suitable quality peat, normally found only in certain categories of peatlands such as bogs and fens, are a basic requirement for peat harvesting interests.

The objective of this paper is to examine the relationship between peatlands and the horticultural peat industry. The study provides an evaluation of environmental and sustainable wise use issues in a Canadian context, and provides an international perspective where possible. Case studies are used to examine several specific situations where peatland development proposals have undergone environmental assessments. The present status of peatland conservation in Canada is reviewed and topics relating to sustainable development with respect to the horticultural peat industry are examined in greater detail.

Overview of Canada's Wetlands

According to *The Canadian Wetland Classification System* (National Wetlands Working Group 1987), the term "wetland" has a broad definition and is used to describe areas which are waterlogged all or most of the time. A "peatland" is a wetland on which extensive organic material has accumulated. The European terms "mire" and "moor" have related meanings. Accumulation of peat can occur when climatic and other physical conditions result in a rate of production (growth) of plant materials such as mosses, reeds, or sedges which exceeds the rate of decomposition. About 90 percent of the wetlands in Canada are classed as peatlands (Zoltai 1979). The volume of peat present in these peatlands has been estimated by the National Research Council to be over three trillion cubic metres (Tarnocai 1984).

Wetlands are dynamic ecosystems that continue to evolve and change over time. Wetlands in Canada developed following the most recent retreat of glacial ice and are typically between 5 000 and 10 000 years old. The rate at which wetlands evolve is controlled by a complex interaction of climatic, biological, hydrologic and related factors.

Photo: Ducks Unlimited Canada

Prairie pothole wetlands such as these in Alberta are one focus of wildlife habitat conservation programs.

Wetland Development and Classification

Wetlands are subdivided into five "classes": bog, fen, swamp, marsh, and shallow open water. Definitions of these terms and methods for wetland differentiation have been developed for Canada by the National Wetlands Working Group (1987, 1988). Each of the five classes can be further subdivided into various "forms" based on landscape, hydrological and other physical factors and "types" related to vegetation characteristics.

In the initial stages of wetland development, where vegetation obtains its nutrients from soil and groundwater, a wetland is termed "minerotrophic". Common vegetation types in the swamp, marsh, and shallow open water classes include a variety of reeds, sedges, shrubs, and other species. Because there is a nutrient-rich environment, a diverse range of plant species is typical.

Accumulation of organic matter, in the form of peat, can occur under favourable conditions. The rate of accumulation can be as much as one to two mm/year (10 to 20 cm per century) but generally may average from 0.6 to 0.7 mm/year in many Canadian peatlands. A minimum accumulation of 40 cm of peat is used to define the term peatland. As the peat layer accumulates, access to nutrients in the underlying soil is reduced and the vegetation must obtain its requirements

from groundwater seepage. The type of vegetation and the diversity of species tend to reflect this change in nutrient regime. Plants such as mosses (*Sphagnum* spp.) and sedges (*Carex* spp.) become common and the overall diversity of species becomes lower. These conditions are frequently associated with the "fen" class of wetlands.

The accumulation of peat in bogs can result in the surface of the wetland being raised above the surrounding waters and mineral soils. The surface vegetation is then virtually unaffected by base cation-rich waters and it obtains nutrients primarily from precipitation. The wetland is termed "ombrotrophic" and includes species such as *Sphagnum* mosses and shrubs. The diversity of species tends to be low, presumably due to the acidic, low base cation environment. Such conditions are typical of the "bog" class of wetlands.

Many peatland forms commonly expand in a lateral direction as well as having vertical accumulation. This process of "paludification" results in more land gradually becoming part of the peatland ecosystem. Natural activities such as beaver ponds can contribute to this process. Generalized cross-sections of a bog and fen are shown in Figure 1. In the case of the fen, base cation-rich groundwater percolates through the system and influences the nature of the vegetation. In the bog illustration, a living surface layer (usually 10 to 20 cm thick) is underlain by an accumulation of weakly decomposed *Sphagnum* peat which formed in a bog environment, i.e. under ombrotrophic conditions. Underlying this is a layer of moderately decomposed *Sphagnum* peat which accumulated in a fen environment influenced by seepage of minerotrophic waters. The basal layer consists of highly decomposed sedge peats which accumulated in a fen and/or marsh environment. An open water phase may have been present in the centre of the basin during the early stages of peatland development. Reconstruction of the development history of a peatland can be achieved by an evaluation of peat cores to determine the stratigraphy of the accumulated peat.

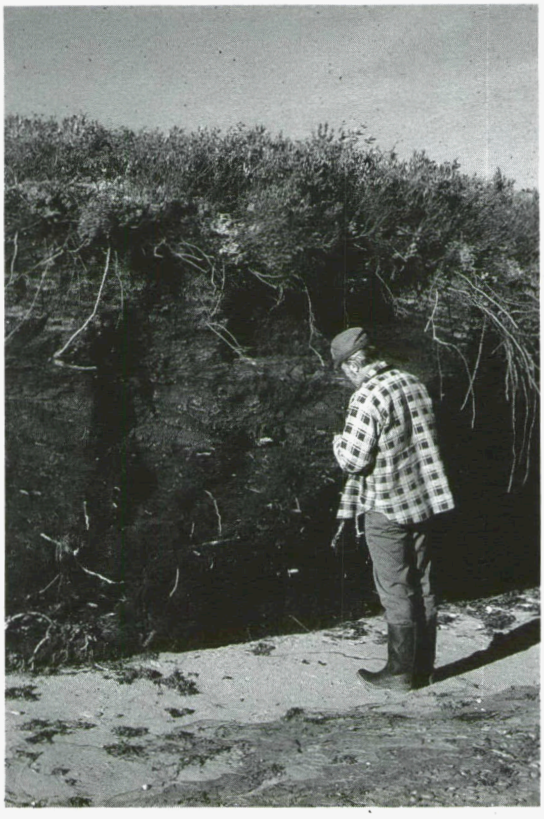


Photo: C. Rubec

Peat deposits in bogs can be metres deep. Pointe-Sapin, New Brunswick.

A detailed discussion of wetland classification is presented in *Wetlands of Canada* (National Wetlands Working Group 1988). A brief summary of the major wetland classes is presented below.

Bog

An ombrotrophic peatland with the water table at or near the surface. Bogs may be treed or treeless. Vegetation species tend to show a limited diversity due to the acid, nutrient-poor environment with *Sphagnum* mosses and ericaceous shrubs common.

Fen

A minerotrophic peatland with the water table usually at or just above the surface. Vegetation may include sedges, grasses, reeds, brown mosses, certain *Sphagnum* species, ericaceous shrubs, and trees.

Swamp

A mineral wetland or peatland with standing or gently flowing waters occurring in pools or channels. The water table usually is at or near the surface. The vegetation is characterized by a dense cover of deciduous or coniferous trees or shrubs, herbs, and some mosses.

Marsh

A mineral wetland that is periodically inundated by standing or slowly moving waters. Surface water levels may fluctuate seasonally and vary from fresh to highly saline. Vegetation includes emergent sedges, grasses, rushes and reeds, which may have interspersed areas of open water and aquatic plants.

Shallow Open Water

A mineral wetland that is intermittently or permanently flooded and has open expanses of standing or flowing water. Shorelines, mud flats, shallow lakes, ponds, pools, oxbows, channels and similar features are included in this class. Vegetation, when present, consists of submerged and floating aquatic plant forms.

