Chapter 3

The Future of Peat in Nova Scotia

3.1 The Economic Value of Peatlands

3.1.1 Introduction

Peatlands are almost unknown to the general public except as sources of peat moss or as a no mans land infested with bugs and soaked with water. However, peatlands have several intrinsic ecological and economic values that make them worthy of public awareness.

For the sake of simplification Nova Scotia's peat resource has three primary economic or potential commercial uses:
1. production of peat moss and associated by-products,
2. fuel peat production and utilization, and
3. as land for the cultivation of various cole, forage and wild crops.

The drainage of peatlands for silvicultural and horticultural crop production is common practice in many European countries. However, these practices are still fairly new to Nova Scotia.

Cultivation of carrots, lettuce, potatoes, and various cole crops on peatlands has been demonstrated in Nova Scotia (Chipman and MacKay unpublished report, Agriculture Canada, Kentville, N.S.). Cranberry cultivation has also been attempted, with some limited success (unpublished material, Nova Scotia Dept. of Agriculture and Marketing, Truro).

The development of peatlands for extraction of moss peat and fuel peat products, shows a great deal of potential in the province. There are many varied uses of peat and peat products, both in horticultural and energy markets.

This chapter will provide information on both the natural and economic values of peatlands, with particular reference to the extraction of peat for industrial use. The chapter also provides an overview of standard methods of peat extraction, an assessment of the feasibility of peat harvesting in Nova Scotia, and consideration of some of the potential impacts of peatland development.

3.1.2 The Harvesting of Peat

Peat harvesting has been practiced for centuries to supply fuel for cooking and home heating. The most traditional method is hand cutting the peat into sods, drying them in the fields, and piling them for later use. Although this method is still in use, increased demand for horticultural and fuel grade peat has led to much larger scale peat production methods. Modern production operations utilize many large pieces of equipment and require vast expanses of peatland to meet demand.

Two principal methods of peat harvesting are dry harvesting and wet harvesting. Dry harvesting is the more popular method.

Dry Peat Harvesting

The dry harvesting of peat relies on natural environmental conditions (sunshine, wind etc.) to dry the peat at the surface of the peatland before removal for use. Dry harvesting techniques remove peat from the deposit in the form of chunks or "sods" or in a powder or "milled" form.The following section describes practices currently used successfully in dry peat harvesting and illustrates the current scale of peat operations.

Pre-production Phases
Prior to peat harvesting, two pre-production operations, bog drainage and surface preparation, allow for peat drying and the access of heavy production machinery.

Drainage
The level of groundwater in an unharvested peatland lies just beneath the surface. Preparation of the peatland involves lowering the water table through excavation of a network of ditches. A level is maintained that prevents moisture "wicking" up to the drying surface, yet which is high enough to lend stability to the surface for support of harvesting machinery.

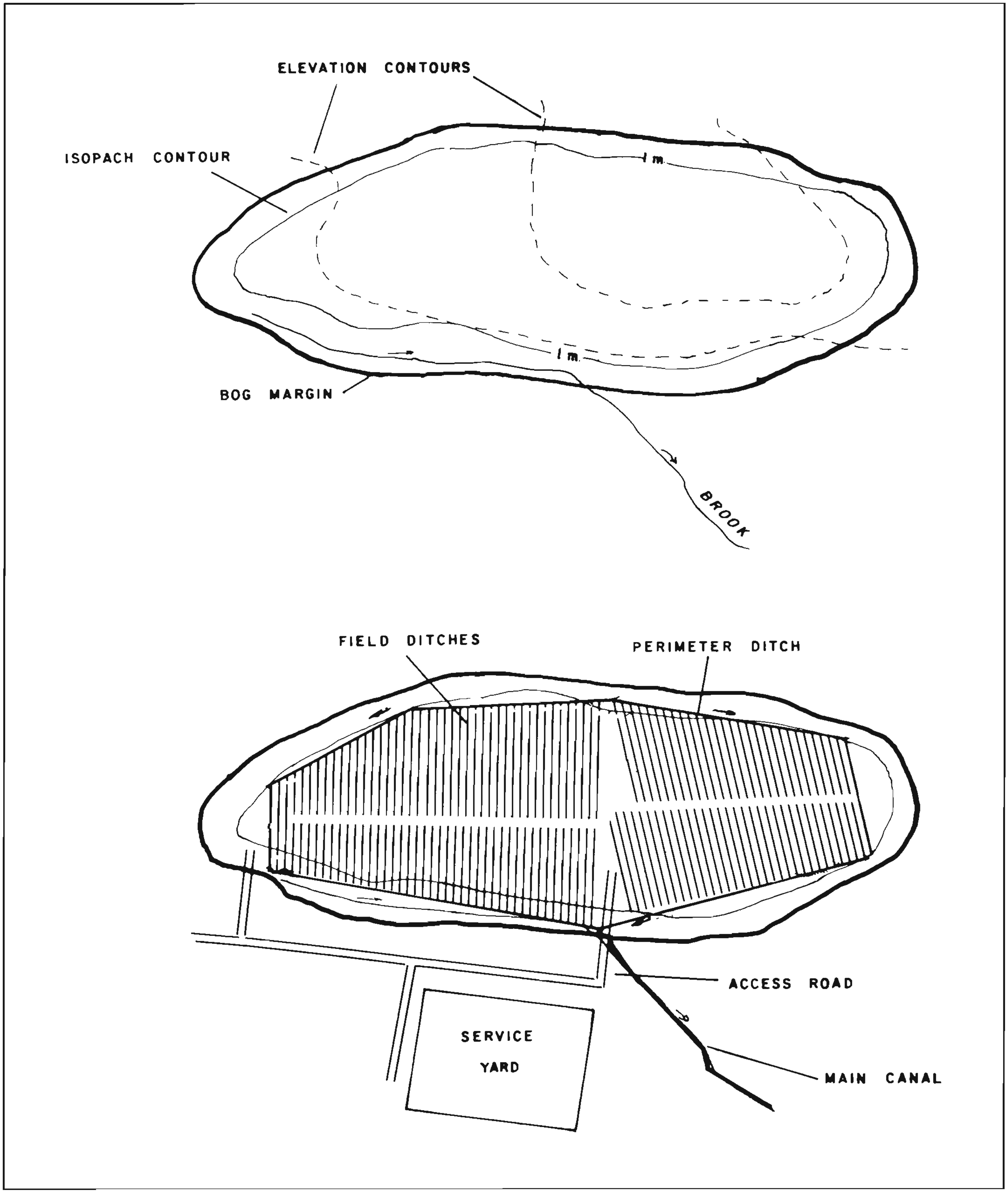


Figure 3.1
Typical drainage plan for peatland development.

