A little NATURAL HISTORY OF NORTHERN GEORGIAN BAY

by
G.M. Courtin, Professor Emeritus, Department of Biology
Laurentian University, Sudbury, ON. P3E 2C6

Georgian Bay

Georgian Bay has been described as the sixth Great Lake but, in fact, it comprises the eastern portion of Lake Huron. Manitoulin Island to the north and the Bruce Peninsular to the south effectively isolate Georgian Bay from the remainder of Lake Huron. Between Manitoulin Island and the north shore of Lake Huron lies the North Channel which is connected narrowly with Georgian Bay both at the town of Little Current, and on the north side of Great Cloche Island near Dreamer's Rock, at Swift Current which was the passage originally used by the Voyageurs as they traded furs by canoe. To the south, Manitoulin Island is separated from the northern tip of the Bruce Peninsular by Main Channel. This is the only other connection between Georgian Bay and the main portion of Lake Huron.

Northern Georgian Bay may be defined as that portion of the bay that lies between Parry Sound and Killarney. Its coastline, if one ignores the numerous channels, islands and embayments, stretches for approximately 150 km and because of its coastal characteristics it provides excellent cruising water for kayakers.

Geology

Georgian Bay owes its characteristics to both an old and fascinating geological history, considerable sculpting of the the rock surface by very recent glacial events, and the deposition of glacial debris in the form of till and outwash.

Collins Inlet at the northern end of Georgian Bay separates Philip Edward Island from the mainland. A major fault system, the Grenville Front passes through the western end of the inlet, at the mouth of Chikanishing Creek. This geological structure is of both considerable importance and of considerable interest. It is of importance because it separates the Superior Province and Southern Province of the Precambrian Shield from the Grenville Province to the south of the fault. It is of interest because the faulting, or fracture zone, can be traced northeastward all the way to the southern tip of Greenland and was caused by the collision of the western side of South America (in the area of what is now Peru) with southern Labrador some two billion years ago when the continental plates as we know them today were arranged in the form of a 'supercontinent' called Gondwana.

The resultant movement of one side of the fault against the other caused supplemental faulting and a high degree of metamorphism; alteration of the rock owing to both heat, 650-750°C, and pressure,

6000-9000 times atmospheric pressure. Moreover, because the earth's crust was cracked, molten material was extruded towards the surface in the form of the Killarney Batholith. An example of the gneissic granite rock of this batholith is visible at the mouth of Chikanishing Creek.

To the south of the Grenville Front is the Grenville Province that is composed of both rocks of molten origin (igneous rocks) and of rocks made up of fine material deposited by and in water (sedimentary rocks). These rocks have undergone both metamorphism and folding; again, as continental plates rammed into one another. The result of this folding resulted in a Syncline (Fig. 1) composed of alternating layers of the materials of igneous (orthogneiss, pink and red in colour) and sedimentary (paragneiss, alternating pink and grey layers) origin. A syncline can be imagined as being like the bow of a canvas-covered canoe in which the layers of rock are shaped just like the planking but in which the entire bow is filled up with planks of different hardness. With time, the softer rocks (paragneiss) erode away more quickly than the harder rock (orthogneiss) leaving a landscape that resembles a corrugated iron roof. The final touches to this landscape were provided by the impact of glaciation (see below). The effects of this differential hardness between the two types of gneiss is evident along the south side of Philip Edward Island because stream channels and the deeper bays are in areas of paragneiss where the weathering,erosion and glacial scouring of the softer rock has been more pronounced (Fig. 2).

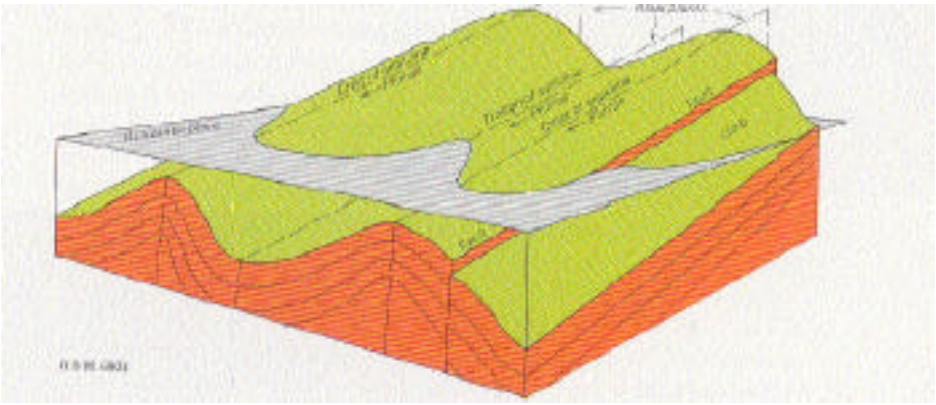

Figure 1. Schematic diagram of Anticlines, Synclines and Faults. (Taken from Robertson and Card, 1972).