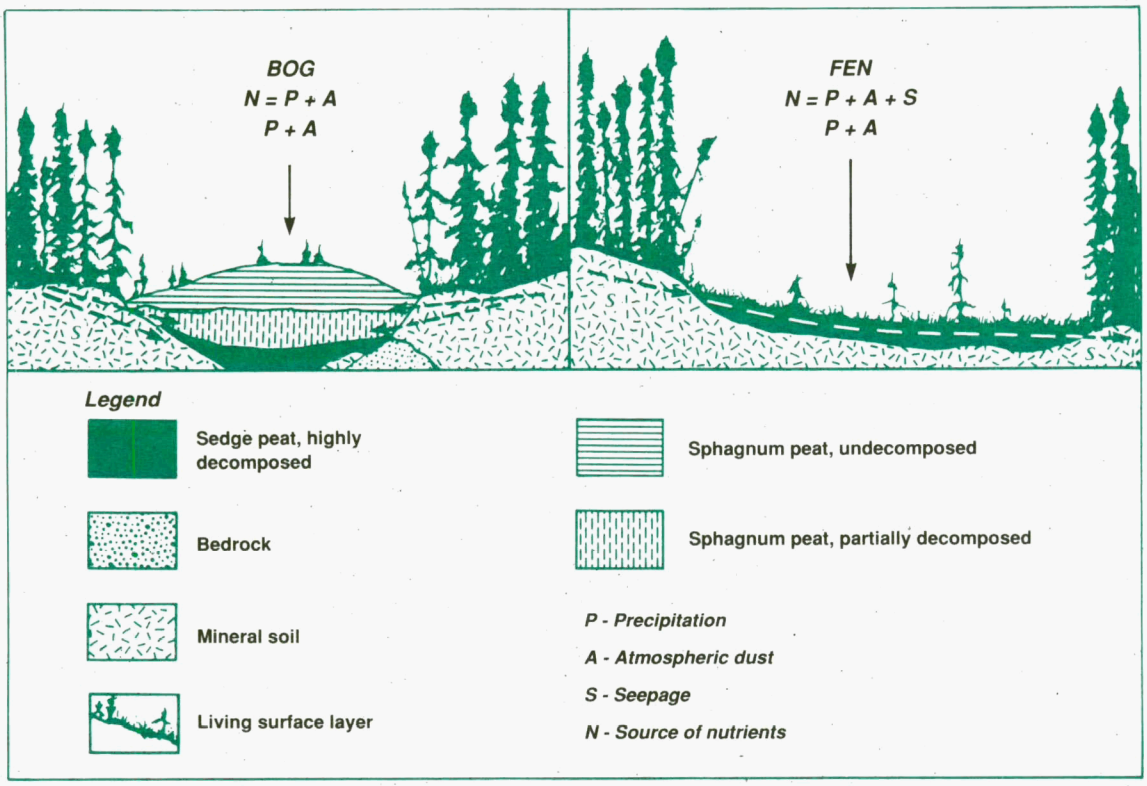


Figure 1: Generalized illustrations of bog and fen showing differences in morphological development and sources of nutrient input.

Source: Wells and Hirvonen (1988)

Distribution of Canadian Wetlands

The distribution of wetlands is controlled by many factors including surface hydrology and the interaction of climatic and topographic factors. Table 1 lists Canada's wetland occurrence on a provincial basis and provides an overview of comparable peatland distribution. Major wetland or peatland inventory programs have been completed in several regions of Canada including the Pacific estuaries, the southern Prairies, southern Ontario, southern and eastern Quebec, and the Atlantic Provinces excluding Labrador.

Climatic and topographic factors also influence the type of wetland which occurs in a particular region. Twenty wetland regions, and a series of wetland subregions based upon climatic factors, are recognized in Canada (National Wetlands Working Group 1986). A detailed discussion of wetland distribution and of the characteristics of the wetlands in each wetland region is provided in *Wetlands of Canada* (National Wetlands Working Group 1988). Figure 2 illustrates the location of the four boreal wetland regions (including High, Mid-, Low and Atlantic Boreal). Over 70 percent of Canada's wetlands are estimated to occur within this zone. The majority of these are bog and fen ecosystems, and most of the peat harvesting operations are within these boundaries.

"Peatlands, covering over 111 million ha of Canada's land and freshwater area comprise 90 percent of the 127 million ha of the wetlands across Canada."

Zoltai (1979)

Photo: G. Wickware

Peatlands dominate the landscape in many boreal areas such as northwestern Ontario.

PROVINCE OR TERRITORY	PEATLAND AREA		TOTAL WETLAND AREA	
	ha x 10^3	% of area of province or territory	ha x 10^3	% of area of province or territory
Alberta	12,673	20	13,704	21
British Columbia	1,289	1	3,120	3
Manitoba	20,664	38	22,470	41
New Brunswick	120	2	544	8
Newfoundland - Labrador	6,429	17	6,792	18
Northwest Territories	25,111	8	27,794	9
Nova Scotia	158	3	177	3
Ontario	22,555	25	29,241	33
Prince Edward Island	8	1	9	1
Quebec	11,713	9	12,151	9
Saskatchewan	9,309	16	9,687	17
Yukon Territory	1,298	3	1,510	3
Canada	111,327	12	127,199	14

Table 1: Occurrence of Wetlands and Peatlands in Canada

Source: Modified from National Wetlands Working Group (1988)

Communities in Canada that are the Focus of Peat Harvesting Operations and Employment

Alberta:

1 Athabasca
2 Evansburg
3 Mallaig
4 Seba Beach

Saskatchewan:

5 Carrot River

Manitoba:

6 Elma
7 Giroux

Quebec:

8 Baie Comeau
9 Escoumins
10 Grondines
11 La Baleine
12 L'Ascension-de-Notre-Seigneur
13 Lac-St-Jean
14 L'Île-Verte
15 Pointe-Lebel
16 Port Cartier
17 Rivière-du-Loup
18 Rivière-Ouelle
19 St-Alexandre
20 St-André
21 Ste-Anne-de-la-Pointe-au-Père
22 St-Arsène
23 St-Bonaventure
24 St-Charles
25 St-Eugène-de-L'Adrière
26 St-Fabien
27 St-Henri
28 St-Ludger-de-Milot
29 St-Modeste
30 St-Paul-du-Nord
31 St-Simon
32 St-Ulric-de-Matane
33 Senneterre
34 Sept-Îles

New Brunswick:

35 Baie Ste-Anne
36 Escuminac
37 Pointe-Sapin
38 Rexton
39 Shippagan
40 Tabusintac

Prince Edward Island:

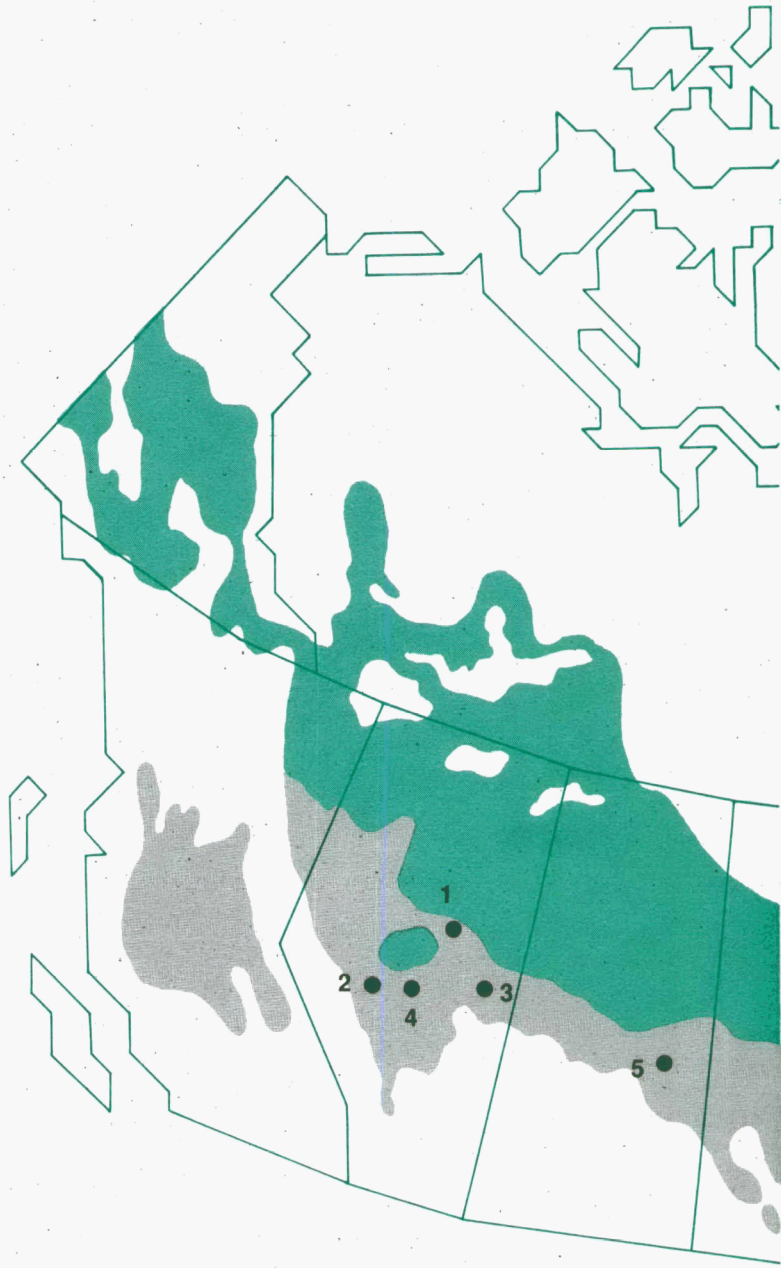
41 Foxley River
42 Portage

Nova Scotia:

43 Berwick

Newfoundland:

44 Bishops Falls
45 Gander



(Adapted from Buteau 1989 and Prud'homme 1990)

LEGEND

BA Atlantic Boreal

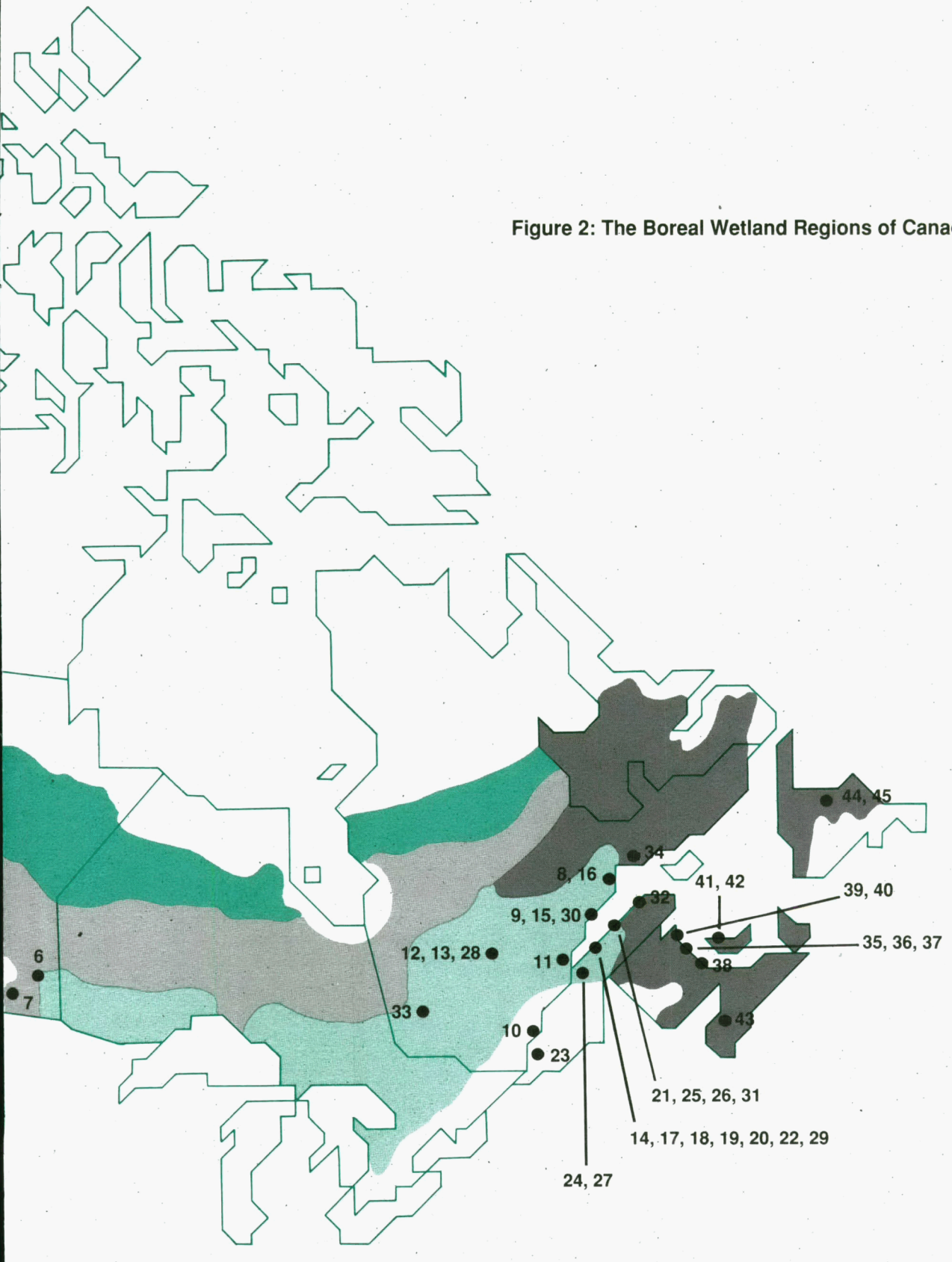
BM Mid-Boreal

BL Low Boreal

BH High Boreal

Source: Modified from National Wetlands Working Group (1986)

Figure 2: The Boreal Wetland Regions of Canada



Wetland and Peatland Utilization

Wetlands and peatlands can be utilized for a variety of purposes, but these typically require the alteration of their natural state. Some utilization involves the extraction of the peat layer whereas other uses are non-extractive. Agricultural use of peatlands is one type of non-extractive use. Developments such as the Holland Marsh and Bradford Marsh in southern Ontario, and similar areas in British Columbia, southern Quebec, Newfoundland, New Brunswick and other regions, are used for vegetable production, pastureland and related purposes. Rubec *et al.* (1988) have estimated the value of market gardening crops derived from peatlands exceeds $100 million annually in Canada. Canada's wetlands are further estimated to provide in excess of $10 billion in economic benefits to Canadians each year.

Peatland forestry is another non-extractive use. About 25 000 ha of Canadian peatlands are now partially drained to facilitate forest operations. However, most of the harvesting of timber from Canada's large expanse of forested peatlands is carried out in winter during frozen ground conditions, minimizing site impacts and facilitating use of appropriate machinery. Peatland drainage is used to enhance tree growth in several European countries, but this is not widely practised in Canada at present. Pilot peatland forestry developments in Alberta, northern Ontario, eastern Quebec, and Newfoundland are being used to evaluate peatland drainage as a forest management tool in Canadian conditions.

A non-extractive use of wetlands and peatlands is the use of water control structures and other methods to enhance wetlands as waterfowl and wildlife habitat. This is extensively practised in several regions of the country. Ducks Unlimited Canada, for instance, in its 1990 Annual Report notes that they currently manage over 5 000 wetland sites in cooperation with landowners and other government and non-government partners to enhance waterfowl and wetland values. Wetland enhancement and development are widely accepted as key elements in national and international programs to conserve and/or reestablish migratory waterfowl populations. One of the world's most successful examples of sustainable development in action is the North American Waterfowl Management Plan. To date over 130 000 ha of wetland and upland habitats have been secured or enhanced under this international plan (North American Wetlands Conservation Council Canada 1991, 1992).

Photo: Canadian Wildlife Service

Water level control on managed wetlands in New Brunswick ensures sustained habitat for wildlife.

On a global scale, development of peatlands for the purposes of peat extraction can be divided into two main categories: (i) fuel peat use, and (ii) horticultural peat and other peat moss applications. The use of peat as a fuel source is extensive in several European countries including Finland, Ireland, and the former Soviet Union. There was considerable interest in fuel peat development in Canada during the mid-1970s but actual production for this purpose has been minimal. To date, economic factors and the availability of other energy sources has not resulted in peat becoming an attractive energy product in Canada. Production of peat for horticultural and other non-fuel purposes, however, has been undertaken in several regions of Canada. The section which follows provides a detailed review of this industry.

Photo: Canadian Sphagnum Peat Moss Association

Tractor-drawn vacuum machines are used to harvest dried peat from production areas across Canada.

The Horticultural Peat Industry in Canada

In 1990, there were approximately 75 operations in Canada which produced horticultural peat (Prud'homme 1990). About 90 percent of the production comes from the combined operations of 17 corporate groups who currently form the Canadian Sphagnum Peat Moss Association (CSPMA). The location of principal production sites are shown on Figure 2. Some operations have been in production for over half a century. Peat production has occurred in each of the provinces at one time or another. At present, the majority of the operations are located in southern and southeastern Quebec and eastern and northeastern New Brunswick. Peat production also occurs in western Canada in central Alberta, southern Saskatchewan, and eastern Manitoba as well as in Nova Scotia, Prince Edward Island, and Newfoundland. Table 2 provides a summary compiled by Energy, Mines and Resources Canada of recent peat shipments by province.

Figure 2 shows that peat production occurs primarily in the boreal wetland regions. Most of the operations are situated in the Atlantic Boreal (BA) and the Low Boreal (BL) Wetland Regions. The bog class of wetland, which is characteristic of these wetland regions, is also the focus of horticultural peat developments in Canada. This reflects the demands of the marketplace for high quality peat products. Canadian *Sphagnum* peat in 1990 represented about 45 percent of the volume and about 85 percent of the dollar value of peat products purchased in the United States. Figure 3 shows that annual shipments of Canadian peat for the past five years have ranged from 662 000 to 812 000 tonnes.