The production area is made up of fields 50-70 feet (15-20m) wide, separated by ditches which run to main ditches at the ends of fields leading to a trunk drain (Figure 3.1). The trunk system of ditches removes water quickly from the production area and usually ends at a natural water course. Perimeter ditches are used to isolate the production area from the surrounding water table. Ditching plans or layouts are designed to minimize the number of bridges or culverts and reduce excessive travelling over the developed surface. This reduces overhead costs as well as reducing damage to the fields.

Surface Preparation

Before production can begin, the surface of the fields must be levelled. This is done by first removing the surface vegetation along with some of the peat overburden. The exposed surface is then crowned and smoothed to create a level surface for peat harvesting (Figures 3.2 and 3.3).

Milled Peat Production Phases

Prior to harvesting the peat is milled and turned several times. To lift the milled peat off the surface, large vacuums attached to tractors are pulled repetitively across the bog (Figure 3.4). The height of the vacuum nozzle can be adjusted to allow for selective harvesting of the driest peat. The peat collected is dumped into stockpiles at the end of the production fields. Stockpiled peat is then transported off the fields to a central stockpile, or directly to a thermal plant or to other industrial users (Figure 3.5).

One producer in New Brunswick and one in Newfoundland use the "ridge method", which differs from the above only in its collection techniques. Tractors use wide plow blades to scrape the dried peat into windrows in the centre of the production fields. After several days these field ridges can be combined using conveyors, or loaded directly into trailers for transportation to a central stockpile. The "ridge method" is more weather dependent, relying on a longer drying period. However it has the advantage of having a higher production output and lower operating costs than vacuum harvesting. (Monenco Ontario Limited 1981)

Block Cut Peat Production

Block cut peat production involves the extraction of blocks of peat from a vertical face in the peat deposit. The blocks are stacked wet and are turned once or twice during the next three months to promote drying. The peat blocks are then taken to a plant where they are shredded to produce a long fibrous moss for horticultural use. In Canada, block cut peat is used primarily for horticultural purposes.

Sod Peat Production

Sod peat is produced most notably for use as a fuel. It is easier to handle in small and medium scale industries than the loose, low bulk density, milled peat.

One form of sod peat is commonly produced by large machines referred to as "baggers" (excavators). The machines are simple crawler mounted tractors using a bucket excavator to cut peat from a deep vertical face in the peat. A deep cut allows for complete mixing of peat, as well as for one pass removal. As it is removed from the cut, the peat is mixed and then kneaded before being extruded onto a chain belt travelling the length of a 30-60 metre spreader arm. When the peat reaches the end of the arm, it is tipped onto the surface of the bog for drying. A series of cutting discs trailing the arm cut the peat into sods. These sods are left to dry on the fields and are harvested in a manner very similar to the ridge peat method (Callanan 1972). Peat sods produced in this way tend to be quite uniform in quality because of the mixing that takes place.

In many sod peat operations, smaller machines attached to tractors produce sods that lend themselves to mechanized handling. These machines cut peat from angled slits in the bog, macerate it, and extrude it onto the field surface. The sods are turned several times before being ridged, collected, and transported to the stockpile in a manner similar to the bagger harvesting method (Figure 3.6).

The use of the smaller sod extruders provides a greater flexibility in the selection of production areas, as well as reducing the potential downtime losses that would affect operations relying on one or two of the large sod extruders or "baggers" as used in Europe.

The production of peat sods is not new to Canada. In 1910-1915 about 5000 tons (4500 tonnes) of peat sods were produced in Ontario at the Farnham and Alfred bogs using large digging and spreading machines. The machines cut and spread the peat, but the sods were all turned and stacked by hand (Anrep, 1911; Haanel 1926). The sod peat machines were large and cumbersome, and required large tracts of peatland to operate. Similar machines are still in use in Ireland, Germany and Sweden.

Figure 3.2
Surface preparation of peatland.

Figure 3.3
Prepared surface of peat production field.

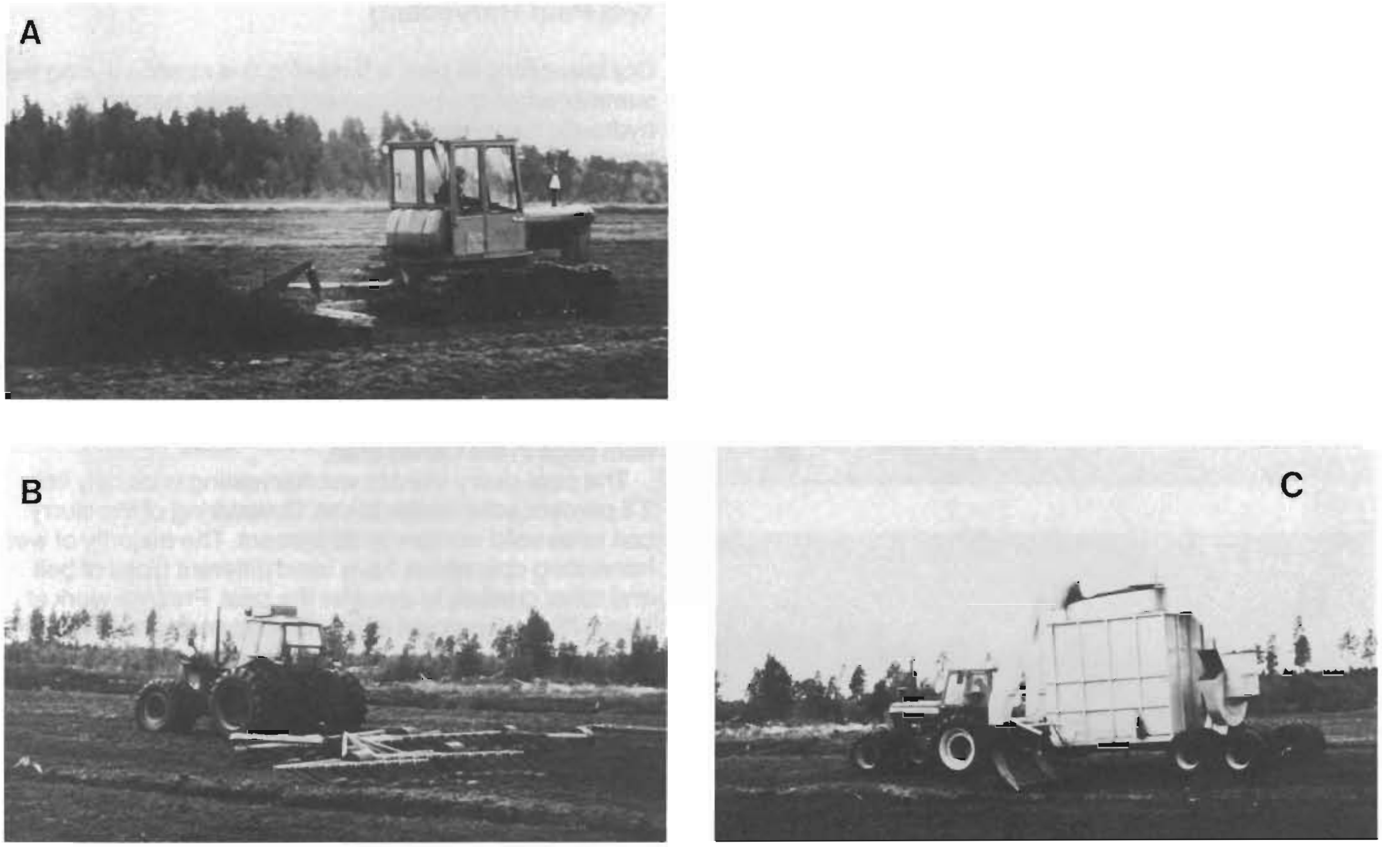


Figure 3.4
Milled peat production and vacuum harvesting. A. Production milling. B. Peat harrowing. C. Vacuum harvesting.

