

2.0 Physical Description of Sifton Bog ESA

2.1 Landform Setting of Kettle Lake Wetlands

The Sifton Bog ESA is an isolated depressional or kettle lake wetland situated near the Thames Spillway on the beveled till plain between the Arva and Ingersoll Moraines. Map 4 illustrates the physiography of the London region. Sifton Bog is one of several kettle depressions running in a swath that trends along a northwest to southeast direction across the City as illustrated in Figure 2 from Dreimanis, Winder and Aaltonen (1998). All of the kettles are in various stages of bog succession, from open water lakes with floating bog mats to closed bogs (i.e., no open water present). The best known are the Sifton Bog near the northwest end of the kettle row,

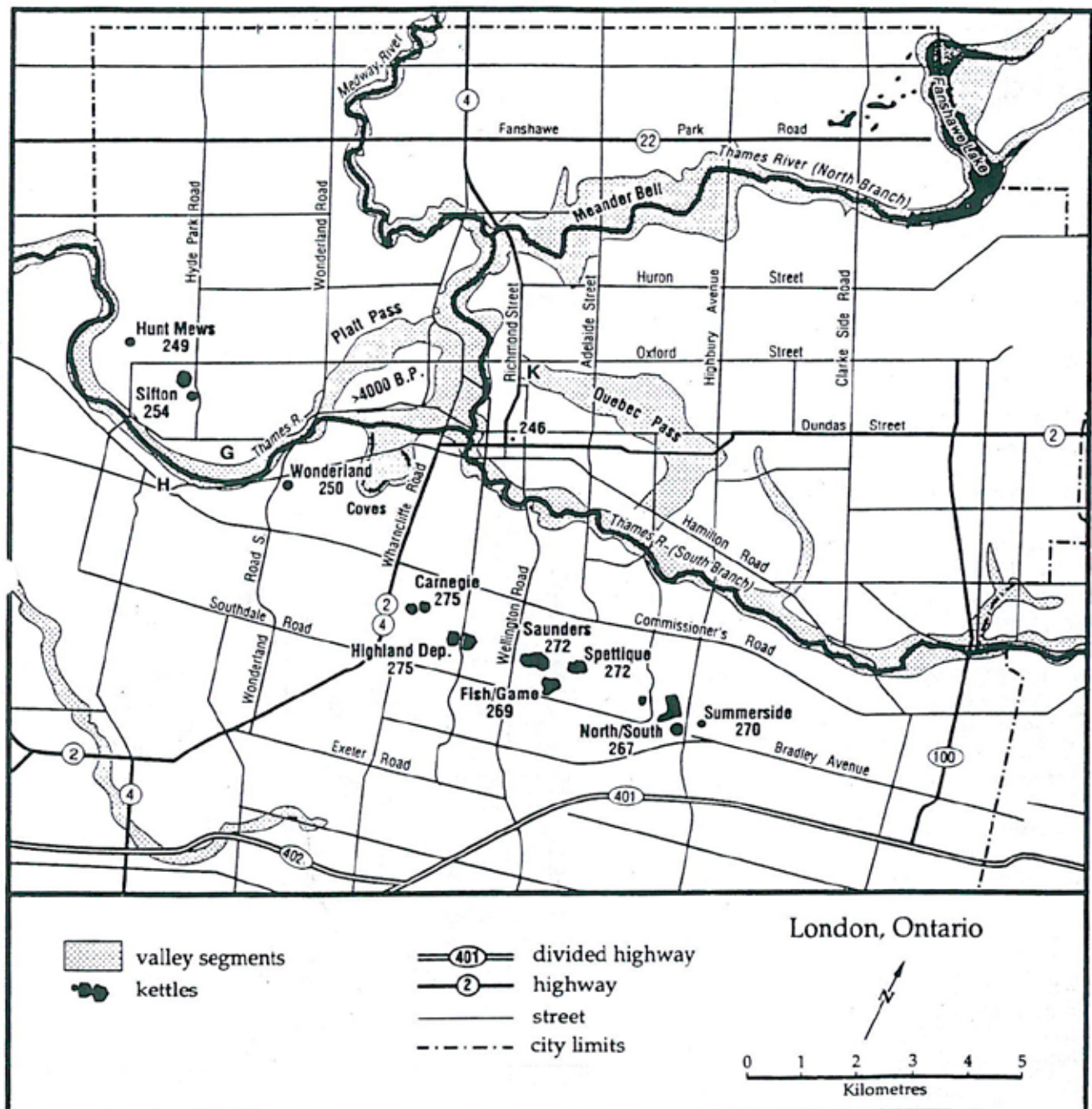


Figure 2. Alignment of kettles, organic soils and depressions as well as alluvial gravels and meander belts in London (Source: Dreimanis, Winder and Aaltonen 1998)

and Westminster Ponds/Pond Mills ESA between Wellington Road and Highbury Avenue. A closed bog is present in the Regina Mundi ESA/Conservation Area south of Highway 401 near Wellington Road (not mapped). The alignment of the kettles in this area suggests that their formation probably began as a sub-glacial stream valley under the terminus of the Huron Lobe; the collapse of parts of the underlying glacier ice into the subglacial stream tunnel produced stagnant ice blocks that left kettle depressions when these ice blocks melted at the end of the last glaciation (Dreimanis *et al.* 1998).

2.2 Wetland Formation and Types of Wetland

Locations where water collects on the landscape are commonly found in areas of dead end topography (i.e., areas of isolated depressions), referred to as hummocky or kettle topography, and are often associated with moraines. Moraines are landforms that form along the margin of a disintegrating glacier. Wetlands occur where precipitation accumulates and collects at shallow depths long enough to sustain waterlogged conditions (intermittently to permanently flooded or saturated). The three fundamental attributes governing the location of wetlands are recharge, storage, and transmission of water (i.e., a water budget that describes the hydrologic system of input, throughput/storage, output/discharge). The ideal landscape for wetland development in southern Ontario is characterized by till plains and glaciolacustrine clay deposits that are poorly drained (Warner 2004).