A weakly decomposed peat composed mainly of *Sphagnum* mosses is the preferred product for a horticultural peat operation. This peat type is found in regions where the appropriate combination of climatic and topographic factors have resulted in the development of bogs and fens. Thick layers of weakly decomposed *Sphagnum* peat can accumulate when the right combination of factors exist. However, even when peat quality is acceptable, several other criteria must be met in order for a peat deposit to be suitable for production. There are many basic considerations in the selection of a peatland for production of horticultural peat:

- peat quality must meet market requirements: In Canada and the United States, the preferred composition is a weakly decomposed *Sphagnum* peat with a minimal content of shrubs or other vegetation types. For other markets, a mix with higher shrub and root content is preferred.

PROVINCE	1986		1987		1988		1989		1990p	
	QUANTITY (000 T)	VALUE ($000)	QUANTITY (000 T)	VALUE ($000)	QUANTITY (000 T)	VALUE ($000)	QUANTITY (000 T)	VALUE ($000)	QUANTITY (000 T)	VALUE ($000)
Newfoundland	2	149	1	45	2	53	1	77	2	96
Prince Edward Island	—	—	—	—	—	x	x	x	x	x
Nova Scotia	x	x	x	x	x	x	x	x	x	x
New Brunswick	228	21,351	211	20,405	241	25,428	251	24,910	275	28,273
Quebec	334	30,059	274	25,731	317	30,313	335	41,516	297	35,839
Ontario	x	x	x	x	x	x	x	x	—	—
Manitoba	x	x	x	x	x	x	x	x	x	x
Saskatchewan	x	x	x	x	x	x	x	x	x	x
Alberta	72	13,930	78	15,221	78	15,150	93	18,626	64	13,129
British Columbia	x	x	—	—	—	—	—	—	—	—
Total*	**738**	**80,152**	**662**	**75,484**	**736**	**82,832**	**812**	**99,666**	**749**	**89,535**

"p" Preliminary
"—" Nil
"x" Confidential
* Includes "confidential" values not listed above.

Table 2: Canadian Peat Shipments by Province, 1986-1990
Source: Prud'homme (1991)

- the thickness of the high quality peat layer must be sufficient to warrant development. An average depth of two meters is generally considered to be a minimum.
- the areal extent of the peatland should be large enough to warrant development. An area of 50 hectares is usually required, although smaller sites are occasionally developed.
- the peatland must have a good potential for development of enhanced drainage.
- proximity to a transportation infrastructure (highways, truck availability), a low density of tree cover, availability of a labour force, access to electrical power, and similar factors are preferable.
- climatic factors must be suitable for drying of the peat layer during the harvesting period (such as there being appropriate periods of consecutive days without rainfall).

Once a peatland has been selected for development, surveying is carried out and a drainage plan is prepared. The high water holding capacity of the peat layer necessitates the use of closely spaced ditches. A 20 m ditch spacing is common. The surface vegetation is removed following the completion of the ditching. The deposit is then ready for peat production.

Production requires the use of the sun and wind to dry the surface peat layer. An uppermost layer is usually harrowed, breaking capillary flow and enhancing the drying process. After one to three days, the dry peat layer is then collected using large vacuum harvesters or other equipment. The peat is transported to a processing facility for screening and packaging. The main peat production season in Canada is the late May to mid-September period. Production can be severely inhibited by abnormally wet spring or summer weather resulting in significant variation in annual production (as can be seen in Table 2).

Most of the peat which is produced is sold in compressed bales for use in the horticultural and nursery industries and for domestic (household) consumption. Some peat is used for the production of soil mixes by adding nutrients and other materials. Some peat is also used for compressed peat pots and, recently, surface layer peat mosses are being used for hygienic products. Feminine napkins incorporating *Sphagnum* peat moss are presently being marketed in Canada and the United States.

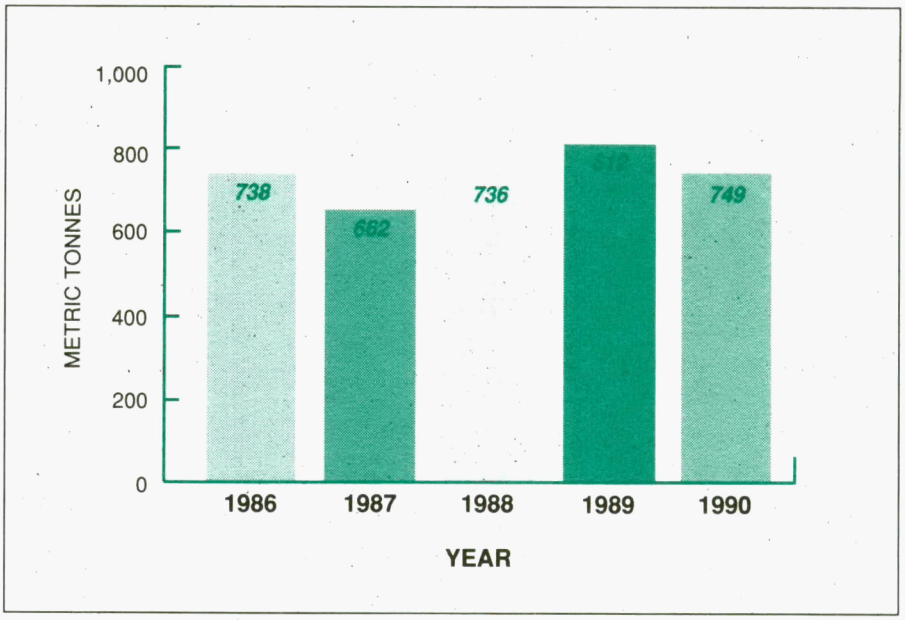


Figure 3: Canadian Peat Shipments 1986-1990
Source: Prud'homme (1991)

In 1990, peat shipments in Canada were valued at $90 million (Prud'homme 1991). The industry employs the majority of its workers on a seasonal basis and provides the equivalent of 1 400 to 1 600 person-years of direct employment annually. It is also estimated that several thousand additional jobs in Canada and the

United States are related to the shipping, trucking and handling of these peat products. In many regions, such as rural Alberta, Quebec or New Brunswick, the peat industry is an important employer.

On an international basis, Canada ranks third in the global production of horticultural peat, after the former Soviet Union and West Germany (Table 3). In 1989, total world-wide production of peat for horticultural, fuel and other purposes was about 194 million tonnes, of which only 13% was designated for fuel uses. About 93 percent of the total 1989 world peat production was in the former Soviet Union. Less than one percent of total world-wide peat production occurs in North America. Canada currently accounts for about two-thirds (Prud'homme 1991) of North America's production with about 700 000 to 800 000 tonnes of peat harvested each year.

Canadian production has been undergoing a steady growth over the past decade. The United States continues to represent 80 to 90 percent of the export market for peat produced in Canada, while Japan consumes up to about 10 percent of Canadian exports with the remainder being sold to a variety of other markets. About 10 percent of the total Canadian production of horticultural peat is sold on the domestic market. Peat produced in Canada is gradually capturing an increased market share in the United States. In 1987, imports from Canada represented 35 percent of consumption, but this had risen to 44 percent by 1990 and continued growth is projected (Cantrell 1990, United States Department of the Interior 1991). Peat produced in the United States is generally classed as reed-sedge or *Hypnum* peat whereas the imports from Canada typically are a weakly decomposed *Sphagnum* peat which has a higher market value per tonne.

Photo: C. Rubec

Some bogs near urban centres are managed for the production of market garden crops such as raspberries and vegetables, southern Manitoba.