Figure 3.5
A large central stockpile at a briquetting factory in Finland.

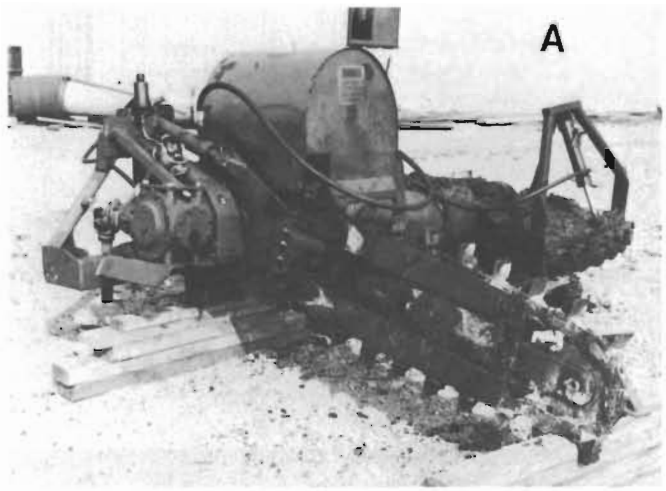


Figure 3.6
Sod peat harvesting. A. Herbst Difco Turf Cutter (sod extruder).
B. Collection and loading.

Wet Peat Harvesting

Dry harvesting of peat is limited to 3-4 months during the summer when the peat can dry naturally, but wet or hydraulic harvesting can be conducted eight or nine months of the year, sometimes year round. In wet harvesting, peat is pumped as a slurry from a dredge to a dewatering plant for artificial drying. Various types of barges and dredges have been used. In some cases hydraulic "monitors" (spray guns) have been used to wash peat into a slurry pond. Clam shells, draglines, and backhoes mounted on barges, have been used to harvest peat (Figure 3.7). In Nova Scotia, a small hydraulic harvesting operation used a barge, suction pump, and conveyor system to harvest horticultural peat from bogs in the Canso area.

The peat slurry used in wet harvesting is usually only 2.5 percent solid matter (peat). Dewatering of the slurry can raise solid content to 35 percent. The majority of wet harvesting operations have used different types of belt and roller presses to dewater the peat. Presses work at about 75 to 85 percent efficiency depending on the state of humification or fibre content of the peat. Recently wet suction techniques used in Finland have been up to 90 percent effective in lowering the moisture content of non-fibrous peat to 55 to 65 percent. However the technology is more cost effective on higher value materials such as mineral slurries. The Finnish wet suction method, coupled with condensation dryers, is capable of producing 45 to 50 percent moisture content peat with virtually no loss of material (Valmet O.Y.; Bjarne Ekberg, Paper Machinery Group, Valmet Corp., Finland, personal communication).

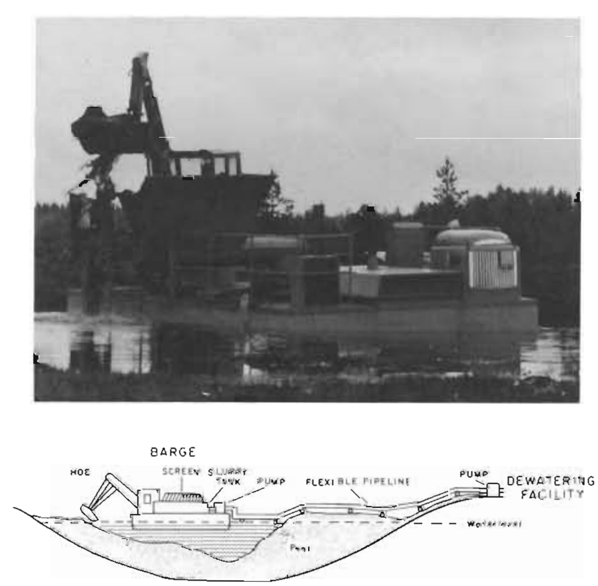


Figure 3.7
Hydraulic mining of peat.

3.1.3 Economic Viability of Fuel Peat Production and Utilization in Nova Scotia

To become a viable alternative to liquid fuels, solid fuels such as peat have to be easily handled, cheap to burn and control, and as well provide significant energy cost savings to consumers.

Energy cost savings generated by using less expensive solid fuels must be enough to offset installation costs and additional maintenance, and must provide a short payback period (2-3 years). Prior to conversion to solid fuels, the consumer must be assured that the fuel will be securable at competitive prices for relatively long periods of time.

Large Scale Applications

The use of peat for utilities is commonplace in countries such as Finland, Ireland, and the U.S.S.R., where very large base peat resources and energy demands exist. However, large 40-50 MW peat fired thermal electric plants that are feasible in Europe, may not be so in Nova Scotia because of the rather limited population base and limited resources. A 40 MW thermal electric plant would require on the order of 380,000 tonnes of peat, usually in the form of milled peat, annually. At the known annual production rate for Northeastern New Brunswick (160 tonnes/ha), Southwestern Nova Scotia's inferred resources could support such a facility, but the annual peat demand would exhaust the inferred reserves in less than 35 years and known reserves in less than 20 years.

Large scale applications may not be feasible until further reserves have been proven or until fossil fuel prices rises to a point where the construction of a 10-20 MW plant would be cost effective. A typical 10-20 MW plant is illustrated in Figure 3.8.

Where solid fuel reserves and markets exist, the economic viability of fuel peat production will depend on the cost of other solid fuels such as forest residue, mill waste and woodchips. To compete on the same cost per unit energy level, peat will have to be delivered to the consumer for roughly $30-45 per tonne. To provide fuel at this delivered cost, production levels will probably have to exceed 20,000-30,000 tonnes per annum (Technopeat 1984). Markets in regions such as southwestern Nova Scotia, where the fuel peat resources are large enough to support this level of production, would be primarily small to medium scale industries whose annual peat demand would vary from 1000 to 4500 tonnes. Figure 3.8 shows the relative scale of small to medium sized peat fired heating plants.

To be more attractive to these consumers, peat would have to be delivered on a regular basis in a manageable form. Milled peat tends to be very dusty and hazardous under some conditions, and thus peat sods or chunks would be more appropriate, although a little more expensive.