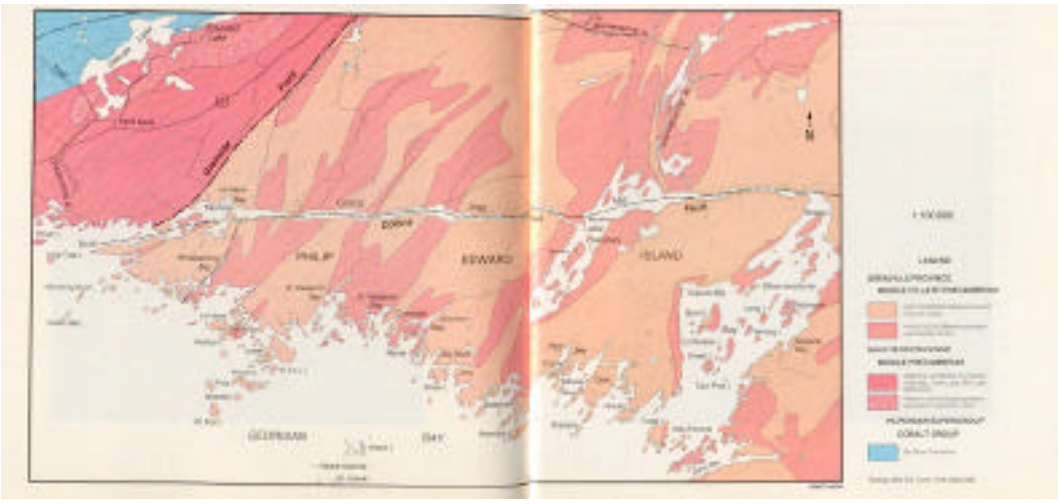

Figure 2. Alternating bands of Orthogneiss and Paragneiss across Philip Edward Island. Note the indentations in the coast line and Mill Lake which correspond with zones of the softer paragneiss. (taken from Debicki, 1982)

The effect of this pattern of banding is evidenced almost continuously as one's route down Georgian Bay changes from a generally eastern to a generally southern direction. All the way down this coast the islands trend parallel to the main coast line. These islands are all formed from the more resistant orthogneiss and the deep channels in between correspond to the more easily eroded paragneiss (Fig. 3). Frequently this pattern is interrupted by bands of very dark, igneous rock (diabase) that have been intruded into the existing, older, metamorphic rocks. Such layers are called dikes.

Figure 3. Effect of differential weathering of softer rock to form Franklin Is. and the Mink and McCoy Island chain.

Much more recently in geological time, some 400 to 500 million years ago, the central part of the continent was a vast inland sea that connected the present day Gulf of Mexico with the present day Arctic Ocean. The limestones laid down during that time form what is known as the Paleozoic Cover. The rocks are all sedimentary and have not undergone any metamorphism. It is these rocks that form the Niagara Escarpment over which tumble the waters of Niagara Falls. The escarpment also forms the Bruce Peninsular and covers Manitoulin Island. The eastern side of this extensive layer of limestone rocks outcrops as Green Island just beyond the Hawk Islands, a few kilometres

south of Philip Edward Island; and, as the Limestone Islands, just to the west of the Mink Islands. During the span of 180 million years several distinct series of rocks were laided down. The oldest, are from the Ordovician Period and are from 505 to 538 million years old, the next are from the Silurian Period, from 438 to 408 million years old and the next are from the Devonian Period and are from 408 to 360 years old. Other, younger rocks overlie the ones mentioned but are not present in the Georgian Bay area.

The Michigan Basin formed as a result of sinking of the earth's crust over a 20 million year period, which is very rapid movement in geological terms. The reason is unclear. The result, however, was to cause the various layers to take on the shape of shallow, nested bowls such that the oldest (Ordovician) rocks are presently exposed at the surface in a band that begins around Kingston, passes through Midland, parallels the Georgian Bay coastline, and is found again on Grand La Cloche Island just north of Little Current. These rocks form the Limestone Islands. The next band, which is also Ordovician but younger, covers the area roughly delimited by Oshawa, Toronto, Hamilton, and north to Newmarket. It then continues as a narrow band through Collingwood and northern Manitoulin. The next layer is of Silurian age and forms the famous Niagara Escarpment that runs from Niagara Falls up through the Bruce Peninsular and the south side of Manitoulin Island.

Although the metamorphic rocks of the mainland was also covered by layers of sedimentary rock, the layers were much thinner and these have all been eroded away. Because the older rock was relatively flat, however, the erosion of the limestone has left an almost perfectly straight shoreline that runs from Midland to Byng Inlet.