COUNTRY	1985	1986	1987	1988	1989
AGRICULTURAL USE (000 TONNES)					
U.S.S.R.	158,725	163,260	163,260	163,260	163,260
West Germany	1,515	2,015	2,000	2,000	1,815
Canada	645	740	610	735	810
United States	750	830	865	765	685
Netherlands	455	400	400	400	400
Ireland	320	325	370	355	365
Finland	340	350	350	350	350
France	200	220	210	200	200
Poland	200	195	250	200	200
Hungary	70	70	70	70	70
Sweden	40	60	60	60	60
Denmark	40	45	50	50	50
Norway	30	30	30	30	30
Spain	55	50	50	55	25
Israel	20	20	20	20	20
Other	40	30	30	20	55
Subtotal	**163,445**	**168,640**	**168,625**	**168,570**	**168,395**
FUEL USE (000 TONNES)					
U.S.S.R.	15,965	19,500	11,430	17,500	16,960
Ireland	2,670	4,710	6,135	5,440	5,440
Finland	3,140	3,175	3,175	3,175	3,175
West Germany	280	245	240	200	180
Subtotal	**22,055**	**27,630**	**20,980**	**26,315**	**25,755**
WORLD TOTAL	**185,500**	**189,605**	**189,605**	**194,885**	**194,150**

Table 3: World Production of Peat, by Country, 1985-1989

Source: Prud'homme (1991)

Environmental Issues related to Peatland Development

Development of peatlands for horticultural peat production involves several environmental issues of a general nature as well as more site-specific concerns. General issues include conservation of wetland functions including provision of wildlife habitat. These also involve a site-specific component, but this is better evaluated in a regional context. Other factors such as protection of rare or unusual species and release of stored carbon in relation to global warming should also be evaluated as a site-specific concern within a regional or global framework.

Site-specific issues relating to individual peatland developments include a variety of management considerations. Water quality aspects such as suspended solid discharge and changes in water chemistry, as well as water quantity factors such as runoff rates and flow attenuation also must be considered. Air quality considerations (i.e. dust control), and reclamation/restoration issues also are of a more site-specific nature.

General Issues

Conservation of wetlands for their wildlife habitat and other ecological values is an important issue. Wetland loss has become acute in some regions of Canada and has become a public concern. A diverse range of development factors have resulted in this loss of wetlands. Figure 4 portrays data showing that agriculture, urbanization, and industrial developments including port and harbour projects, have been the cause of the majority of the wetland loss in Canada since the nation was settled. Agricultural development, particularly in the Prairie regions of Canada, is the single greatest cause of wetland loss in Canada. In comparison, the horticultural peat industry has affected only a relatively small number of wetlands relative to these impacts (Rubec, in press).

Wetland loss due to urban, industrial, and agricultural development has been greatest in the marsh, swamp, and shallow open water classes with only a relatively low percentage of bogs and fens affected by these factors. This is because the bog and fen wetland classes are the less common wetlands present in areas of Canada where settlement and development have occurred. Horticultural peat developments, however, tend to mainly affect the bog wetland class and have minimal relationships with other wetland classes such as marshes and swamps. As previously discussed, horticultural peat developments are primarily found on bogs within the boreal wetland regions. Due to the geographic location of these regions, many of the conservation issues of greatest concern, i.e. agricultural

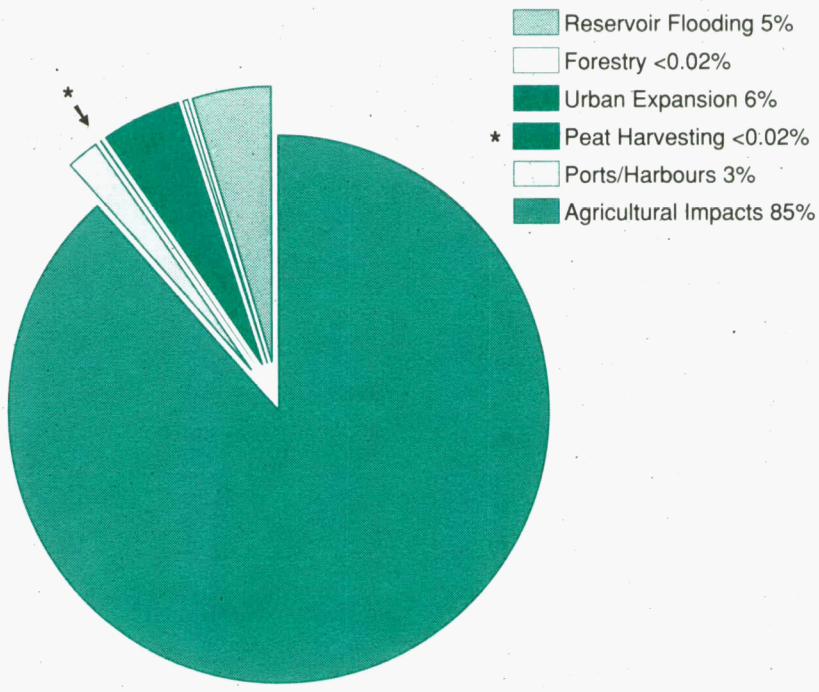


Figure 4: Land Use Impacts on Canadian Wetlands since Settlement
Sources: Rubec and McKechnie 1990; Rubec, in press.

drainage or infilling, urbanization, and industrial development, have relatively little relationship to the horticultural peat industry. The peat industry, due to its concentration in certain geographic areas of the nation such as the Prairie provinces, northeastern New Brunswick and southeastern Quebec, is focusing its attention on the effects of peat harvesting in these areas.

Nevertheless, the overall impacts of peatland development are not well documented. Osborne (1982) discusses potential impacts and presents a set of assessment guidelines developed by Environment Canada for peatland developments. A study by Clarke-Whistler *et al.* (1984) provides a summary of the technical literature on the topic. This study was based on the premise that an understanding of the structure and functions of the peatland ecosystem was needed to evaluate the significance of potential environmental impacts. The report provides considerable detail on the physical and biochemical properties of peat. The study concluded that potential aquatic impacts arising from peatland development relate to alteration of the hydrological regime and impairment of water quality, with subsequent direct or indirect effects on aquatic biota. An evaluation of the relative merits of wet and dry peat mining techniques was included in the study. The study proposed a modelling method for the prediction of impacts but noted that additional research was required to confirm the validity of the model.

Wildlife Habitat

Loss of wildlife habitat, particularly waterfowl nesting areas, is another general wetland issue of concern. The swamp, marsh, and shallow open water wetland classes are favoured habitat for most waterfowl and a wide range of other wildlife species due to the diverse range of vegetation and the common occurrence of open water. In contrast, bogs tend to have a minimum of open water, low diversity of vegetation and limited cover for waterfowl or other bird nesting purposes. The number of waterfowl and wildlife species and the total wildlife populations in bogs are generally lower in comparison to other wetland classes or to mineral soil ecosystems. However, a few species of small mammals, such as muskrat and beaver, and game species such as caribou, moose and deer, utilize peatland habitat. Other species use peatlands on a seasonal basis (IEC Beak Consultants 1983). Rare or endangered bird and mammal species that are known to utilize peatlands include Whooping Crane, Trumpeter Swan, Piping Plover, and the wood bison.

Horticultural peat developments are primarily found on bogs within the boreal wetland regions. Many of the wetland conservation issues of national concern have relatively little relationship to the horticultural peat industry.

A recent study (Gautreau-Daigle 1990), evaluated natural peatlands (domed bogs) and peat harvesting areas in close proximity to each other in New Brunswick. Some use of bog ponds by waterfowl was observed but usage seemed to be primarily for staging and migration with only limited brood-rearing. Usage appeared to be directly proportional to the availability of open water. Little difference was noted between the natural and developed areas. Overall, wildlife use of the bogs was found to be low, probably due to the low vegetation productivity of the bog

habitat. A related investigation of moose populations (Gautreau-Daigle 1990) indicated some usage occurred but a difference in population or activities was not observed between developed and undeveloped bogs.

Vegetation and Rare Plant Species

Vegetation conservation, especially the protection of rare or endangered species, is also an issue relating to peatland utilization. The composition of the vegetation community is largely a function of wetland class, in combination with factors such as climate and topography. The vegetation community which occurs on a typical peatland bog includes several species which are not common in mineral soil ecosystems. For example, pitcher plants (*Sarracenia* spp.), butterworts (*Pinguicula* spp.) and sundews (*Drosera* spp.), which can all capture insects to provide nutrients, are considered unusual and unique in some areas (Warner 1992). Many of these species, however, are widely distributed throughout Canada's boreal wetland regions. The pitcher plant for example, while the provincial flower for the Province of Newfoundland and Labrador, is found across the entire boreal zone of Canada.

Rare orchids capture the eye in their occurrences in peatlands across the nation. Outside Edmonton, Alberta in the Wagner Bog Natural Area, 16 species of provincially or nationally rare orchids have been identified (Thormin 1982). Much work needs to be done to document the richness and variety of rare and endangered flora in our nation's peatlands.

The ability of unusual flora, such as the pitcher plant, to obtain nutrients from sources other than groundwater enables them to survive in the ombrotrophic and acid conditions that are found on bogs. They occupy an ecological niche that few other species are suited to and can be found on many bog ecosystems.