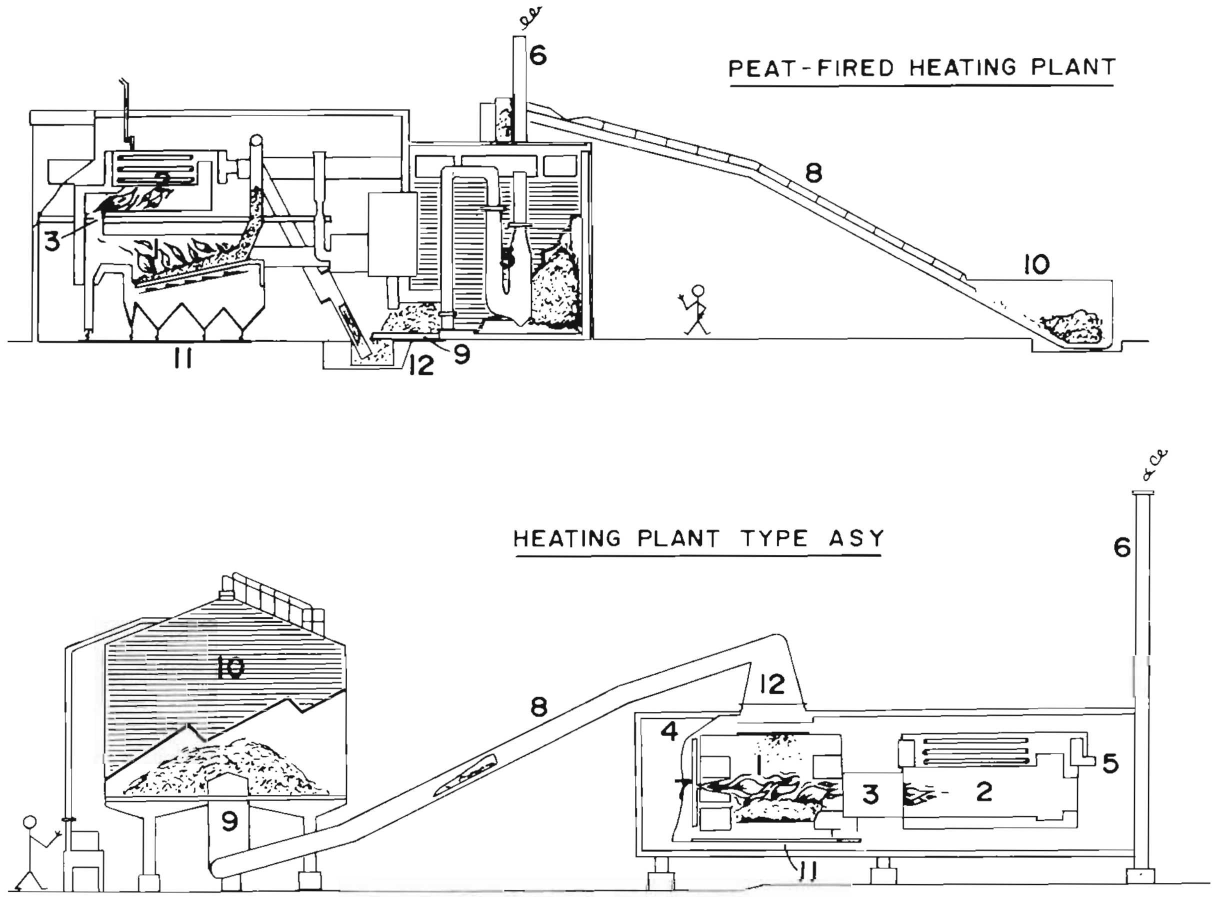
Currently solid peat combustion systems are very large capital investments. However, if sufficient price margins and suitable energy demands existed in these industries, conversion costs could be repaid within a few years. As shown in Figure 3.9, energy cost savings begin to be realized using peat when oil prices are above $0.14/l (No. 2) and $0.18/l (No. 6). Under current production costs, i.e. $30-$45 per tonne peat (delivered), peat begins to provide savings when oil prices would exceed $28 BBL (CDN).

Assuming that peat can be delivered for a cost of between $30-35 per ton ($3.00-3.50 per million BTU) and energy costs for No. 6 and No. 2 fuel oil are as illustrated in Table 3.1., a small to medium scale consumer could realize a fuel cost saving of as much as 40 to 50 percent for displacing No. 6 oil, and 50 to 60 percent for displacing No. 2 fuel oil.

Fuel	Cost per Unit Delivered ($)	Cost of Delivered Energy ($/MMBTU)
No. 2 Oil	0.20-0.30	5.45-8.15
No. 6 Oil	0.15-0.21	3.80-5.06
Hardwood Chips	23-27	2.45-2.85
Coal	75-80	3.00-3.50
Sod Peat (Probable)	30-45	3.00-4.50

Table 3.1
Comparison of Delivered Costs of Various Fuels (December 31, 1986)

A small consumer currently using 80,000 gallons of light fuel oil annually would require approximately 1000 tonnes of peat to generate 90% of the maximum operating load (assuming 10% of energy demand is met with oil to reach peak operating loads). At roughly $0.31/litre ($1.40/gallon) for light oil, the consumer's annual oil bill would be $112,000, while the cost for peat at $35 tonne would be $35,000, a saving of $77,000 or 69% plus overfire oil. If the same consumer acquired a 70 HP (0.36 MW) boiler package costing $150,000, the simple payback period would be less than two years. However, at late 1986 prices (Table 3.2), this same consumer would pay $0.21 per litre ($0.95 per gallon), or $76,000 annually. Savings would only be in the order of $44,000 or 37%, providing a simple payback within four years. The viability of peat as an alternate fuel lies in the context of overall cost savings and security of supply. If the cost of solid fuel systems reaches a level at which consumers can realize a cost benefit in the form of a short payback period along with secured fuel supply, then peat could play an important role in reducing oil demand in the commercial and industrial sectors.



LIST OF EQUIPMENT

1 Front Furnace
2 Boiler
3 Intermediary Channel
4 Combustion Air Fan
5 Flue Gas Cleaner and Flue Gas Absorber
6 Stack
7 Ignition Burner
8 Fuel Conveyer
9 Fuel Unloading Device
10 Fuel Store
11 Ash Remover Screw
12 Boiler Feeding Hopper

Figure 3.8
Typical peat fired heating plants.