Glacial History

The present landscape reflects not only the erosional processes over geological time but the very recent affects of glacial activity. The northern hemisphere Pleistocene glaciation that began a mere 3 to 4 million years ago resulted in the Precambrian Shield, and the Grenville Province being overrun, at least three times, by an ice sheet that exceeded a kilometre in thickness. These ice sheets had their origin in the region that is presently occupied by Hudson Bay and Labrador. Not only did the movement of each ice sheet cause tremendous erosion but also left debris in the form of basal till and moraines. As the ice melted, glacial rivers carried material in the form of outwash that may be found as sand and gravel deposits, and in large, rounded cobbles. Sand beaches are rare in northern Georgian Bay but the evidence of cobbles are frequently seen beneath you in the water as you paddle along. Some of these rocks are a metre or more in diameter and give one pause for thought as to the enormous volume of glacial meltwater that was necessary to carry and tumble them along. On the smooth, glacially-scoured rocks one will frequently find evidence of "chatter marks". These manifest themselves as a row of shallow, crescent-shaped depressions that resulted from a piece of

rock, imbedded in the base of the ice, catching on the bedrock beneath it and because of the immense pressure, chipping out the surface. This is often repeated several times until the piece of rock breaks up and is no longer effective.

A one-and-half to two kilometre-thick sheet of ice imposes an incredible pressure on the earth's crust. The crust 'floats' on the molten material of which most of the earth is composed, rather like a pie crust on its filling. The weight of the ice sheet depressed the earth's crust by as much as 200 m over a very large area. When melting of the last ice advance took place, between 13,000 and 8,000 years ago in our region, and the front of the ice sheet retreated northward, two things happened. First, the front of the ice sheet itself acted as a dam for the vast volumes of water flowing southward off the ice sheet as the ice melted. The result was the formation of Glacial Lake Agassiz which encompassed all of the present Great Lakes and extended westward to include Lakes Winnipeg and Winnipegosis. Second, as the earth's crust was relieved of its weight it began very slowly to rebound. The process of isostatic rebound, as the process is called, is not gradual but occurs in a series of 'jumps' as stress builds up and is suddenly relieved. The result is that the lake that was empounded to the south of the ice progressively became shallower as the earth rebounded. At the same time, with each 'jump' the shoreline was eroded by wave action and beaches were established. On a clear day when Manitoulin Island is visible one can see some of these prominent beach lines looking like giant steps.

Another effect of the rebound was to force the empounded water to drain east rather than south as is now the case (Figure 4). That drainage corresponded to what is now the basins of the Whanapitae, the French, the Pickerel, the Still, the Magnetawan, the Key and the Naiscoot Rivers. All these rivers now flow westward into Georgian Bay but some 4000-6000 years ago these rivers and the land between them were flooded and the drainage was eastward into what is now the Ottawa River. The gorge of the French River was carved during this time.

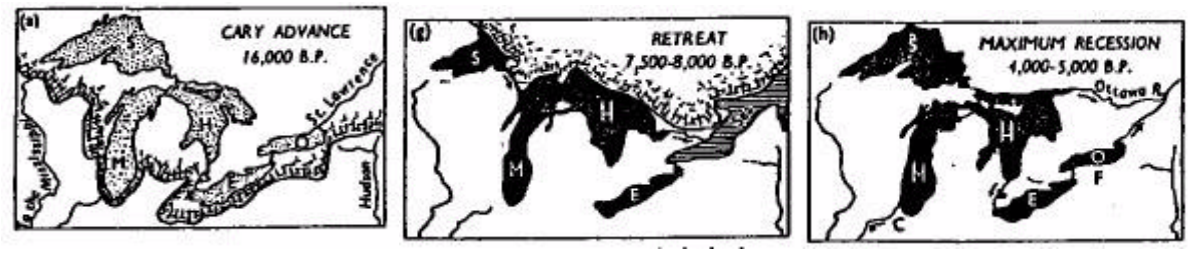

Figure 4. a) Entire Great Lakes Basin covered by the ice sheet. g) Retreat of the ice front led to damming of the melt water to form lakes that were both larger and deeper than presently. h) With recession of the ice the principal drainage was eastward from Georgian Bay. As glacial rebound continued with recession of the ice, the uplift caused the eastward flow from Lake Huron to be cut off and for all flow to be directed into Lake Erie.

From the point of view of those travelling the water trail through Georgian Bay the legacy of the Pleistocene Ice Age is the ice-scoured topography of smooth rocks and islands that gives the area its beauty and character, and the thin layer of glacial till and outwash that has given rise to soil for plant growth. One is reminded of how shallow the soil is each time that one attempts to dig a latrine (Fig 5).

