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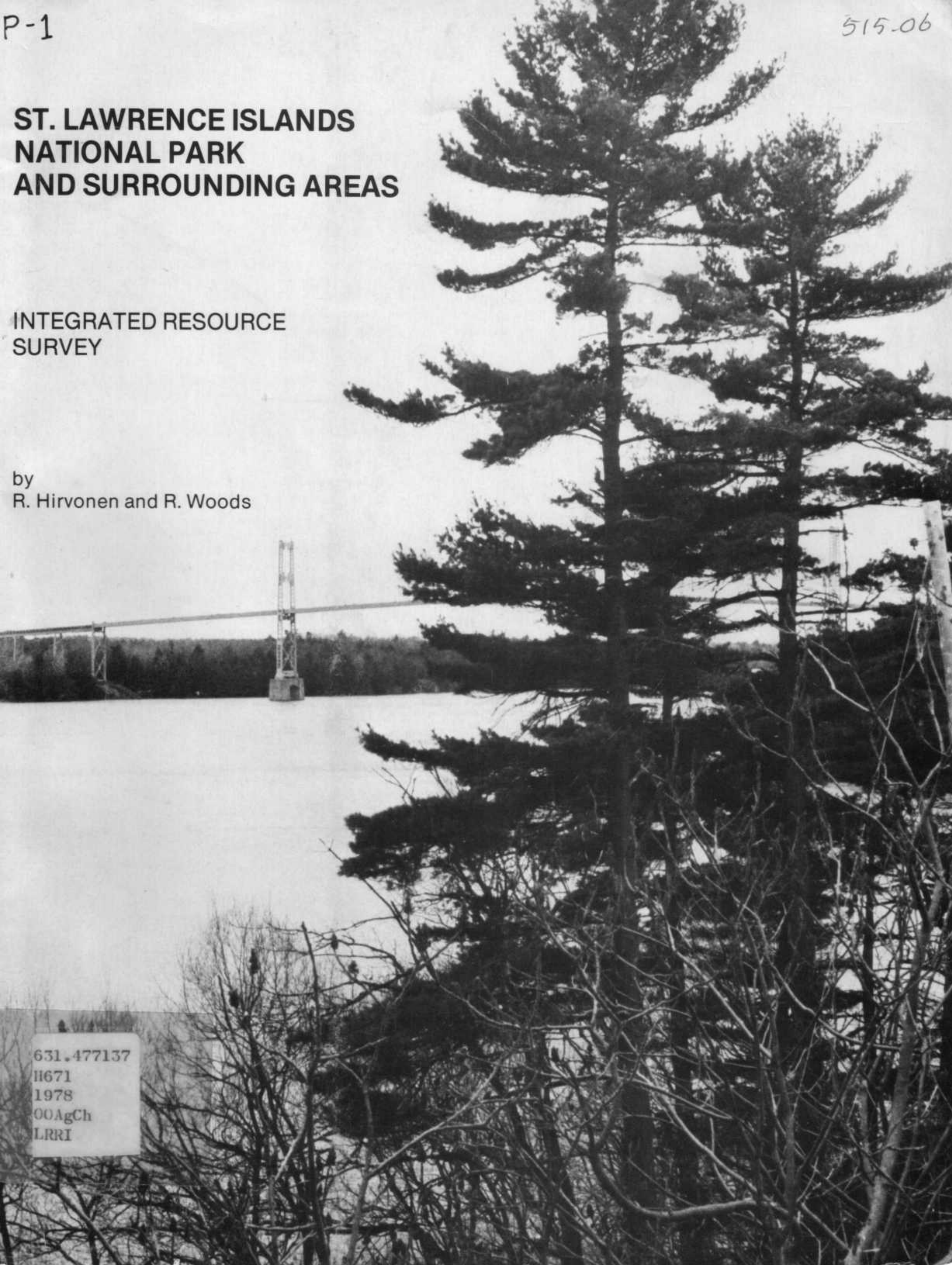
ST. LAWRENCE ISLANDS NATIONAL PARK AND SURROUNDING AREAS

INTEGRATED RESOURCE SURVEY

by
R. Hirvonen and R. Woods



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INTEGRATED RESOURCE SURVEY OF ST. LAWRENCE ISLANDS NATIONAL PARK AND SURROUNDING AREAS

by

R. Hirvonen and R.A. Woods

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ABSTRACT

The land, vegetation and surface drainage patterns of St. Lawrence Islands National Park and surrounding areas are described and mapped at the scale of 1:10 000, except Cedar, Milton and Stovin islands which are at 1:5 000. The land resource is mapped at the land type level where segments of the landscape are separated on the basis of their topography, drainage, soil texture, origin of parent material and depth to bedrock. The vegetation is mapped by basic non-forested categories or by forest cover types as defined by stand height, species composition, crown closure and stand condition. Major soil types, forest cover type groups, lower vegetation communities, drainage and rivers are described in the text.

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Photo interpretation of forest cover was done by Mr. D. Wilson.

Compilation of all maps and overlays was under the supervision of Mr. M.W. Robinson, assisted by Messrs. Wilson, Bouillon and Leskie. Scribing was done by Mr. J. Leblanc and Mr. R. Beauchamp.

Computer programming for data compilation was provided by Mr. H. Mucha of the Forest Management Institute Computing Unit.

Thanks are due to the personnel of St. Lawrence Islands National Park for their cooperation in various phases of the project.