Region	Measured Resources: Total Area (ha)	Surveyed Area	In situ Surveyed Volume × $10^6 M^3$: Moss	Fuel	Overall	Inferred Resources Volume × $10^6 M^3$: Moss	Fuel	Overall
Southwestern Counties Yarmouth, Shelburne Queens	54 515	17 875	177.0	221.0	398.4	541	674	1 215
Central Counties Kings, Hants, Cumberland, Pictou	18 105	6 261	121.5	56.5	178.0	351	163	514
Eastern Counties Halifax, Inverness Guysborough, Cape Breton, Richmond, Victoria	52 010	9 083	173.5	43.6	217.1	994	250	1 244
Remainder Non Inventoried Regions Digby, Annapolis, Colchester, Lunenburg, Antigonish counties	37 185	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Total	161 815	33 219	472	321	793	2 299	1 564	3 862

Table 3.2
Measured and inferred peat resources of Nova Scotia

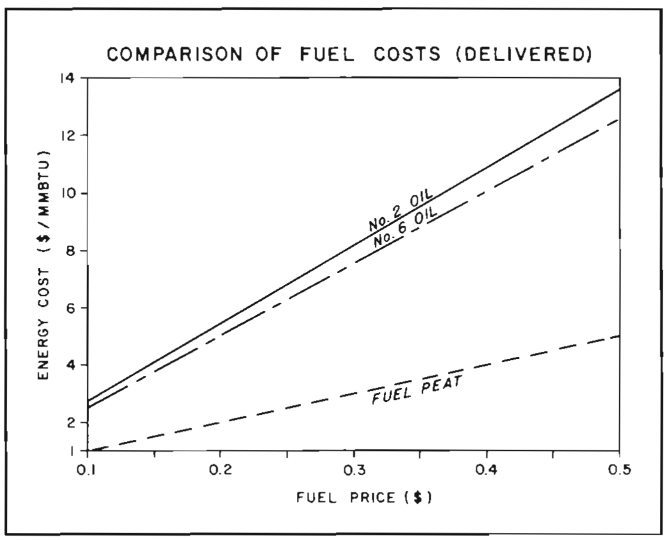


Figure 3.9
Cost comparison of oil versus fuel peat.

Domestic Applications

Once a commercial peat harvesting operation has been developed, and has secured long term supply contracts to make up a base production level, it can sell some peat fuel for domestic use. For household use, peat can be burned in a modified wood-coal capable stove, furnace, or fireplace.It produces a warm steady heat similar to coal. Currently peat is being sold as briquettes, charcoal, and in the raw chunk or sod form, in many countries in Europe. Where it is sold in Canada it is priced comparatively to wood.

3.1.4 The Feasibility of Peat Production in Nova Scotia

There is a great potential for development of peatlands for peat moss or fuel peat extraction in various regions of the province. Nova Scotia peatland resources are very extensive; roughly 400,000 acres (160 000 ha) of peatland have been identified in the Province. The peat resource of these areas is currently estimated at five billion cubic yards (3.9×10^9 M^3) of which three billion cubic yards (2.3×10^9 m^3) have been inferred to be of peat moss grade and two billion cubic yards (1.6×10^9 m^3) fuel peat grade (Table 3.2).

Fuel Grade Peat Potential

Roughly 30 percent of the provinces peat resources are located in southwestern Nova Scotia, 45 percent in other major concentration zones, and the remaining 25 percent distributed throughout the Province.

The major fuel peat resources of the Lake Rossignol area occur in seven deposits (Table 3.3). Total potential production area is estimated to be 2025 acres (820 ha), with an average exploitable depth of 7 feet (2 m). The average "life expectancy" for each area is 15-20 years, depending on harvesting rate and the depth of the peat. Preliminary evaluation of the reserves of this region indicate about 3.3 million tonnes of fuel peat (50% moisture content), enough to supply 50,000 tonnes annually for 60 years (Table 3.3). The area is well accessed by a network of logging roads leading to a major secondary road to Liverpool.

The Barrington-Argyle fuel peat resources extend from Clyde River to Yarmouth, and exist primarily within a few miles of Highway 103, the main transportation route.

Few other areas of the Province with significant fuel reserves were found. Only three sites outside southwestern Nova Scotia were delineated; a deposit at Lake Ainslie, Inverness County, "Shaws" bog in Falmouth, Hants County, and the Aylesford Bog in Kings County.

The Lake Ainslie deposit, although composed of fuel grade peat, occurs in a bog which is, for the most part, at or below the resident groundwater system. It has also been recommended as a valued unique ecological site. "Shaws Bog" in Hants County is potentially harvestable for fuel grade peat, but the deposit is small, low lying, and heavily treed. The Aylesford bog in Kings County is also potentially harvestable for fuel peat. Peat moss harvesting is currently underway there, and there are a number of potential markets for fuel peat in the region. This deposit is roughly 730 acres (295 ha) in size of which 250 acres (100 ha) can supply fuel grade peat. Assuming an average of 2 meters (6 ft) of fuel grade peat, this deposit could supply 420,000 tons (380,000 tonnes) of exploitable fuel.

Peat Moss Resource Potential

Peat of moss grade can be found throughout the province. Almost every deposit surveyed had a substantial layer of moss peat overlying the fuel grade peat. For the most part this peat was a pure or nearly pure *Sphagnum* based peat. Minor occurrences of shrub and sedge remnants could be found in most deposits. However in the surficial layer of harvestable deposits these constituents were not significant. The grade of the peat surveyed appeared to be quite high, with H_3 peats the most common. This is a very light, fibrous grade of peat, with very high water retention capablities (linked to the high structural integrity of the peat and low amorphous material content). Data collected by Sutherland and Shea (1976) and Leverin and Cameron (1949) indicate similar findings in various bogs surveyed in their respective reports. Water holding capacities for Nova Scotia moss peats were estimated to be between 15 to 25 times their sample weight at 25 percent moisture content.

Roughly 30 of the deposits surveyed in the current program show excellent potential for commercial development. Although there are many more deposits yet to be inventoried, and smaller deposits or groups of deposits with suitable harvestable reserves, the moss peat resources outlined in Table 3.4 warrant strong consideration for resource development. The current survey has indicated that there are about 20,100 acres (8 140 ha) of harvestable moss grade deposits in Nova Scotia, containing some 180 million cubic yards (136 Mm^3) of peat moss. Assuming a 75 percent recovery, this would be equivalent to 410 million bales of peat moss.

Several areas are shown to hold substantial peat moss reserves (Table 3.4). However the harvestability of the resource depends on a number of factors, such as shape and size of the deposit, climate of the region, height above local groundwater table, and distance from an export centre.These factors are evaluated in Table 3.5.