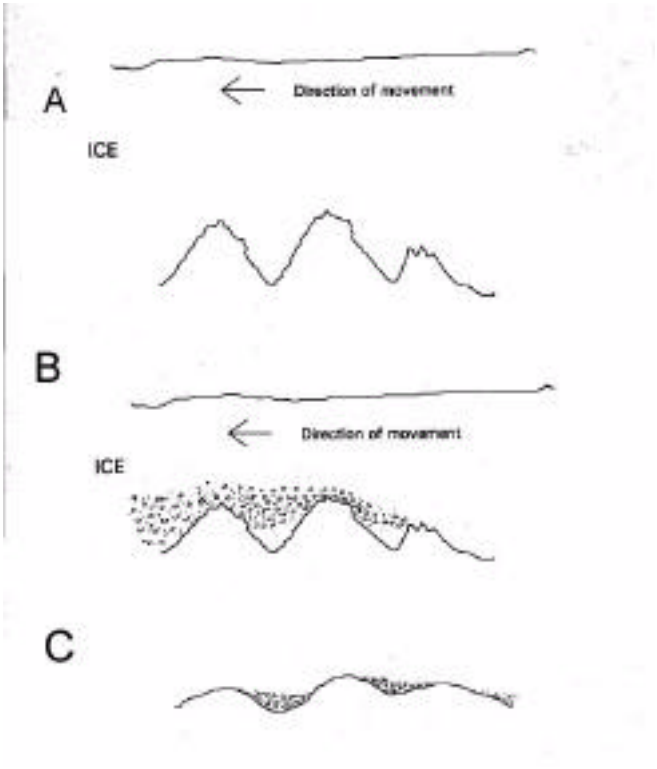

Figure 5. A) Landscape freshly covered with ice. B) Scouring leads to erosion of the more prominent features and entrainment of glacial debris. C) Final ice-free landscape. Prominent features have been ground down and glacial debris lodges in the depressions.

Weather and Climate

The majority of Georgian Bay has a July average water temperature of between 16 and 18° C. Although precipitation in summer for Lake Huron occurs with a frequency of 5% during daylight hours one can expect a somewhat higher frequency close to shore owing to topographically-induced rain events. As elsewhere in the Great Lakes, thunderstorms are always a possibility and should be respected not only because of the waves generated by high winds but also because of the danger from lightning. The southeasterly trend of the Georgian Bay coastline often causes winds to be funnelled from a northwestly direction. In areas with a long fetch from the west such as Little Current to Collins Inlet, Point Gereaux to Bustard Island, and Byng Inlet to Hangdog Point, heavy seas can build up.

Although the nature of the northern Georgian Bay coastline, with its hundreds of islands and thousands of rocks, offers protection to the kayaker, there are a number of other factors that should be borne in mind and for which the paddler should be prepared. They are as follows:

Prevailing winds are predominantly onshore
Winds may be funnelled between islands giving rise to strong, gusty winds
Shoaling of the lake bottom begins from 2 to 8 km offshore which can result in steep waves
During periods of high winds narrow channels between islands and within island groups can generate wind set-ups and seiches of 1 metre or more
Advection fog can occur with little or no warning.

Inspite of this ominous list of potential hazards northern Georgian Bay is still one of the safest areas in which to paddle. Nevertheless, a measure of safety is added when one is forewarned and hence forearmed to the sorts of conditions that may develop during periods of bad weather.

"....and I tell these kids a hundred times, don't take the lakes for granted...."
Stan Rogers - from the song "White Squall"

Vegetation

Northern Georgian Bay is in a climatic zone that is influenced both by latitude and by the effects of a large body of water; namely, Lake Huron. Not only does the lake act to moderate temperature extremes but also the vegetation on islands and on the adjacent mainland is subjected to the full force of the prevailing winds. As a result there is a general northward extension of plant species but at the same time one finds numerous examples of the effects of exposure.

Because the soils are shallow, plant distribution is affected both by a lack of moisture and a limited nutrient supply. The result is that there are often very marked changes in plant species composition within a very short horizontal distance. The tendency is for soil conditions to be either droughty on the higher ground, or saturated at the shoreline and where water is empounded in shallow basins. The richest growth occurs in small valleys where soil has accumulated and soil moisture loss is reduced because of the shading provided by the walls of the valley.

In very general terms one can categorize the vegetation into a number of habitat types whose characteristics are dictated by the overall environmental conditions.

A. Upland forest

Dominated by trees, shrubs and herbs that can withstand drought. Typical species are: red oak, jack pine, red pine, red maple and blueberry.

B. Lowland forest

Dominated by trees shrubs and herbs that require more moist conditions. Typical species are: white pine, red maple, sugar maple, white birch, yellow birch, mountain ash, mountain maple, blueberry, huckleberry, bluebead lily (yellow clintonia), Canada mayflower, starflower and bunchberry.