The vegetation types found on bogs tend to have fairly typical associations of individual species which are well adapted to the conditions present on bogs. Some species, such as black spruce (*Picea mariana*), can tolerate a wide range of conditions and also can be found in non-wetland environments. Other species can tolerate a relatively narrow range of conditions and are not typically found outside a bog environment. While the development of a particular peatland can result in the loss of local habitat for certain species that occupy a narrow ecological range, the relative level of impact which results can also be considered within a regional context rather than just a site-specific basis. Development of the only remaining bog in a particular region must be viewed differently than the development of a bog in a region where the majority of the wetlands are of the bog class and representative and/or unique bog ecosystems have been earmarked or are secured for conservation objectives.

Photo: Ducks Unlimited Canada

Ducks utilize wetlands as critical habitat throughout much of southern Canada.

Other Biological Resources

Peatlands are also recognized as rich refugia for a wide range of other biological resources including invertebrate species. For example, the Biological Survey of Canada of the National Museums has organized a national peatland entomology project. This project is leading to a better understanding of the distribution and composition of the biodiversity of peatlands beyond our more obvious plants

and animals or birds. Some of the species now being found in Canadian peatlands are new to science. The Wagner Bog in Alberta is one site where focused biological research is ongoing.

Release of Carbon

Carbon gases release due to peatland development is another environmental issue of concern. The accumulation of peat in a peatland is a function of the anaerobic environment, i.e. lack of oxygen due to a high water table, which exists at the site. Draining of the peatland lowers the water table and accelerates the decomposition process. As a result, carbon which is stored in the peat is released to the atmosphere as carbon dioxide. Release of carbon gases to the atmosphere, which is primarily due to the combustion of fossil fuels (including coal, wood, peat, and petroleum products), has been suggested as a cause of global warming (the "greenhouse" effect). In addition to combustion of fossil fuels, other sources of carbon also contribute to this process. These include the loss of peatland vegetation as a net carbon accumulator through photosynthesis as well as the role of peatland waters in the carbon cycle.

Gorham (1991) assesses the impact of peatland development on the carbon cycle. The study indicates that, on a global basis, combustion of peat as a fuel releases about three times the quantity of carbon as is released from drained peatlands. Drained peatlands for fuel peat production represent a large percentage of the total area of developed peatlands on a global basis. The study also notes that the release of methane from undrained peatlands has a greater impact than the combined total impact from areas used for peat combustion and other drainage. On the basis of this information, the current level of development of peatlands in Canada, for horticultural peat production or other applications, would not appear to impact significantly on the global carbon cycle.

The total volume of horticultural peat shipped in Canada in 1990 was approximately 749 000 tonnes and was comprised of about 50 percent water and 50 percent dry peat (i.e. the quantity of bone dry peat was about 375 000 tonnes). In comparison, the mean annual rate of accumulation of dry peat and organic matter in boreal peatlands over the past 1 500 years, after compaction and losses by decomposition are figured in, was about 0.1 kg per square metre per year (Zoltai 1991) or about 1 tonne per hectare. While accumulation rates are lower in many northern peatlands, the total annual accumulation on the 111 million hectares of peatland in Canada still is

Photo: C. Rubec

Many rare and unusual plants are found in boreal peatlands.

substantially greater than the annual quantity of peat and peat moss harvested. If an average estimated peat accumulation figure of only 0.5 tonne per hectare per year can be assumed to be reasonable, the total peat volume accumulating in the natural environment in Canada would exceed 50 million tonnes each year.

Site-specific Issues

Site-specific issues relating to peatland development include a range of water management considerations which result from the development of a drainage system on the peatland. Water quality factors including suspended solids and various chemical parameters are an important concern. The impact on the water flow regime must also be considered including the runoff rate, attenuation of peak flows, groundwater recharge, and several related parameters. Air quality, due to wind erosion of production areas and stockpiles, is also a site-specific concern for horticultural peat developments. Reclamation and restoration of peatlands at the conclusion of harvesting is another issue that is receiving increased attention.

Water Quality

The potential effect on downstream aquatic ecosystems of drainage waters from developed peatlands is a significant environmental issue that has received considerable research interest. Several studies (Carpenter and Farmer 1981; Monenco Maritimes 1986; Shotyk 1986; Washburn and Gillis 1982) have compiled data on this topic. Much of the work was oriented toward fuel peat developments but is generally applicable to horticultural operations. Both the physical and chemical quality of the water must be considered.

Physical parameters such as suspended solids are a concern for a horticultural peat development. Preparation and operation of a bog results in the removal of surface vegetation. The exposed peat particles can be transported into the drainage system and leave the peatland. Sedimentation ponds are now being installed at many new horticultural peat developments as a means of controlling this situation. Design of the ponds must incorporate sufficient residence time to permit settling of solids during periods of peak rainfall.

Photo: NAWCC (Canada)

Education is a critical component in understanding the balance between the needs for sustainable resource use and peatland conservation.

Chemical parameters, such as pH and a range of elements, are also a consideration in the operation of a peatland. These factors receive less emphasis because natural drainage waters from bogs tend to already have a low pH. Dilution of drainage waters by receiving bodies minimizes the impact of these factors but short-term anomalous concentrations could occur during the initial development of drainage systems when large quantities of water are being released.

Responsible, environmentally-sensitive management of such sites in the development phase is required.

Runoff Quantity

The amount of water discharged from a developed peatland relative to the amount discharged from a natural peatland has been a subject of increased interest. The establishment of an extensive network of drainage ditches enhances the opportunity for precipitation to be transported off a peatland. This would be expected to result in a quicker rate of runoff in mineral soils but does not appear to be the case with peatlands. The reduced water level in the peatland which results from the introduction of a drainage system allows greater storage of water following a precipitation event. As a result, runoff peaks tend to be of a lower magnitude from developed peatlands rather than from natural, undisturbed peatlands. The water stored in the peat layer tends to discharge over a period of several days. Recent studies of peatland hydrology have been conducted in New Brunswick (Gemtec 1991) and Newfoundland (Northland Associates 1989).

Reclamation and Restoration

According to industry sources, only about 1 500 ha of peatland have been fully harvested for peat and/or peat moss in Canada as yet. However, the concepts of "reclamation" and "restoration" are now becoming important for peatland management in this nation. "Reclamation" is focused on the after-use of harvested peatland sites. "Restoration" implies reestablishment of the site as a peatland with a functioning natural ecosystem with characteristics as close as possible to pre-harvesting conditions.

Reclamation requirements for peatland developments in Canada have not been clearly defined. With few peatlands at the end of the production life, Canadian industry has little direct experience in this field. In countries such as Finland, Ireland and Germany, peatland reclamation has received significantly greater attention. This reflects their long history of peatland use and the more frequent occurrence of peat deposits where the reserves have been exhausted. Recent reviews of the literature on reclamation are provided by Daigle *et al.* (1988) and Nilsson *et al.* (1990).

"Reclamation" and "restoration" are now becoming important for peatland management in this nation.

There are several options for peatland reclamation. This includes the transformation of the site into a new (but ecologically changed) functioning wetland providing values such as waterfowl habitat, and development of an agricultural cropland or a forestry plantation on-site.

Afforestation of depleted peatlands (also termed cut-over peatlands) is practised in many European countries with several techniques used. Most involve the use of the drainage systems left at the conclusion of peat harvesting. In some cases, a 30 to 50 cm (or more) layer of peat is left on the peatland for afforestation purposes. In other cases, deep ploughing is carried out to blend the basal peat with the underlying mineral soil. Fertilizer and lime may also be applied to enhance tree growth or increase the pH. Similar techniques can be used to develop biomass production sites where rapidly growing species such as willow (*Salix* spp.), alder (*Alnus* spp.), or cattail (*Typha* spp.) can be harvested as a fuel source.

Agricultural use of peatlands can also be a viable option for depleted peatlands. Agricultural development on the organic soils characteristic of peatlands is common in several parts of Canada, i.e. southern Ontario, southern Quebec and the Fraser Delta of southwestern British Columbia. Site preparation techniques, equipment, and fertilization requirements, for example, have been refined through experience. A variety of crops is produced including carrots, cabbage, and onions. The technology used at these sites is likely to be readily transferable for horticultural peatland reclamation. The existing drainage system from peat harvesting would facilitate agricultural use. As with most agricultural endeavours, climate and growing season are major factors in the overall viability of crop production.