Deposit	Exploitable Area (ha)	Fuel Peat Reserves		Moss Peat (Overburden) Reserves
A) Lake Rossignol area		(×10[6]M[3])	(×10[6] tonnes)*	(×10[6]M[3])
P11-5	150	2.38	0.45	0.41
P12-7	45	0.80	0.15	0.04
Q12-3	105	2.50	0.48	—
Q11-2a	45	0.70	0.13	—
Q11-2	35	0.70	0.13	—
Q12-4	370	9.04	1.72	1.63
P14-3	70	1.44	0.27	—
Total	820	17.56	3.33	2.08
B) Barrington-Argyle area				
U7-12	85	1.80	0.34	—
U7-23	45	1.34	0.25	0.07
U7-27	35	1.19	0.23	0.16
U8-12W	190	4.39	0.83	0.16
U8-120	25	0.59	0.11	0.09
U8-17	40	1.13	0.21	0.14
U9-7	15	0.22	0.04	—
U9-11	30	0.42	0.08	—
U9-13	75	1.38	0.26	0.18
T7-5	70	1.20	0.23	0.03
T7-9	125	2.47	0.47	0.81
T9-7	70	1.30	0.25	0.28
Total	805	17.43	3.30	1.92

*A conversion factor of 0.19 tonnes/M[3] is used to derive an in situ tonnage at 50% M.C.
(Montreal Eng. Monenco and ADI Ltd. 1980)

Table 3.3
Harvestable fuel peat resources of Southwestern Nova Scotia

Region	Number of Potentially Harvestable Bogs*	Total Area Harvestable	In situ** Harvestable Volume	
			× 10^6M^3	× 10 Bale Eq.
Southwestern N. S.				
Lake Rossignol	8	2 870	30.9	93
Inland	2	300	4.2	13
Barrington-Argyle	8	1 379	21.7	66
Central Nova Scotia				
Hants Co.	3	1 010	33.5	100
Kings Co.	1	215	3.2	10
Pictou Co.	N.A.	N.A.	N.A.	N.A.
Cumberland Co.	3	1 320	21.0	63
Eastern Nova Scotia				
Guysborough Co.	3	475	8.3	25
Cape Breton High.	1	134	2.3	7
Cape Breton East	2	266	5.5	16
Halifax Co.	1	170	5.4	16

*Harvestable deposits are defined as having 100 ha or greater with 1m of surficial peat in areas where overall peat depth is greater than 1 m in depth.

***In situ* volumes are for moss grade peat only. 1 M^3 of *in situ* peat will yield three 170 l (6 cu ft) bales of peat moss.

Table 3.4
Potentially harvestable peat moss deposits (Surveyed Bogs, inventoried from 1980-1985)

Region	Character of Deposits	Approximate Distance to Export Center	Peat Profile	Climatic Variables	Other Remarks
Southwestern Nova Scotia	large, irregular shaped bogs with extensive, relatively flat domes	— 30 miles (Liverpool) — 60 miles (Yarmouth) — 180 miles (Halifax)	weakly defined moss layer, often mixed with thin layers of fuel grade	long freeze free period, high frequency of fog in coastal zones	inland deposits at or near ground water levels, substantial fuel resource in the region
Central Nova Scotia Cumberland Co.	large regular shaped bogs with evenly sloped domes	— 100 miles (St. John, NB) — 110 miles (Halifax)	well defined moss peat layers; however deposits often shallow with small harvestable areas	moderate freeze free period; average fog and rain days for Atlantic Region	very high resident water table in area of Tantramar Marshes
Hants Co.	large well domed regularly shaped bogs	— 40-60 miles (Halifax)	very thick, well defined moss peat layers	moderate freeze free period; low fog frequency	deposits near railway and highways leading directly to Halifax for export
Eastern Nova Scotia Guysborough	small deposits forming a number of peatland complexes	— 90 miles (Pt. Hawkesbury) — 120 miles (Halifax)	large lenses of well defined moss grade peat	moderate freeze free period: frequent fog occurence	deposits have very good peat moss, often raised above surrounding terrain
Cape Breton Highlands	small deposits	— 120 miles (Sydney)	thin well defined peat moss layers	short freeze free period; frequent fog and rain	large number of deposits; many unique to N.S.
Cape Breton East Sydney Basin	relatively large peat moss deposits	— up to 50 miles (Sydney)	good peat moss layer above thin fuel grade peat layer	moderate freeze free period cool moist climate	fairly good potential for peat moss development if environmental conditions allow for sufficient annual production
Eastern Coastal Plains	large number of peatland complexes	— 60 miles (Sydney) — 60 miles (Pt. Hawkesbury)	good moss peat, coastal bogs have large number of bog pools	moderate freeze free period cool moist climate and frequent fog occurrence	area may not yield sufficient annual production per unit area to warrant development

Table 3.5
Local factors affecting the expansion of the peat moss industry in Nova Scotia

3.2 The Impacts of Peatland Development

3.2.1 Potential Environmental Impacts of Peatland Development

The disturbance of any ecosystem by man, be it by the clearing of land for agriculture, forestry, or mining, induces a wide range of effects that have varying degrees of impact on existing biotic and abiotic systems. The following sections will briefly describe impacts that may be expected to occur should large areas of peatland be developed in the Province.

Peatland Drainage

By their very nature, peatlands develop in areas where high levels of groundwater or surface water exist. Under natural conditions, most peatlands in Nova Scotia are saturated with water to the point where the existing water table may be at, or just below, the surface of the bog. In most cases the level of the water table rarely changes more than a few centimeters, because of the moist maritime climate. This very high water table leaves little potential storage for precipitation, and runoff peaks entering the peatland are immediately felt on downstream areas.

Drained, the same bog area would have a lowered water table (20 to 30 cm below the surface in the middle of the production fields and 50 to 80 cm below the surface near the ditches). The result is an increased short term storage capacity in the bog, delaying runoff into the outlets until the water can percolate through the drained peat. Annual runoff from the bog would not be greatly increased, but the peaks in runoff would be stabilized as water is released slowly from the peat into the ditches.

The downstream effects of this flow pattern would be to cause changes in vegetation near the stream, increased sediment and colour loads (as there is now exposed peat), and increased movement of organics and organic sediments into runoff, resulting in increased acidity, BOD (biological oxygen demand), and COD (chemical oxygen demand). These factors can shift or cause eutrophication (stagnation) of downstream waters (Technopeat 1986).

Peatlands can develop a water table distinct from the local ground water system (Figure 1.7). The two tables will interact depending upon the percolation or conductivity of the organic and boundary mineral soils. The drainage of a perched water table will have little effect on lowering the groundwater table level. However it may effect its recharge potential.

After the drainage procedures lower the peatland water table below the top of the groundwater system, drainage ditches have the primary effect of removing excess surface recharge plus removing some of the internal water from the groundwater system.

In areas of high recharge capacity, peatland ditches normally only affect a small area within 50 metres of the ditch. Lowering of the water table near the bog margin in a number of instances has proven beneficial because of increased vegetation growth and the expansion of wildlife habitat (Technopeat 1984).

Peatlands are commonly sinks for heavy metals transported through air or water and which chelate or bind to molecules in the organic mat. Drainage waters have increased levels of ammonia, nitrate, nitrogen, phosphorous, aluminium, suspended solids, etc. The construction of sedimentation ponds, and cattail marshes at the outlet of the bog can relieve the increased nutrient loads from bog drainage into natural drainage systems. To ensure that bog waters have little effect on surface water outside the bog, monitoring and sedimentation ponds should be incorporated into the development plan of major peatlands whose exploitation will effect large quanitites of surface water.