C. Evergreen scrub

This vegetation type tends to occur in shallow areas with impeded drainage. The typical species is common juniper.

D. Rock crevices

Rock crevices are occupied by plants that are both agressive and opportunistic. Typical species vary from place to place but are likely to include: blueberry, juniper, goldenrod, meadowsweet, red chokeberry, winter holly and the dry-site sedges and rushes.

E. Rock basin

These basins, which can vary from a metre to several metres in diameter, are typified by internal drainage and rainwater as their only source of moisture. Typically these are bogs and hence are dominated by peat mosses and heaths such as leatherleaf, sheep laurel, velvet leaved blueberry and low sweet blueberry. Other bog species such as sundew and cranberry are often also found associated with the peat. Somewhat drier depressions will be dominated by star moss rather than peat moss.

F. Shoreline flats

These areas are defined by the lake shoreline and may receive water directly from the lake or by wave splash. Typical species are: leatherleaf, meadowsweet, blue toadflax, boneset, and rushes and sedges, and emergent species such as arrowhead, pickerelweed and spike rush.

G. Glacially-scoured rock

Here there is little or no soil, and it is here that lichens predominate. Away from the erosive effects of pounding by waves one finds the caribou lichens, often in extensive mats. Nearer the water the rocks are dominated by crustose lichens that adhere to the rocks like splashes of paint. The most conspicuous of these is the orange lichen *Xanthoria* and the pale green *Lecanora*. Also found here are foliose species such as the brownish-black rock tripe and the large, round patches of the green *Parmelia.*

H. Shallow water emergents

All the species in this habitat grow in protected areas such as bays and inlets where the water is sufficiently shallow to permit rooting in the bottom sediments. Typical species include: water lilies,

pondweeds, arrowhead, and pickerel weed.

Fauna

The species, density and distribution in the region are typical of central and eastern Ontario with two major differences; the presence of wapiti (elk) that have been introduced in the general area of the French River, and the use of the profusion of off-shore islands as a pathway for many migratory bird species. The larger animals such as timber wolves, brush wolves (coyotes) moose, deer and black bear are all present. Both black bears and racoons cross from the mainland to islands readily so that the same care to protect food and garbage needs to be exercised as elsewhere.The weasel family is well represented in that otter, mink, ermine and possibly fisher are present. Otter scat can frequently be found near the water and often contain large quantities of crayfish remains. Mink may be seen frequently, either alone or as families, swimming from island to island or bounding across open rock surfaces. Other aquatic animals are the beaver and muskrat.

The solitude offered by the islands has given rise to their use as colonial nesting sites. For instance, at least two heronries of great blue herons are known to be active. Birds of prey that one is likely to see are bald eagles and merlins. Several species of warblers, finches and sparrows nest on the islands and adjacent mainland. On almost every island one can count on hearing the common yellow throat, white throated sparrow and the yellow rumped warbler.

Bibliography

(The author admits openly to having plundered shamelessly from most of the material listed below.)

Anonymous. 1992. Great Lakes Marine Weather Guide. Environment Canada, Atmospheric Environment Service. Ministry of Supply and Services, Cat. No. En 56-93/1992E. 98pp.

Chambers, B, K. Legasy, and C.V. Bentley. 1996. Forest Plants of Central Ontario.. Lone Pine Publishing, Edmonton, Alberta. 448pp.

Debicki, R.L. 1982. Geology and Scenery. Killarney Provincial Park Area Ontario. Ontario Geological Survey Guidebook No. 6. OMNR-OGS. 152pp.

Elias, T.S. and P.A. Dykeman. 1990. Edible Wild Plants: a north american field guide. An Outdoor Life Book. Sterling Publishing Co., Inc. New York. 286pp.

Glime, J.M. 1993. The elfin world of mosses and liverworts of Michigan's Upper Peninsular and Isle Royale. Isle Royale Natural History Association, Houghton, Michigan. 148pp.

Newmaster, S.G., A.G. Harris, and L.J. Kershaw. 1997. Wetland plants of Ontario. Lone Pine Publishing, Edmonton, Alberta. 240pp.

Robertson, J.A. and K.D. Card. 1972. Geology and Scenery. North Shore of Lake Huron Region. Ontario Geological Survey Guidebook No. 4. MNDM. 224pp.

