Chapter 2: Site Description

2-1 Introduction

The Shelburne Barrens is located on the border of Yarmouth and Shelburne Counties, in the interior of southwestern Nova Scotia (fig. 1-1). The site is 5653ha in size, with 113ha privately owned. The northern third of the area lies within the Tobeatic Wilderness Area, and the southern third lies within Indian Fields Provincial Park Reserve (IFPPR) (fig. 2-1). Designation of a Park Reserve, which often occurs prior to establishment of a Provincial Park, does not protected the site under official legislation (NSDNR, 1984).

Many studies have been conducted in southwestern Nova Scotia in an attempt to characterize the wilderness in that region of the province. The most important of these were done under the auspices of the Department of Lands and Forests (now the NSDNR). R.M. Strang studied the barren ecosystems of southwestern Nova Scotia between 1965 and 1968, and G.E. Mailman studied the Tobeatic Wilderness Management Area (TWMA) in the early 1970's. Mailman defined ecosystem boundaries within the entire TWMA, which included the Shelburne Barrens, by landscape, vegetation, geology and hydrology.

Under the Theme Region system for Nova Scotia (Davis and Brown, 1996), the Shelburne Barrens is divided between two sub-units within the Atlantic Interior Region. The northern portion of the study area lies in the Flintstone sub-unit of the Granite Barrens district (unit 440a). The southern portion of the region is included in the Lake Rossignol sub-unit of the Mersey Meadows unit, within the Quartzite Plains district (unit 412a).

Figure 2-1: Connection of the Shelburne Barrens with the Tobeatic Wilderness Area and Indian Fields Provincial Park Reserve

Defining the area in terms of the Natural Landscapes of Nova Scotia (NSDNR, 1997c), the Flintstone Barren unit corresponds to Natural Landscape 8, the Shelburne River Plain, and the Lake Rossignol portion of the study area is also defined as Natural Landscape 9, the Roseway River Glacial Plain.

The Shelburne Barrens lay within the boundaries of the Tobeatic Wilderness Management Area (TWMA) during the initial stages of what was to be multi-use management of the 1200km^2 area (MacLean, 1975). The land inventory of the TWMA completed in the early 1970's has the Shelburne Barrens region divided amongst 5 landscape systems. Each of these systems is defined by the dominant vegetation, geology, landscape features, soil type and accessibility to the area. These landscape systems can be grouped together into a northern and southern region, which roughly correspond to the boundaries of the Natural Landscapes. The study area will be divided into these two regions for the purposes of the next section of this chapter; the northern portion will be referred to as the Flintstone Barrens, and the southern region as Mersey Meadows.

2-2 Description of Landscape Features

2-2-1 Formation of the Barrens

The Shelburne Barrens are part of a larger barren ecosystem, which extends over 34,000ha of south-western Nova Scotia (Strang, 1971). The formation of these barrens began during the Pleistocene glaciations, which stripped the fertile soil and compacted the substrate that was left behind, forming the initial stages of the Ornstein iron pan (Strang, 1969). Over the last 10,000 years, rain and meltwater have dissolved humic materials in the upper layers of the substrate, and mobilised iron from soil and rocks. Moving down through the soil, the water is impeded by the compacted layer, and the dissolved material is deposited along this horizon (Strang, 1969). The presence of iron rich rocks, such as the Meguma Group strata in the southern portion of the study area, may also have contributed to the development of an iron pan. This could not be solely responsible for this however, as the iron pan also exists extensively in areas underlain by granite. The iron pan which exists within 38cm of the surface of the soil over much of the study area is impermeable to both plant roots and water (Strang, 1971).

There are five possible factors in the formation and maintenance of a barren, all of which have played a role in southwestern Nova Scotia:

1) The presence of an iron pan which restricts plant rooting and vertical water movement.

2) Repeated burns.

3) Numerous boulders, which impede plant growth and development.

4) Excessive leaching, resulting in infertile soils.

5) A cover of thick heath vegetation which prevents the establishment of tree seedlings.

(Davis and Brown, 1996).

2-2-2 Landscape

The landscape of Nova Scotia has been shaped by the action of the Wisconsisn glaciers which existed in this area throughout the Quaternary period (Davis and Brown, 1996). The glaciers stripped most of the lands of soil, which has been replaced slowly due to the nature of the bedrock in Nova Scotia (Roland, 1982). Glaciation of Nova Scotia spread from local ice caps, reaching a climax of 3km thick 20,000 years ago

(Roland, 1982). Retreat of the ice began 18,000 years ago, and lasted for 6000 years. Poorly sorted glacial deposits, known as till, are found scattered over the province. Ground moraine, drumlins, eskers, outwash plains and erratics are all topographic features attributable to the action of the ice sheets (Davis and Brown, 1996).