Surface Preparation

Open bog or peatland areas used for peat production are relatively low in biological production. Nevertheless these areas support a wide variety of plant and animal life. Usually the edges of the bog are left relatively undisturbed by peatland development. As this is the primary area of biotic production, little significant impact may be expected.

Surface ponds or streams are often frequented by waterfowl, furbearers, and fish that will be affected by runoff or infilling. However in most areas of potential peat production there are nearby areas that provide similar habitat and can support the same forms of wildlife. The displacement of organisms from the developed areas may cause some temporary pressures on surrounding ecosystems. However in most cases pressures are anticipated to be minimal.

The peatlands of Nova Scotia will never all be utilized. Therefore much of the impact from areas which are developed could conceivably be absorbed by other non-utilized deposits near these areas.

Peat Production

The production of peat affects the surrounding environment in a number of ways, including production of dust, noise, traffic, and fire potential. Production of dust can be a nuisance to workers and surrounding dwellings. Wind blown dust will often fill ditches and smother vegetation near the peat bog margin. However, it may be somewhat beneficial to soil conditions near the bog. Most deposits in Nova Scotia are distant from communities and are not likely to create a problem. Sod peat operations have less problems with dust but there is some dust generated in handling and transporting of the sods.

3.2.2 Socio-economic Impact of Peatland Development

The development of any natural resource means an expanded industrial base and an increase in direct expenditure into local economies. Direct employment benefits are one of the primary socio-economic impacts but increased revenues in service industries that would supply the operation with fuel, logistical supplies, equipment, parts and maintenance, will also occur. For example, a small demonstration project of 35 hectares requiring about one million dollars of capital investment over 5 years would contribute an additional $200,000 annually to the local economy (Technopeat 1984).

The use of peat as a fuel would also have a direct impact on the amount of imported oil being used in the region, reducing energy costs for consumers and thus expanding their profit margins. This would lead, in turn, to further industrial growth in the region. The extent to which impacts from peat harvesting will reach into the various economic sectors of the region is difficult to determine. To do so, it would be necessary to analyse some of the existing peat producing areas and extrapolate base assumptions from those regions into Nova Scotia.

3.3 The Economic and Intrinsic Value of Natural Peatlands

Peatlands are one type of wetland ecosystem that provide several intrinsic and economic values or benefits. In their natural state, peatlands regulate or influence the hydrology of watersheds, provide habitat for many forms of wildlife, produce many varied types of wild or "semi-managed" food crops, and provide areas for human recreation and learning.

The hydrological role of peatlands in most watersheds is believed to be as storage reservoirs and filtering bodies that regulate water flow and remove sediments and chemicals such as mineral ions, from water moving through the watersheds. As well, these areas are to some extent considered to level out the flow to the watershed of water from runoff and precipitation. Acting as storage reservoirs, peatlands not only regulate the release of water — they act to maintain higher water tables in the mineral soils adjacent to the deposit. Although there is little information available on the interplay between large expanses of wetlands (peatlands) and the atmosphere, a number of climatic and atmospheric effects characteristic of higher latitudes have been attributed to the occurrence of large wetland areas (Bardecki 1984).

The seepage or flow of water through and over peatlands brings water in contact with organic matter which has a great capacity for "ion exchange". Heavy metals, chemicals, and toxic materials that may or may not be harmful to the ecosystem are often chelated or bound to the organic molecules of peat, effectively removing them from the ecosystem. The reduced rate of flow through peatland vegetation and debris also removes sediments and pathogens by allowing the material to settle out. Although there are still a number of unanswered questions regarding the effect of peatlands on waterflows, and the effect of released peatland sediments on the environment, the potential exists for the development of peatland and wetland areas for use in wastewater treatment and water management programs.

Peatlands also act as storage areas or reservoirs of organic carbon. Recent concerns have attributed the burning of fossil fuels to the increased "CO_2" level in the atmosphere and a potential "greenhouse" effect. This has led to studies concerning the amount of stored carbon or extent of carbon reservoirs available to fix carbon from the atmosphere. Standing forests are obvious stores or reservoirs, as are peatlands.
The Atlantic Provinces are believed to have roughly 2.5 million tons (2 billion tonnes) of stored carbon in 5 to 7 million acres (2 to 3 million ha) of peatland (Boville *et al:* 1983).

The recreational use of wetlands (peatlands), including trapping and hunting of the many furbearers and game species, is an important recreational as well as an economic value of many peatlands. Furbearing species (muskrat, mink, beaver, etc.) contribute about $850,000 annually to the total annual furbearer harvest. Muskrat and other wetland inhabitants make up about 80% of the harvest, and 36% of the total annual market value.

A number of peatlands have been set aside as preservation areas. Most notable are peatlands found within National Parks. "French Mountain Bog" in Cape Breton Highlands National Park is an example of a case where an interpretive boardwalk allows visitors to see the beauty and diversity of the plant life of a highland peat bog. Sites such as these are helping to educate the public to the unique nature of peatlands and to their importance as components of the natural environment.

A number of bogs in Nova Scotia, outside the National Park system, have been recommended as International Biological Preserves (Figure 3.10). These areas represent either unique ecosystems and/or harbour rare or endangered plant species. One such deposit, the Black River Bog at Lake Ainslie, is very unique to Nova Scotia in its form and biological diversity. Some of the unique features of this deposit are shown in Table 3.6. Peatlands such as these provide information the past climate and vegetational history of this region. Stratigraphic analysis of pollen as well as insect parts and charcoal found in the peat provide clues as to the cyclical climatic and fire sequences since the last ice age (Railton 1972, 1975, Ogden 1960; Auer 1930).

3.4 Sensitive and Unique Peatlands in Nova Scotia

As wetland ecosystems, peatlands are perhaps the least productive in terms of wildlife potential. However specific peatlands in Nova Scotia are known to harbour rare or isolated populations of plants and animals. As part of the inventory program special care was taken to make note of unique peatland areas, rare or unusual plants, and environmentally sensitive watersheds. These are summarized in Table 3.7.

During the course of the inventory program at least two deposits which had been listed as valuable ecological preserves, were surveyed to provide not only a record of the peat which was held in these areas but to provide a record of the surface vegetation. These two deposits are the Spinney Heath, in Yarmouth County and the Black River Bog in Inverness County. Spinney Heath is an excellent example of an Atlantic Plateau bog. Open *Scirpus* lawns and fairly steep sided domes are well demonstrated at the site. The Black River Bog, at Lake Ainslie, Inverness County, is a type unique to Nova Scotia. This densly treed, "alkaline" bog has some very unusual plant life (Table 3.6) as well as some unusual covertypes. Sampling data also revealed large numbers of bivalves and gastopods in the mineral sediments below the peat.