List of commonly-found plants for Northern Georgian Bay, Ontario

Trees

Pinaceae (Pine Family)	
White pine	***Pinus strobus***
Red pine	***Pinus resinosa***
Jack pine	***Pinus banksiana***
Tamarack	***Larix laricina***
White spruce	***Picea glauca***
Black spruce	***Picea mariana***
Balsam fir	***Abies balsamea***
Cupressaceae (Cedar Family)	
Eastern white cedar	***Thuja occidentalis***
Salicaceae (Willow Family)	
Trembling aspen	***Populus tremuloides***
Betulaceae (Birch Family)	
White birch	***Betula papyrifera***
Speckled alder	***Alnus rugosa***
Fagaceae (Beech Family)	
Red oak	***Quercus rubra***
Ulmaceae (Elm Family)	
American elm	***Ulmus americana***
Rosaceae (Rose Family)	
Black cherry	***Prunus serotina***
Mountain ash	***Pyrus americana***
Aceraceae (Maple Family)	
Red maple	***Acer rubrum***
Sugar maple	***Acer saccharum***

Shrubs

Cupressaceae (Cedar Family)	
Common juniper	***Juniperus communis***

Taxaceae (Yew Family)	
Ground yew	***Taxus canadensis***
Salicaceae (Willow Family)	
Slender willow	***Salix petiolaris***
Myricaceae (Bayberry Family	
Sweet gale	***Myrica gale***
Aquifoliaceae (Holly family)	
Winterberry	***Ilex verticillata***
Mountain holly	***Nemopanthus mucronata***
Grossulariaceae (Gooseberry Family	
Wild goosebery	***Ribes hirtellum***
Rosaceae (Rose Family)	
Mountain juneberry	***Amelanchier bartramiana***
Black chokeberry	***Pyrus (***or ***Aronia) melanocarpa***
Red chokeberry	***Pyrus (***or ***Aronia) arbutifolia***
Choke cherry	***Prunus virginiana***

Shrubs (cont.)

Pin cherry	***Prunus pennsylvanica***
Sand cherry	***Prunus pumila***
Meadowsweet	***Spiraea latifolia***
Steeple-bush	***Spiraea tomentosa***
Wild raspberry	***Rubus idaeus***
Swamp dewberry	***Rubus hispidus***
Prickly wild rose	***Rosa acicularis***
Smooth rose	***Rosa blanda***
Mountain ash	***Pyrus americana***
Anacardiaceae (Cashew Family)	
Poison ivy	***Rhus radicans***
Staghorn sumac	***Rhus typhina***
Ericaceae (Heath Family)	
Leatherleaf	***Chamaedaphne calyculata***
Sheep laurel	***Kalmia angustifolium***
Velvetleaf blueberry	***Vaccinium myrtilloides***
Low sweet blueberry	***Vaccinium angustifolium***
Huckleberry	***Gaylussacia baccata***
Bog cranberry	***Vaccinium macrocarpon***
Wren's egg cranberry	***Vaccinium oxycoccus***
Caprifoliaceae (Honeysuckle Family)	
Red elderberry	***Sambucus pubens***
Wild raisin	***Viburnum cassinoides***
Mooseberry	***Viburnum edule***

Herbs

Liliaceae (Lily Family)	
Canada mayflower	***Maianthemum canadense***
Yellow clintonia (bluebead lily)	***Clintonia borealis***

Solomon's seal	***Polygonatum pubescens***
Iridaceae (Iris Family)	
Blue flag	***Iris versicolor***
Orchidaceae (Orchid Family)	
Small purple fringed orchis	***Platanthera psycodes***
Ranunculaceae (Buttercup Family)	
Marsh marigold	***Caltha palustris***
Meadow rue	***Thalictrum dasycarpum***
Fumariaceae (Fumewort Family	
Pale corydalis	***Corydalis sempervirens***
Primulaceae	
Starflower	***Trientalis borealis***
Droseraceae (Sundew Family)	
Spatulate-leaved sundew	***Drosera oblongifolia***
Round-leaved sundew	***Drosera rotundifolia***
Polygonaceae (Buckwheat Family)	
Virginia knotweed	***Tovara virginiana***
Sheep sorrel	***Rumex acetocella***
Santalaceae (Sandalwood Family)	
Commandra	***Geocaulon lividum***
Herbs (cont.)	
Saxifragaceae (Saxifrage Family)	
Early saxifrage	***Saxifraga virginiensis***
Crassulaceae (Stonecrop Family)	
Stonecrop	***Sedum acre***
Leguminosae (Pea Family)	
Purple vetch	***Vicia americana***
Hypericaceae (St. John's wort Family)	
Common St. Johnswort	***Hypericum perforatum***
Shrubby St. Johnswort	***Hypericum kalmianum***
Marsh St Johnswort	***Hypericum virginicum (var fraseri)***
Rosaceae (Rose Family)	
Three toothed cinqefoil	***Potentilla tridentata***
Rough cinquefoil	***Potentilla norvegica***
Marsh cinquefoil	***Potentilla palustris***
Balsaminaceae (Touch-me-not Family)	
Touch-me-not	***Impatiens capensis***
Violaceae (Violet Family)	
Lance-leaved violet	***Viola lanceolata***
Onagraceae (Evening primrose Family)	
Evening primrose	***Oenothera biennis***
Araliaceae (Ginseng Family)	
Bristly sarsaparilla	***Aralia hispida***
Cornaceae (Dogwood Family)	
Bunchberry	***Cornus canadensis***
Umbelliferae (Carrot Family)	
Yarrow	***Achillea millifolium***
Pyrolaceae (Shinleaf Family)	