The Shelburne Barrens has a gently undulating topography, with no drastic relief or steep slopes (Strang, 1971; Mailman, 1975). The irregular ridges are cut by a large number of swales, bogs and swamps throughout the area (Mailman, 1975; Davis and Brown, 1996). The Mersey Meadows theme unit contains the largest concentration of peat bogs and fens within the province, although the concentration within the study area alone was not detailed in these studies (Davis and Brown, 1996). Drumlins are only found in the Mersey Meadows portion of the study area. The Flintstone Barrens are strewn with boulders and poorly drained, with a number of irregular lakes (there are four in total that border or lie within the northern region of the study area) (Davis and Brown, 1996). The granite barrens in the north are at a higher elevation than the surrounding lands, which lie on Meguma rocks (see section 2-2-6) (Mailman, 1975; Davis and Brown, 1996).

2-2-3 Soils

The Flintstone Barrens region is underlain by a well drained, coarse textured, shallow Gibraltar series soil (Davis and Brown, 1996; Strang, 1971; Mailman, 1975). the soil is acidic and loamy, and contains many stones and boulders (Strang, 1971). This soil type is infertile, and as such there is low productivity on these lands.

The Mersey Meadows region is underlain by a well drained, moderately coarse textured soil, but of the Halifax and Mersey soil series (Davis and Brown, 1996;

Mailman, 1975). The Halifax soil is less stoney and more fertile than the Gibraltar series. It reaches depths of ½ m, and as such the area supports a larger portion of forest cover than does the thin soil of the Flintstone Barrens (Mailman, 1975).

The entire region has a low level of productivity, due in part to the extensive iron pan which lies close to the surface (see section 2-2-1). The region has also undergone severe burning from both natural and anthropogenic influences (Beazley, 1998). The worst of the fires spread through the area in 1903, and there was a second severe series of fires during the 1960's which caused a loss of organics matter from the soil (Strang, 1972). The soil depth is lowest on the tops of ridges and knolls, increasing downslope and reaching a maximum in the hollows and swales. These areas therefore are able to support more vegetation, and in particular an increased proportion of trees (Strang, 1971).

Less fire damage was done in the southern portion of the study area, because the concentration of lakes prevented fire spread. Because the soils are better and the forest has not been burned severely, this region is more productive.

2-2-4 Vegetation

The Shelburne Barrens is a large area of land, containing many types of plant communities, from bog to barren and forest. The Shelburne Barrens exists in a humid, temperate climate regime, and it is unlikely that it is this is the major factor affecting the type of vegetation found (Strang, 1972). The vegetation types are dependent on the moisture level, soil type and depth, and history of the area (Mailman, 1975; Strang, 1971). Mailman (1975) made some generalizations concerning the variation and distribution of species found in the study area.

In 1975, the ground vegetation on the granitic soils, in areas that had undergone extensive burning were characterized as a *Corema-Arctostaphylos* plant community, with *Gaultheria, Kalmia, Pteridium, Cladonia* and *Gaylussacia* species associating (Mailman, 1975). Tree growth on these areas was mainly white pine, red oak, and aspen, with some red maple, black spruce, and wire birch (Mailman, 1975). According to Strang (1971), many of these trees were stunted and had malformed crowns, which was likely due to the strong southwestern winds on the exposed barren lands. The granitic areas which had not undergone extensive burning were characterized by a *Gaylussacia* and *Pteridium* community, with *Viburnum* and *Alnus* commonly found (Mailman, 1975). Tree cover in the granitic areas was mainly white pine, aspen, black spruce, red pine, red maple and red oak on the barrens, and white pine, black spruce and balsam fir in the forested regions (Mailman, 1974; Davis and Brown, 1996). The southern areas, with a graywacke substrate, were dominated by a *Kalmia-Pteridium* plant community (Mailman, 1975). White pine, Eastern hemlock, and red spruce were found scattered, with the occasional wire birch, red maple, red pine and red oak (Mailman, 1975). On the better drained Halifax soil, the dominant trees were red oak and white pine, with aspen, red pine, wire birch and red maple scattered (Mailman, 1975). The poorly drained swamps and swales were dominated by ferns, *Alnus, Rhododendron,* grasses and mosses, while the bogs were a *Chamaedaphne-Sphagnum* community, with *Rhododendron*, *Ledum* and *Carex* species also found (Mailman, 1975). The trees in the poorly drained sites were a complex of black spruce, red maple, (Mailman, 1975). The better drained forested sites had a tolerant hardwood cover (Davis and Brown, 1996).