Establishment of waterfowl habitat is also a peatland reclamation option in certain circumstances (Clarke-Whistler and Rowsell 1983). When the configuration of the base of the peatland is suitable, the drainage system can be blocked to create ponds or lakes. Sites that have been subject to wet mining techniques, which involve extraction of peat and pumping of a slurry to a processing location, would have good potential for this type of reclamation. Ponds established during peat production at a wet mining operation in British Columbia (Carncross 1983) have been used for the creation of waterfowl nesting areas for example.

Revegetation of depleted peatlands with naturally occurring wetland vegetation is a viable peatland restoration option. A study by Nilsson *et al.* (1990) presents several case histories from eastern Canada and the northeastern United States for harvested peatlands that were abandoned and allowed to naturally revegetate. The rate of revegetation was found to be as short as a few years on minerotrophic sites. For large expanses of ombrotrophic bogs, vegetation cover required in the range of 15 to 20 years to become fully reestablished.

Several factors influence the nature and rate of revegetation. The hydrologic regime at the site, nutrient status (ombrotrophic versus minerotrophic conditions), and proximity to other vegetation for recolonization all have significant influence.

Revegetation of depleted peatlands with wetland vegetation is a viable restoration option.

The hydrologic regime is largely a function of the status of the peatland's drainage system. If the drainage system is functional, there is a reduced water level relative to natural conditions. The type of vegetation, as well as the rate of revegetation, reflects this situation. Species which prefer "wet" conditions are infrequent whereas species more tolerant of "dry" conditions tend to recolonize. The method of peat harvesting is also a factor (i.e. block-cut peatlands tend to have ridges of dry peat interspersed with moister areas). The drainage networks on peat harvesting sites are designed to "manage" the water level in the peatland. This network can also be used to influence the hydrologic regime during restoration of the peatland. For example, the drainage system can be blocked to result in a higher moisture level which will influence the type of plants that recolonize the site.

The nutrient status of a peatland is also a controlling factor on the rate of revegetation and on the type of species that recolonize a site. If a site is ombrotrophic (nutrient-poor), plant species tolerant of these conditions are the main recolonizing species. Overall

species diversity tends to be low, as is the case in a natural ombrotrophic peatland. On minerotrophic sites, herbaceous species tend to represent the initial phase of succession, followed by shrub and tree-dominated communities. Species diversity is higher and the vegetation tends to be more robust than that found under ombrotrophic conditions. Nutrient levels also control the rate of revegetation. Fen sites typically revegetate in three to seven years. Ombrotrophic sites can take between one and two decades to revegetate in unmanaged locations. However, liming to reduce soil acidity accelerates revegetation. Nutrient amendments on ombrotrophic sites can result in revegetation of naturally occurring species in less than five years (Nilsson *et al.* 1990).

The availability of species for recolonization is also a factor in the revegetation process. For some species, wind borne seeds enhance the recolonization process. Other species propagate by less mobile methods. Transplants of rhizomes (root structures) could be considered as a method of recolonization of some species. Transplants of "clumps" of shrubs and herbs also is a potential method of recolonization. In Germany, the retention of "strips" of natural vegetation in the design of new peatland developments has been suggested as a means to enhance the availability of plants for propagation.

Case Studies

Environmental regulations have undergone substantial change in the past decade. Environmental impact assessments are now commonplace for peatland developments in many provinces. For example, the Provinces of New Brunswick and Nova Scotia require that all undertakings which involve more than two hectares of wetland must be registered for review to determine whether a full environmental assessment is required. Several recent cases in Canada have arisen where developments for horticultural peat production have undergone review. Canadians have also had the fortune to learn from European experience. Examples from Canadian provinces and Europe are discussed below.

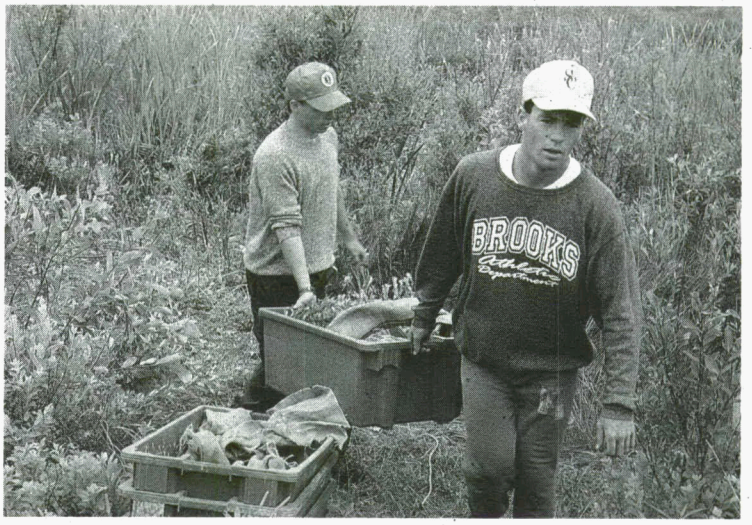


Photo: Island Nature Trust

Transplanting of rare and unusual species at Miscouche Bog, Prince Edward Island.

Miscouche Bog, Prince Edward Island: In 1990-1991, a proposal to develop the Miscouche Bog on western Prince Edward Island was reviewed under that province's environmental assessment legislation. This site, the single largest bog in the province, is owned by the Acadian Land Purchase Trust. In 1990, the Trust proposed economic development of the peat on this site. A provincial Environment Assessment Panel was established and public review was undertaken. The proposal entails provision of 20 permanent and seasonal jobs and a $1.4 million development with an

expected 20-year production period of 100 000 standard peat bales per year. The site was identified by the International Biological Program over 20 years ago as a peatland of international significance and is known for significant occurrence of numerous unusual plants considered rare in Prince Edward Island. Hence, the Island Nature Trust, a non-government conservation foundation, proposed full protection of the area.

In February 1991, the Minister of Environment for the province had received the Panel's recommendations and ruled that the development proceed with the following conditions:

(i) allow time for the scientific community to transplant endangered plants from the Miscouche site to other secured areas.

(ii) the province compensate the scientific community by acquisition of three other important but smaller bogs on the Island: Brae Harbour Bog, St. Peter's Bog, and Wood Island Bog; these sites be turned over to the Island Nature Trust for long-term protection and management.

(iii) the proponent provide for and be committed to site restoration/reclamation after peat harvesting to either a natural state or one useable for an appropriate agricultural purpose.

Subsequently, in July 1991 the Island Nature Trust undertook a plant rescue mission at this bog. Some 50 students during a three-day period moved over 2 000 rare or unusual plants amid considerable television and other media coverage. The province has since proceeded with acquisition of the three designated bogs for protection and the peat development project is underway.

Barrington Bog, Nova Scotia: In Nova Scotia, a proposal to develop 32 hectares of a 100-hectare peatland at Barrington was reviewed under the provincial Environmental Impact Registration Process. Peat extraction for fuel purposes was the intended utilization. A study found that the thread leaved sundew (*Drosera filiformis*) grows on the peatland (and three other sites in the area) and that the proposed development would endanger this plant species (The Chronicle-Herald 1991). As a result, the Plant Subcommittee of the Committee on the Status of Endangered Wildlife in Canada has added the plant to its endangered species list. The Nova Scotia occurrences apparently are the most northerly reported occurrences of the plant. The plant is also reported to occur in several New England States and has been identified as requiring "protection" in some states. However, the species is designated "common" in some other United States Gulf Coast states. The Nova Scotia Department of Environment has determined a full environmental impact study would be necessary and has recommended the proponent evaluate an alternate location.

Bull Pasture Bog, New Brunswick: In New Brunswick, any development involving more than two hectares of wetland must be submitted for review under provincial environmental impact legislation. A proposed development is reviewed and a decision is made as to whether a full environmental impact assessment would be required. A recent proposal for a horticultural peat development on the Bull Pasture Bog near Fredericton has undergone this process and it has been determined that an environmental impact assessment is required. Draft "Terms of Reference" have been prepared by the Department of Environment and made available for pub-

lic review. The proponent must now complete an environmental assessment study before a decision can be made on approval of the proposed development.

Alberta: In Alberta, public hearings were held in 1990 to discuss a draft "Policy for Wetland Management in the Settled Area of Alberta." A series of meetings, public open houses, written submissions, and similar approaches were used to solicit input on a variety of management issues. Management of peatlands was one aspect of the discussions and several issues were raised. These included the need to recognize the values of bogs and fens for purposes other than peat extraction and the need to incorporate peatlands into the development of an overall provincial wetland management policy.