The four main wetland types found in Ontario are swamps, marshes, bogs and fens. Swamps, followed by marshes, are the most common wetland types occurring in southern Ontario (Site Region 7E-6). Bogs and fens are considered rare wetland types in southern Ontario. Sifton Bog ESA contains all four wetland types.

Swamps are wooded wetlands with 25% cover or more of trees or tall shrubs. Swamps occur in poorly drained or low-lying basins or in floodplains near rivers. They are characteristically flooded in spring, with dry relict pools apparent later in the season. The substrate is usually continuously waterlogged. Waters are circumneutral to moderately acid in reaction, and show little deficiency in oxygen or in mineral nutrients. Vegetation cover consists of deciduous trees (e.g., Red and Silver Maple, Black Ash, White Elm and Yellow Birch), coniferous trees (e.g., Black Spruce, Tamarack and White Cedar), tall shrubs (e.g., dogwood, willows, alders), herbs and mosses (MNR Ontario Wetland Evaluation System 1993, as amended).

Marshes are open wet areas periodically inundated with standing or slowly moving water, and/or permanently inundated areas characterized by robust emergent vegetation such as cattails.

Bogs are peat-covered areas or peat-filled depressions with a high water table and a surface carpet of mosses, primarily *Sphagnum*. Peat is slowly decomposing plant matter. The mosses often form raised hummocks, separated by low, wet hollows. The bog surface is often raised such that the water mound isolates the surface from mineral soil waters. Moisture is derived primarily by precipitation (hence bogs are ombrotrophic). The surface bog waters and peat are strongly acid, mineral and nutrient deficient, as well as low in oxygen saturation (anaerobic). Since kettle bogs are located in depressions, cool, moist conditions prevail, allowing the boreal bog species to survive. The term “bog” refers to nutrient-poor, acid peatlands with ericaceous shrubs, sedges and stunted Black Spruce trees.

Southern Ontario bogs are often represented by a community that is weakly minerotrophic, with intermediate surface water pH, but includes species associated with more nutrient-rich sites. Generally, indicator species for bog and fen communities may be found in either community. For example, at Sifton Bog, the bog indicator Cotton Grass is found along with the fen indicator Beak Rush. Some wetland classification systems would call this type of bog a [nutrient] Poor Fen or an Acid Fen (Kavanagh and McKay-Kuja 1992).