2-2-5 Hydrology

Several irregular lakes lie within and just outside the study area (fig. 1-2). According to Davis and Brown, (1996), the surface waters tended to be brown, turbid and acidic, with a pH range of 4.0-6.1 (see also, Mailman, 1975). The quantity of dissolved solids is reported to have been limited, with low conductivity and primary production in these waters. Peat bogs, swamps and swales were common in the area (Strang, 1969; Davis and Brown, 1996; Mailman, 1975). The drainage of rivers is generally parallel and to the south, because of the higher elevation of the northern section of the study area (Mailman, 1975).

Freedman (1995) states that large amounts of nitric and sulfuric acids are deposited in southeastern Canada due to atmospheric transport of these chemicals from the United States. This acid precipitation has significant effects in southwestern Nova Scotia, where the soils are thin, coarse grained and noncalcareous, therefore having a low buffering capacity. This has resulted in low pH values for the waters of the Shelburne Barrens region.

Monthly and annual precipitation was taken from the Tusket River Weather Station, the nearest to the study area (table 2-1).

Table 2-1: Mean Monthly Precipitation; 1990-97

January:	124.0mm
February:	115.3mm
March:	133.5mm
April:	121.1mm
May:	112.4mm
June:	104.4mm
July:	91.4mm
August:	75.6mm
September:	126.5mm
October:	106.8mm
November:	144.9mm

December: 144.1mm
(Atlantic Climate Centre, 1998)

The main types of fish inhabiting four of these lakes was determined by the Nova Scotia DNR (1984) (table 2-2). The lakes contained a mix of fish, with yellow perch being dominant.

Table 2-2: Fish Species of four lakes in the Shelburne Barrens

	Drainage Basin	Size	Depth	Main Fish
Horseshoe Lake	Shelburne	4	3	Y
Clamshell Lake	Jordan	1	2	Y
Sand Lake	Roseway	4	2	T
Long Lake	Roseway	3	1	W-Y

(MacLean, 1975)

Size: 1. <50 acres
2. 50-100 acres
3. 101-200 acres
4. 201-500 acres

Depth: 1. Very shallow
2. Moderately shallow
3. Some deep water—extensive shallows
4. Extensive deep water

Main fish: T trout
(sport fish) Y yellow perch
W white perch

2-2-6 Geology (fig. 2-2)

The sedimentary rocks in the southern portion of Nova Scotia are an exotic terrain from the northwest corner of South America or Africa, which collided with the North American plate during the Acadian Orogeny, and was left there as the present Atlantic Ocean opened (Davis and Brown, 1996; Roland, 1982). These are the rocks of the Meguma Group, which took its name from the Mi'kmaq word for their tribe (Roland, 1982).

Figure 2-2: Geological Map of Nova Scotia (Keppie, Energy, 1979)

Meguma Group Rocks

The Meguma Group can be divided into the basal Goldenville Formation and the upper Halifax Formation. The Goldenville Formation is late mid-Cambrian to early Ordovician (Roland, 1982) These rocks have a high sand-to-shale ratio, consisting primarily of greywacke (often this rock is incorrectly referred to as quartzite), with minor black and grey slates (Roland, 1982;Clarke and Mueke, 1980). The Halifax formation was deposited during the middle Ordovician period (Roland, 1982). It has a low sand-to-shale ratio, consisting mainly of finely laminated grey slate, with black slate and greywacke interbedded (Roland, 1982; Clarke and Mueke, 1980).

Granite Emplacement

The Acadian Orogeny took place in the late Devonian period. Roland (1982) gives a good description of this event. The plate collision which fixed the Meguma Group to North America formed the Acadian Mountains, emplacing granite plutons in their base. The intense heat and pressure created at 20 to 40km depth would have melted the subducted oceanic material and sediments. The aluminum rich magma, being of a lower density than the surrounding material, rose towards the surface and began to cool and crystallize (Davis and Brown, 1996). The South Mountain Batholith (SMB) is a granite pluton which was formed during this time period, around 360mya (Clarke and Mueke, 1980). It is the largest pluton found in Nova Scotia, and extends in an arc from Yarmouth to Halifax County. It was emplaced along paths of weakness between overlying sedimentary rocks, such as at the Tobeatic Shear Zone, and as such there is a steep contact between the granite and the country rocks (Davis and Brown, 1996).