Indian pipe	***Monotropa uniflora***
Primulaceae (Primrose Family)	
Swamp candles	***Lysimachia terrestris***
Asclepiadaceae (Milkweed Family)	
Swamp milkweed	***Asclepias incarnata***
Convolvulaceae (Morning glory Family)	
Ivy-leaved morning glory	***Ipomoea hederacea***
Verbenaceae (Vervain Family)	
Vervain	***Verbena hastata***
Campanulaceae (Bluebell Family)	
Common bellflower, Harebell	***Campanula rotundifolia***
Cardinal flower	***Lobelia cardinalis***
Brook lobelia	***Lobelia kalmii***
Solanaceae (Potato Family)	
Deadly nightshade	***Solanum dulcamara***
Scrophulariaceae (Figwort Family)	
Cow wheat	***Melampyrum lineare***
Cut leaved water horehound	***Lycopus americanus***
Purple gerardia	***Gerardia purpurea***
Small-flowered Gerardia	***Gerardia paupercula***
Blue toadflax	***Linaria canadensis***

Herbs (cont.)

Compositae (Daisy Family)	
Slender white aster	***Aster junciformis***
Canada goldenrod	***Solidago canadensis***
Lance-leaved goldenrod	***Solidago graminifolia***
Plantain-leaved pussytoes	***Antennaria plantaginifolia***
Boneset	***Eupatorium perfoliatum***

Emergent aquatics

Alismataceae (Water plantain Family)	
Arrowhead	***Sagittaria latifolia***
Araceae (Arum Family)	
Water arum	***Calla palustris***
Pondetariaceae (Pickerelweed Family)	
Pickerelweed	***Pondetaria cordata***
Sparganiaceae (Burreed Family)	
Floating-leafed burreed	***Sparganium fluctans***
Cabombaceae (Watershield Family)	
Water shield	***Brasenia schreberi***
Nymphaeaceae (Water lily Family)	
Bullhead (or yellow) water lily	***Nuphar variegatum***
Fragrant water lily	***Nymphaea odorata***
Small pond lily	***Nuphar microphyllum***
Typhaceae (Cattail Family)	
Common cattail	***Typha latifolia***

Cyperaceae (Sedge Family

Inland sedge	***Carex interior***
Elliptic spikerush	***Eliocharis tenuis***

Aquatics

Halagoraceae (Water milfoil Family)

Alternate-leaved milfoil	***Myriophyllum alternifolium***

Hydrocharitaceae (Frogbit Family)

Canada pondweed	***Elodea canadensis***
Pondweed	***Potomogeton crispus***

Lemnaceae (Duckweed Family)

Duckweed	***Lemna minor***

Grasses

Bluejoint	***Calamagrostis canadensis***
Redtop	***Agrostis gigantea***
Wooly panic grass	***Panicum lanuginosum***

Ferns

Polypody	***Polypodium virginianum***
Sensitive fern	***Onochlea sensibilis***
Spinulose wood fern	***Dryopteris spinulosa***
Virginia chainfern	***Woodwardia virginiana***

Mosses and Liverworts

Haircap moss (Star moss)	***Polytrichum commune***
Peat moss	***Sphagnum*** sp
Broom moss	***Dicranum*** sp
Red-stemmed feather moss	***Pleurozium schreberi***
Cushion moss	***Leucobryum glaucum***
Liverwort	***Bazzania, Locopholia?***

Lichens

Caribou lichen	***Cladina rangiferina***
	Cladina mitis
	Cladina uncialis
Star lichen	***Cladonia stellaris***
	Xanthoria parietina
	Caloplaca sp
	Candelariella sp
	Parmelia cumberlandii agg.
Map lichen	***Rhizocarpon geographicum***
	Lecanora sp
	Lecidia sp

Mammals or mammal signs observed

Beaver	***Castor canadensis***
Porcupine	***Erethizon dorsatum***
Black bear	***Ursus americanus***
Racoon	***Procyon lotor***
Moose	***Alces alces***
Red fox	***Vulpes vulpes***
Mink	***Mustela vison***
Otter	***Lutra canadensis***