Fens are also peatlands characterized by surface layers of poorly to moderately decomposed peat. The waters and peats are less acidic than in bogs, and often are relatively nutrient rich and minerotrophic since they receive water through groundwater discharge from adjacent uplands. Fens are usually dominated by low- to medium-height shrub cover, sedges, grasses, brown mosses and herbs such as orchids. There is usually slow drainage down slopes with very low gradients, or surface sheet flow. The slowly moving water is enriched by nutrients from mineral (often marl) soils. Treed fens are dominated by Tamarack. Fens are usually more species rich than bogs.

2.3 Bogs versus Fens

Whole books have been written about the ecology of bogs and fens, and relationships are complex enough to assure that more books will be written.
- Theberge 1989 (pg. 358).

There has been some evidence to suggest that Sifton Bog started out with fen-like attributes and has advanced to a bog wetland and will eventually completely fill in with Black Spruce-Tamarack-*Sphagnum* swamp forest. The primary indicator that might suggest the bog is more fen-like is the pH level. Table 2 summarizes main differences between bogs and fens. The recommended approach in referring to peatlands as either bog or fen is a “weight of evidence” approach rather than a single indicator. Sifton Bog meets nine of the 11 bog indicators listed in Table 2; thus, the weight of evidence supports this site as a true bog.

Table 2. Comparison of Indicators of Fens and Bogs

Indicators	Bogs	Sifton Bog	Fens	Sifton Bog
Surface topography	Convex or raised	✓	Concave or flat	
Peat depth	Deep	✓	Shallow (<2 m)	
pH	< 4.0 (acid bog) 4.0 – 5.5 (poor fen)		>5.5 – 8.5 (neutral to basic)	✓
Calcium concentration	Low	✓	Moderate to high	
Water source + mobility	Precipitation / stagnant	✓	Lateral groundwater flow + surface flow	
Nutrient supply	Atmospheric deposition	✓	Atmospheric + surface runoff	
Productivity	Low (nutrients tied up in peat)	✓	Low to moderate	
Decomposition	Low to moderate	✓	Relatively high	
Floristic diversity	Low (5-25 species)		Moderate to high (>25 species)	✓
Carnivorous plants	Present	✓	Not usually present	
Dominant vegetation	<i>Sphagnum</i> mosses, Ericaceae (heath plants), stunted Black Spruce	✓	Sedge peat and grasses, Tamarack	
Total		9		2

Wilcox (1986) found that elevated pH alone has little effect on *Sphagnum* growth but, in combination with elevated calcium concentrations, growth inhibition can occur. The mechanisms controlling this type of growth suppression are not known; however, calcium concentrations at Sifton Bog are relatively low.

Fens have a much greater variability of nutrient content of waters and peats than bogs do. Because of this variability, adjectives such as “rich”, “intermediate” or “poor” are regularly applied to fens. Nutrient richness is closely paralleled by floristic diversity (Riley 1988). Sifton Bog has a higher diversity of species on the bog mat (54 species recorded by McLeod 1992) than most bogs do, perhaps due to its southern location and greater mineralization of water at the edge of the pond. The site’s earlier name, the Byron Botanical Bog, reflects this unique aspect.

The presence of Common Cattails around Redmond's Pond and on the open shrub bog mat may indicate nutrient enrichment has occurred. Cattails are typically found in nutrient-rich marshes, not bogs. The cattails have been present in the bog at least as far back as 1926 (Crawford 1926) and, since they have not become prolific, the enrichment may not be excessive. Mostly, the cattails grow on exposed muck around the pond's edge in dry years or in ditches or along deer trails where trampling has exposed the muck.