Permeability

The rising granite heated and metamorphosed the host Meguma rocks (Roland, 1982). These rocks, as well as the crystalline granites, are hard and impermeable. Precipitation is therefore held on the surface in bogs and shallow lakes, unless joints and fractures occur in the rocks (Davis and Brown, 1996).

Formation of Kaolinite

According to Davis and Brown (1996), the bulk of granite (80%) is comprised of anhydrous quartz and feldspars, with micas and amphiboles making up the other 20% of the rock. Feldspars can be potassium (K) or sodium (Na) rich, and it is these latter feldspars which readily alter to kaolinite, also known as china clay (Howe *et al.*, 1985; ECC Int., 1995). During this process of alteration, the micas and quartz in the rock are left unaltered, resulting in a non-uniform deposit of the clay. Kaolinite deposits which form from weathering of the granites *in situ* are known as primary deposits, while those which are eroded and deposited at some distance from the host rock are known as secondary deposits (Finke *et al.*, 1996)

There are two possible stages in the formation of kaolinite, both requiring the convective action of hydrothermal fluids (Fehn, 1985; Durrance, 1985). Kaolinization of a granite can begin during the cooling of the rock body, as water is expelled from the forming crystals and begins to circulate in fractures and along contacts, interacting with the granite body and possibly the country rock (Thurlow, 1992). This is often associated with the deposition of metal ores, such as tin and tungsten, as well as uranium enrichment (Fehn, 1985; Ford and O'Reilly, 1985; Thurlow, 1992). The East Kemptville tin deposit, which is the largest discovered in North America, was deposited this way (Clarke and Mueke, 1985). This deposit is located just west of the Shelburne Barrens, on the edge of the SMB. There is significant amounts of tin, tungsten and uranium within the SMB, with concentrations variable over the pluton (Clarke and Mueke, 1985).

Kaolinization of granite can also occur through post-crystallization alteration of the rock body (Thurlow, 1992). Meteoric water enters from the surface, through cracks and fractures in the rock, becomes warmed at depth, and over millions of years of convective circulation of this water, the feldspars near the fractures can be altered to kaolinite (Thurlow, 1992; Howe *et al.*, 1985; Durrance, 1985). Uranium enrichment of the rock during the cooling stage produces high levels of radioactivity in the granite, which increases the heat production and heat flow rate within the rock (Fehn, 1985; Ford and O'Reilly, 1985). These elevated levels of radioactivity have been observed in the SMB, indicating that the process of kaolinite formation could be occurring today (Fehn, 1985; Ford and O'Reilly, 1985). The most likely location for this secondary alteration to occur is at the contact between the granite and the host rock, which in the Shelburne Barrens area is the Tobeatic Shear Zone (fig. 2-3) (Fehn, 1985).

2-2-7 Anthropogenic History of the Area

Fire: The area has been burned naturally and by humans many times over the last few centuries, in order to promote deer and moose populations, as well as produce blueberry crops. (Strang, 1969; Beazley, 1998)

Forestry: During the 1960's the Department of Lands and Forests planted red pine and jack pine stands in an attempt to turn what was thought of as a 'useless' landscape into something more productive (Strang, 1969). Due to the low productivity of the area the plan was unsuccessful; most of the plantations failed. The only areas where

Figure 2-3: Geological map of the Shelburne Barrens

the plantations are possible are on the slopes of hummocks and ridges, in the areas dominated by heath vegetation (Strang, 1969). Plantations would require burning of the native vegetation in order for seedlings to take (Strang, 1971).

Infrastructure: Strang (1971) states that the road from Upper Ohio towards the Flintstone Rock area was first built in 1961 and 1967. This was paved in the 1980's to accommodate traffic to and from the then active East Kemptville tin mine. An airstrip was also built during the 1960's to aid in the fighting of forest fires which swept through the region at that time.

Recreation: The majority of the recreation in the area has been contained to IFPPR, in the vicinity of Horseshoe and Clamshell Lakes. These lakes are the clearest and most accessible of all of the lakes in the region, and have been stocked with small mouth bass for fishing (Muise, 1999).