Europe: In Britain, there has been an ongoing public debate over the continuing use of peatlands. Conservation groups and peat producers have engaged in a controversial media campaign to present their respective points of view. A national boycott of peat products has been promoted by a coalition of British environmental groups as one method for attracting public interest in this debate.

In Ireland, the situation is less controversial but conservation requirements are receiving increased attention. The need to achieve a balance between development and conservation has been recognized by industry (Welsby 1990). Much of Ireland's peat production for both fuel and horticultural purposes is administered by the National Peat Board (Bord Na Mona) and there is a statutory obligation to manage the peatlands in the best interest of the country. Non-government environmental organizations (in particular the Irish Peatland Conservation Council), Bord Na Mona, and the Irish Wildlife Service are working in a positive and cooperative manner to implement a national peatland conservation program with defined targets and firm funding proposals.

Photo: H. Hirvonen

Research on peatland restoration and reclamation ecology and technology is essential to effective peatland management.

In countries such as Germany and the Netherlands there are few peatlands which have not been altered. In the Scandinavian countries and Finland, certain peatland types are becoming scarce but mechanisms for protection are in place. Finland, Sweden, and Norway all have peatland ecological reserve or park programs established to ensure completion of protected peatland networks in the next few years.

Status of Peatland Conservation in Canada

The vast peatland resource in Canada is not extensively used. Only about 16 000 ha (0.02 percent) of the over 111 million hectares (Table 1) of peatland in Canada are used for horticultural peat or peat moss applications. Almost no peatland area in Canada has to date been utilized for peat fuel applications. An additional 25 000 ha have been drained for forestry production and a further undetermined area is used for forest harvesting (mainly in winter for pulpwood). In comparison, it has been estimated that, since the era when Canada was first settled, almost 20 million hectares of wetlands have been converted to other land uses through agricultural development, urbanization and a variety of other factors (see Figure 4).

An inventory of protected peatlands and wetlands in Canada is certainly required. To date, there has not been a comprehensive or systematic national compilation of peatlands which are currently "protected" under some form of federal, provincial or municipal legislation or through private sector land stewardship initiatives. It is known that wetland ecosystems comprise about eight percent of Canada's National Park system, for example, but regional or provincial summaries or wetland and peatland conservation plans are generally non-existent.

However, in some areas, a reasonable balance between development and protection does exist. In eastern New Brunswick, for example, raised bogs are used for horticultural peat production. About 3 000 hectares of similar peatlands are within Kouchibouquac National Park. This "known" level of protected peatlands of the same type can be compared to the approximately 4 000 hectares currently developed for peat production in New Brunswick. About 11 000 hectares of peatland in total are owned or leased by the peat harvesting companies in New Brunswick. An additional wetland area in excess of 5 000 hectares has been secured in New Brunswick for enhancement as waterfowl habitat by Ducks Unlimited Canada. The Province has also conducted studies to identify representative peatlands from each of the seven peatland zones in New Brunswick. These sites are proposed for protection as ecological reserves.

The Government of Canada has announced the adoption of *The Federal Policy on Wetland Conservation* (Government of Canada 1990, 1991). The objective of this policy, perhaps the first of its kind by any nation in the world, is "to promote the conservation of Canada's wetlands to sustain their ecological and socio-economic functions, now and in the future." The policy outlines a series of "guiding principles." These include recognition that on-going development and research is fundamental to the achievement of wetland conservation. In addition, communication and education programs to change the attitude and perception of Canadians regarding wetlands are a vital prerequisite of wetland conservation.

One of the seven strategies for implementing this federal policy is the development of a national network of "secured wetlands of significance to Canadians" which represents the full range of wet-

"Canadian peat producers have a new role to play — not only as producers — but as people responsible to the environment."

Gerry Hood, President CSPMA

land functions and forms. The attainment of this goal will require the cooperation of provincial and municipal governments, conservation groups and industry. As peatlands will be a vital component of such a network, the peat industry in Canada is a significant stakeholder in this concept. Implementation of this strategy will involve the adoption of systematic national and regional criteria for identification and management of significant wetlands and peatlands. The federal policy also identifies the key roles industry and governments must take to promote both research and sustainable wise use of wetland resources in Canada.

The peat industry in Canada is encouraging the development of peatlands in accordance with environmentally sound practices. Gerry Hood, President of the CSPMA, in his opening address to the Association's annual meeting in October 1991, noted that "Canadian peat producers have a new role to play - not only as producers - but as people responsible to the environment." The Canadian Sphagnum Peat Moss Association (CSPMA) has developed a peatland development and reclamation policy which encourages its member companies to interact with conservation groups and enhance public awareness of peatland resources (CSPMA 1990). The Association is promoting guidelines for peat production and for site reclamation.

In February 1992, the CSPMA and government agencies hosted a national workshop on peatland reclamation methods and guidelines. Recommendations for fostering research and appropriate technologies in support of the implementation of peatland reclamation and restoration were developed (see below). An Environmental Task Force, as recommended, is now being implemented.

PEATLAND RECLAMATION AND RESTORATION

As a result of a February 1992 National Peatland Reclamation Workshop, the following recommendations were developed representing the consensus of interested parties from the peat industry, researchers and government agencies.

- The Canadian Sphagnum Peat Moss Association (CSPMA), in consultation with other stakeholders, should work with CSPMA member companies to assist them in effective implementation of the CSPMA Policy on Peatland Development and Reclamation.
- Models for bog reclamation and restoration should be developed and made available to, and shared among, peat industry companies.
- A data base on peatland reclamation and restoration, drawing on experience in Canada and elsewhere, should be established.
- A peatland reclamation and restoration education kit and materials for use with peat industry employees should be developed.
- An Environmental Task Force should be set up with representatives of the industry, peat research agencies and groups, environmental interests and government. This Task Force should develop broad guidelines to the industry for site reclamation and restoration and encourage development of appropriate technologies.

Summary

Canada's vast wetland and peatland resources are gradually being subjected to increased development pressures. Wetland conversion due to urbanization, industrial development, and agricultural practices has been substantial, exceeding 20 million hectares since the early 1800s. The horticultural peat industry in this context has impacted only a minor area – about 16 000 ha (0.02 percent) of all the peatland in Canada. Peatlands developed for horticultural purposes are primarily situated in the boreal wetland regions and consist mainly of the bog wetland class. Boreal peatlands will likely be affected by forestry, hydroelectric development, and other programs to a much more significant extent than by any amount of horticultural peatland development in the future (Rubec, in press). Because bogs are the main source of the *Sphagnum* peat preferred by the peat industry, peat harvesting has had relatively little impact on the swamp, marsh, and shallow open water wetland classes as these are less common wetland classes in the boreal wetland regions.

Several environmental issues related to peatland development have been identified. General issues include the need for conservation of flora, fauna and other ecological values or functions. The potential for release of carbon gases due to Canadian peat harvesting is considered to be insignificant in relation to other uses of carbon sources such as the combustion of fossil fuel (i.e. coal, oil and natural gas), and is unlikely to influence global warming at the present or projected levels of peatland development in Canada. On a site-specific basis, the influence and mitigation of the effects of drainage of peatlands for peat production on water quality and flow regime are being addressed in Canada through existing regulatory procedures and research.

Site development guidelines to minimize environmental effects are being developed and implemented by the peat industry. Reclamation and restoration of peatlands after utilization ceases is being addressed by the industry in consultation with government and environmental groups. A national task force involving industry, university, government and environmental interests is currently being established to coordinate the implementation of peatland reclamation and restoration research. The results of recent research, for example, indicate that many developed peatlands can be restored to ecologically balanced systems in periods as short as five to twenty years after horticultural peat production. However, much more work needs to be done. Long-term management of peatlands no longer used for production is being given priority. Reclamation and restoration options are being incorporated during design and operational development of new peat harvesting areas.

Canada has extensive areas of peatlands in a natural state and has the opportunity to select representative peatlands for conservation securement. This opportunity has been lost in most European countries where peat production has been practised for long periods. However, even in Canada, development pressures are high in some regions and for certain wetland types. Cooperative efforts on a long-term basis between various levels of government, conservation groups, and the peat industry will be required to attain a national network of secured wetlands which represent the full range of wetland functions and types including the many forms of peatlands across the country. Through *The Federal Policy on Wetland Conservation,* a commitment to the creation of such a network has been made by the Government of Canada (1991).

Current initiatives by the horticultural peat industry in Canada indicate a recognition by peat production companies of their responsibilities and roles. The willingness of the industry to be an active partner in wetland conservation with governments and other private sector groups provides a positive atmosphere for the attainment of sustainable wise use of Canada's peatland resources.

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