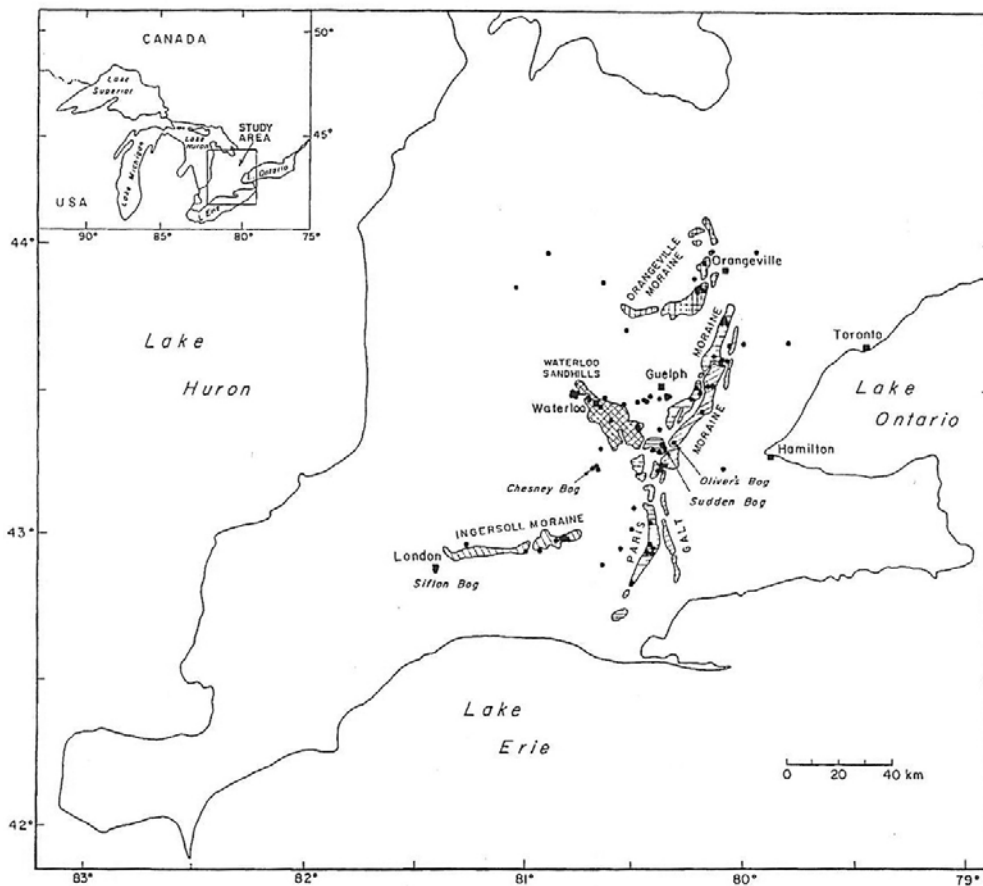


Figure 3. Location of quaking mires, shown as dots, in southwestern Ontario in relation to major moraine systems (Source: Warner *et al.* 1989)

The landscape of pre-settlement southern Ontario supported more bogs than it does today, with losses attributed to draining, agriculture and filling. Warner *et al.* (1989) mapped approximately 50 “quaking mires” (floating carpets of vegetation and mosses over open water bodies) concentrated in the London to Orangeville area (Figure 3). Sifton Bog is one of the more accessible bogs because it is in public ownership.

2.4 Bog Formation

The initiation of a bog requires the development of a floating mat of the roots and rhizomes of plants, mainly sedges, and *Sphagnum* moss around the edge of an isolated depression. From the lower surface of the mat, pieces sink and begin to build up sediments on the lake bottom. The mat is independent of the lake bottom and proceeds to grow out over the water of the central pool. As the mat becomes thicker and more firmly established, other ericaceous shrub species such as Leatherleaf become established and consolidate the mat with intermingled rhizomes. In time, a dense shrub thicket becomes established that can support growth of Black Spruce and Tamarack coniferous trees. This trajectory of bog “terrestrialization” or the in-filling of shallow lakes, reflects a characteristic development pattern where peatlands evolve from sedge-dominated fens into *Sphagnum*-dominated bogs. This is the hypothesis that stands to be supported or refuted among ecologists (Larsen 1982). For a peat bog to form, more organic material must be produced than is removed by decomposition.