Provisional list of birds known or believed to nest in the area

Common loon	***Gavia immer***
Double crested cormorant	***Phalacrocorax auritus***
Great blue heron	***Ardea herodias***
American bittern	***Botaurus lentiginosus***
Canada goose	***Branta canadensis***
Mallard	***Anas platyrhynchos platyrhynchos***
Black duck	***Anas rubripes***
Common merganser	***Mergus merganser americanus***
Red breasted merganser	***Mergus serrator***
Turkey vulture	***Cathartes aura***
Bald eagle	***Haliæetus leucocephalus***
Merlin	***Falco columbarius columbarius***
Ruffed grouse	***Bonasa umbellus***
Spotted sandpiper	***Actitis macularia***
Ringbill gull	***Larus delawarensis***
(Birds cont.)	
Herring gull	***Larus argentatus***
Common tern	***Sterna hirundo hirundo***
Caspian tern	***Hydroprogne caspia***
Whip-poor-will	***Caprimulgus vociferus***
Pileated woodpecker	***Dryocopus pileatus***
Wood Pewee	***Contopus virens***
Crow	***Corvus brachyrhynchos***
Raven	***Corvus corax***
Black-capped chickadee	***Parus atricapillus***
Winter wren	***Troglodytes troglodytes***
Robin	***Turdus migratorius***
Veery	***Catharus fuscescens***
Redwing blackbird	***Agelaius phœniceus***
Boattail grackle	***Cassidix mexicanus***
Cedar waxwing	***Bombycilla cedrorum***
Red eyed vireo	***Vireo olivaceous***
Yellow warbler	***Dendroica petechia***
Chestnut-sided warbler	***Dendroica pensylvanica***
Common yellow throat	***Geothlypis trichas***
American redstart	***Setophaga ruticilla***
Yellow rumped warbler	***Dendroica coronata coronata***

Pine warbler	***Dedroica pinus***
Prothonotary warbler?	***Prothonotaria citrea***
Song sparrow	***Melospiza melodia***
White throated sparrow	***Zonotrichia albicollis***
Chipping sparrow	***Spizella passerina passerina***

Provisional list of adult butterflies

Monarch
Red Admiral
Skipper
Hanson's hairstreak
Common Little Blue
Cabbage
Wood nymph
Copper
Tiger swallow-tail

Glossary of terms

Advection fog - the production of fog when warm, moisture-laden air passes over water that is cold enough to cause condensation.

Basal till - unconsolidated fragments of rock, sand and silt held within the ice of a glacier and deposited on the landscape during melting of the ice

Basalt - a volcanic rock of dark colour made up mainly of the minerals pyroxene or amphibole, and feldspar

Batholith - a mass of igneous rock such as granite which solidified deep within the earth, and which occupies an area greater than 100 km^2

Channelling - the tendency of the wind to follow the axis of a channel or be steered by sloping land, resulting in a change in direction

Diabase - a dark, mafic (containing magnesium and iron) intrusive igneous rock, basaltic in nature, and usually characterized by blade-shaped feldspar crystals

Dike - a tabular mass of intrusive igneous rock cutting across older rock

Fault - A fracture or zone of fractures along which the wall rocks have been displaced

Feldspar - common rock-forming minerals such as orthoclase, microcline, and plagioclase, made up of calcium, sodium, potassium, aluminum, and silica

Fetch - the distance which winds blow over water from a given direction

Granite - igneous rock made up mainly of one or more feldspars, and quartz, with lesser amounts of either mica, or hornblende, or both. It is usually found in batholiths, and is a felsic (iron + silica) rock with a high silica content

Gneiss - a metamorphic rock containing bands rich in granular minerals alternating with bands rich in platy, or micaceous minerals

Igneous rock - rock formed by the crystallization of magma (molten rock from beneath the Earth's crust)

Limestone - a sedimentary rock made up largely of the carbonate mineral calcite and derived from the exoskeletons of marine organisms

Metamorphism - the adjustment in the mineralogy and texture of a rock in response to heat and pressure imposed on the rock when it is buried at depth in the Earth's crust

Moraine - deposit of unsorted glacial debris at the sides or terminus of a glacier

Outwash - transported glacial debris that has undergone rounding and sorting by the action of glacial meltwater

Paleozoic - The Era of geologic time which extended from 570 to 225 million years ago

Plate - a portion of the Earth's mantle that is floating on molten magma. Each continent is made up of one or more plates.

Pleistocene - The Epoch of geologic time between 3-4 million and 10,000 years ago during which the last ice age occurred.

Seiche - the oscillation of water in a lake that follows a wind set-up

Syncline - a fold in which the fold limbs slope towards each other to form a trough-like structure

Wind set-up - the process whereby strong winds blowing down the length of a lake cause water to 'pile up' at the downwind end, raising water levels there and lowering them at the upwind end of the lake