The Bonnet Lake Bog in Guysborough County is also a unique deposit to Nova Scotia although it has not been mentioned as such in earlier lists. This bog is of particular interest in that it has a large number of randomly spaced ponds separated by bands of peatland. The deposit is sloped downward from north to south, overlying several raised beaches or terraces that may be remnant shorelines of Bonnet Lake.

Common Name	Species Name	Remarks
Crested Wood Fern	*Dryopteris reginae*	common swamps and bogs
Pondweed	*Potamogeton obtusifolius* *Potamogeton natans*	rare common
Spike Rush	*Eleocharis pauciflora var Fernadii*	rare, similar to Deergrass, found in alkaline bog
Adder's Mouth	*Malaxis unifolia*	common
Hoary Willow	*Salix candida*	rare
Miterwort	*Mitella nuda*	prefers non acid soils
Showy Lady's Slipper	*Cypripedium reginae*	rare
Ludwigia	*Ludwigia palusties var americana*	common; shallow water
Water Milfoil	*Myriophyllum exalbescens*	alkaline ponds
Swamp Milkweed	*Ascelepias incarnata neoscotia*	known only in Nova Scotia
Brooklime White Brooklime	 *Lobelia kalmii leucantha*	 rare; calacreous soils
Bog Golden Rod	*Solidago uligenosa*	common
Swamp Ragwort	*Senecio Robinsii*	common
Swamp Thistle	*Cirsium mutirum*	only this nature to region
Shrubby Cinquefoil	*Potentilda futicosa*	alkaline soils
Alder Leaved Buckthorn	*Rhamnus alnifolia*	alkaline, alluvial soils

Table 3.6
Partial Species List of Black River Bog
(Nova Scotia Museum, Halifax)

			Intrinsic Value		
Bog	Name	Type/Status	Rare or Uncommon Plants	Hydrological Reserve	Representative or Unique Peatland
S6.13	Spinney Heath	Atlantic Plateau Bog (undisturbed biological preserve)	?	?	Atlantic Plateau Bog
V803 V804 V805 V806	Cape Sable Island	Raised Bogs (relatively undisturbed)	? ? ? ?	X X X X	X Typical Coastal X Bogs
V904	Baccaro Point Bogs	Raised Bogs	X (Drosera filiformis)	X	
T11-3	Broughms Bog	Raised Bog	?	X	X
G4101	Bonnet Lake	Raised (concentric) Bog (remote undisturbed)	?	N.A.	X
X6801	Black River Bog (IBP)	Flat, (treed alkaline) Bog (relatively undisturbed)	?	N.A.	X
X4901	Baeline Bog	Blanket Bog (Coastal) (undisturbed)	?	?	X Peat cliffs
X0873	Big Barrens Bog	Blanket Bog (Inland)	?	—	X Extreme topographic relief
X1021	Everlasting Barrens	Ladder Bog	?	—	X Parallel ridges perpendicular to slope

?-status unknown
x-occurrence

Table 3.7
Unique or Sensitive Peatlands Surveyed, 1980-1985

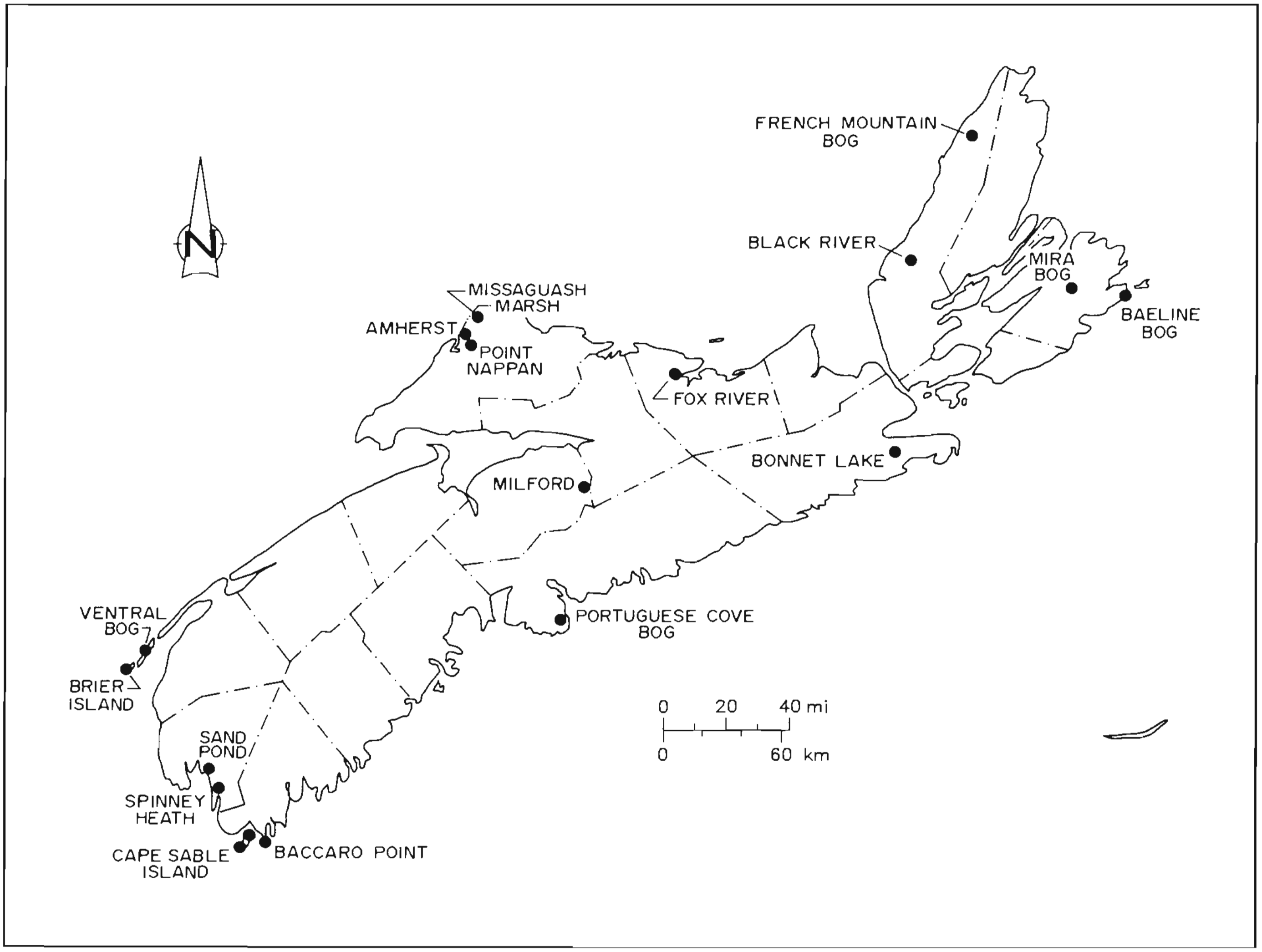


Figure 3.10
Environmentally sensitive peatland areas.