The production potential of bogs varies with the quantity of nutrients available for plant growth. In bogs, nutrients are derived primarily from atmospheric precipitation and growth rate is influenced by temperature, acidity and other environmental factors. There are regional variations in the plant communities that typically occupy peat bogs throughout the wide geographical range in which bogs are found. The variations, however, are less striking than the common features; all bog communities are readily identifiable and remarkably uniform in character throughout four major ecoregions of Ontario (Deciduous-Carolinian, Mixed Great Lakes-St. Lawrence, Boreal Forest, Boreal Barrens).

While the exact nature of Sifton Bog's formation is not known, a generalized description of the formation of a kettle bog is illustrated in Figure 4 and described in the accompanying text.

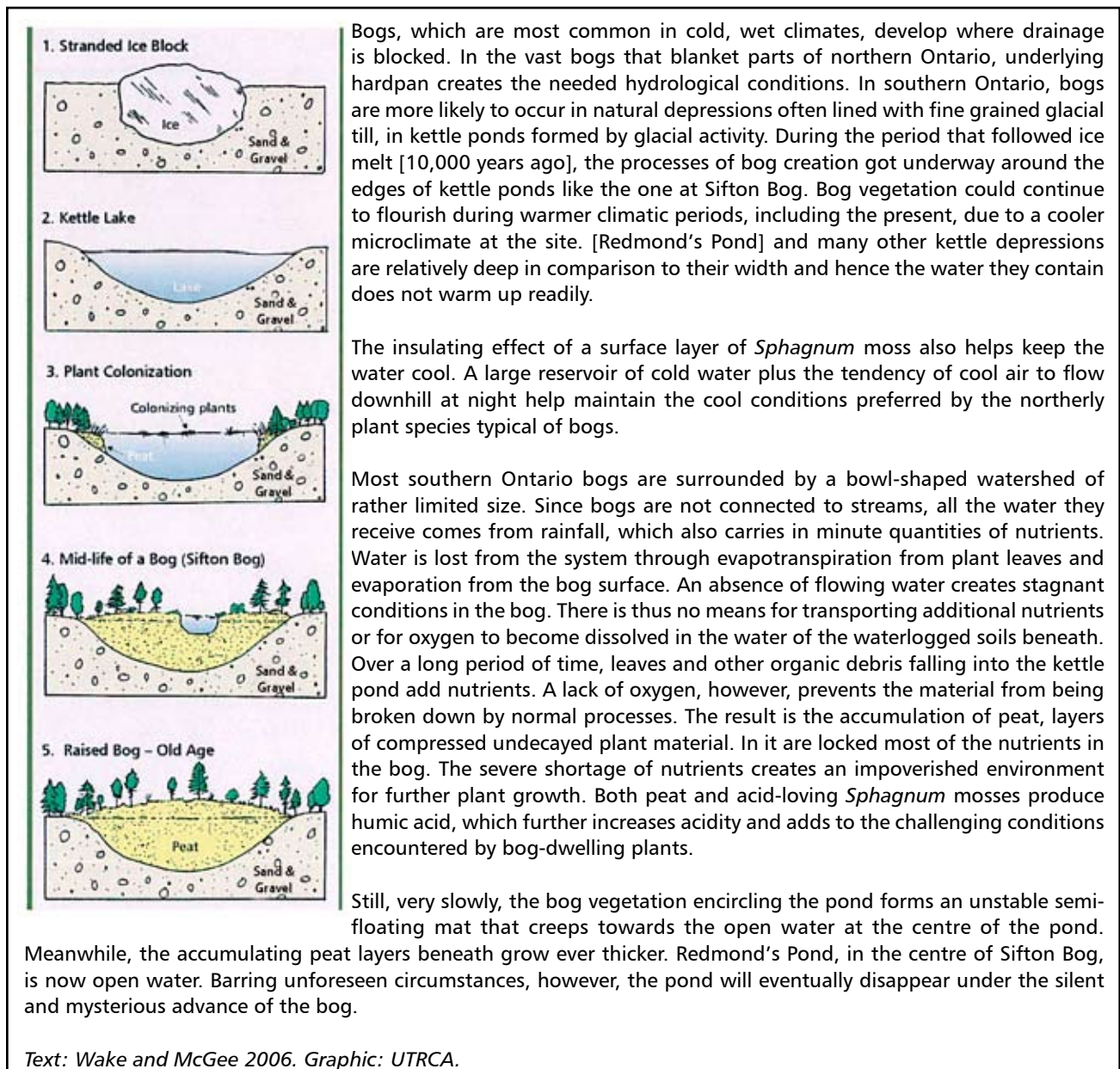


Figure 4. Typical kettle bog formation

2.5 Bog Age

There is speculation over the age of Sifton Bog and other bogs in southern Ontario. It has been suggested that bogs represent relics of an earlier boreal vegetation community that dominated the landscape in the early Holocene. However, research has shown that many examples of this wetland type owe their existence not to long-term survival of a relic community in a restricted habitat niche, but to the major changes in upland hydrology following the removal of the virgin forest by European settlers in the nineteenth century (Warner *et al.* 1989). Paleoecology provides a useful means of determining the composition of vegetation communities before the arrival of humans, and hence before any documentary evidence is available (Bunting *et al.* 1998).

Warner *et al.* (1989) examined cores of peat from the open bog mats of Sifton Bog and three other bogs in southern Ontario. They found the upper 20 cm of peat at Sifton Bog consisted of *Sphagnum* peat. This was underlain by a mixed zone of *Sphagnum* and *Pterocarpus* mosses and sedge peat. At greater depths (>160 cm) a relatively pure sedge peat was identified. Sedge peat is characteristic of fens. They hypothesized that *Sphagnum* bogs in southern Ontario “are largely man made ecosystems of about 150 years old”. They formed as a result of hydrologic changes caused by deforestation for agriculture by the first European settlers (primarily AD 1816-1830 and 1853-1954) that reduced the regulating rates of seasonal runoff, causing the kettle-holes to flood in the spring.

Givelet, Roos-Barraclough and Shotyk (2003) took peat cores from Sifton Bog’s open shrub mat as well as from Luther Bog near Waterloo. While the research was centered on anthropogenic sources of atmospheric mercury, they did age the peat and the findings are summarized below (Table 3). Through carbon-dating, the researchers determined that *Sphagnum* peat at a depth of 66 cm below surface was about 200 years old (AD 1813-1925). At Luther Bog, *Sphagnum* peat at this depth was much older (AD 1290-1408). Thus, the debate surrounding bog age continues.

Table 3. Radiocarbon Dates of Peat at Sifton Bog (Givelet *et al.* 2003)

Average depth (cm)	Material dated	Dating Method	Date (calendar years AD)
0.5	<i>Sphagnum</i>	¹⁴ C bomb pulse	1999-2000
4.8	<i>Sphagnum</i>	¹⁴ C bomb pulse	1992-1993
6.9	<i>Sphagnum</i>	¹⁴ C bomb pulse	1985
9.0	<i>Sphagnum</i>	¹⁴ C bomb pulse	1979-1980
11.2	<i>Sphagnum</i>	¹⁴ C bomb pulse	1972
13.3	<i>Sphagnum</i>	¹⁴ C bomb pulse	1962-1963
15.4	<i>Sphagnum</i>	¹⁴ C bomb pulse	1958-1959
17.5	<i>Sphagnum</i>	Conventional ¹⁴ C	1804-1937
22.8	<i>Sphagnum</i>	Conventional ¹⁴ C	1656-1891
36.7	<i>Sphagnum</i>	Conventional ¹⁴ C	1802-1939
51.5	<i>Sphagnum</i>	Conventional ¹⁴ C	1802-1939
66.4	<i>Sphagnum</i>	Conventional ¹⁴ C	1813-1925
66.4+	Bulk peat sample	Conventional ¹⁴ C	1738-1805

Time works a slow, magical transformation in the peatlands. It moulds and shapes them as it can no other environment. It inexorably transforms some of them from open lake to dry land. Others, it is content to build and destroy by permitting plant succession for a while, then flooding them back to an earlier stage, as if discontent with what it has made. Still others it converts to “floating bogs,” or “raised bogs,” or “string bogs” – the variations with water, pH levels, and nutrients are almost unlimited.

- Theberge 1989 (pg. 358)