RÉSUMÉ

Le terrain, la végétation et le drainage de surface du parc national des Îles du St-Laurent, ainsi que les régions environnantes, sont décrits et cartographiés à l'échelle de 1:10 000, sauf les Îles Cedar, Milton et Stovin traçées à l'échelle de 1:5 000. Les composantes physiques sont cartographiées au niveau du type de terrain et les portions du paysage sont présentées séparément selon la topographie, le drainage, la texture du sol, le matériau d'origine et la profondeur de la roche mère. La végétation est cartographiée par catégories non-forestières ou par types de couverts forestiers, déterminés par la hauteur et la condition du peuplement, la composition des essences et la densité du couvert de la cime. Sont aussi décrits les principaux types de sols et de couverts forestiers, les communautés à végétation réduite, le drainage et les cours d'eau.

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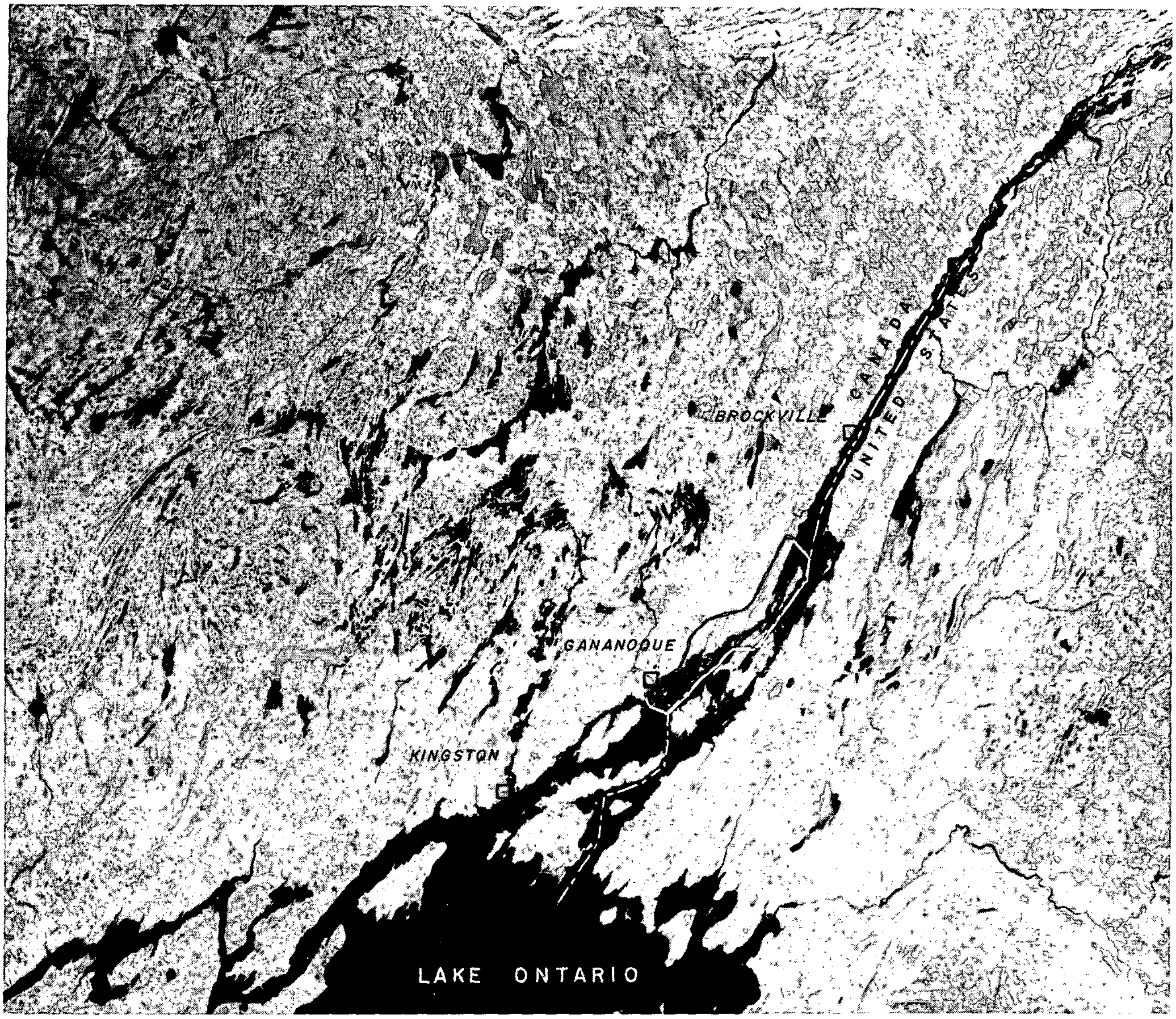


FRONTISPIECE. Satellite view of the Thousand Islands region. The solid black and white line approximately outlines the study area.

INTEGRATED RESOURCE SURVEY OF THE ST. LAWRENCE ISLANDS NATIONAL PARK, ONTARIO AND SURROUNDING AREAS

by

R. Hirvonen and R.A. Woods*

INTRODUCTION

The total study area encompasses the St. Lawrence Islands National Park, its surrounding islands and parts of the mainland (Frontispiece).

The aim of the survey is to provide park planners with basic data on land, vegetation and water-related attributes of the area. The information is presented in the form of maps, overlays and the accompanying text.

In the survey one attempts to differentiate and classify ecologically significant segments of the landscape in order to provide a firm ecological base for resource and park planning. This requires that vegetation be treated as an integral part of the landscape; the physical attributes of the land and the natural vegetation on that land are not separate entities but interrelated and parts of a single association. In this survey the land and vegetation resources are integrated by first establishing the macro- and microdrainage patterns upon which individual land types are then interpreted. These land units provide a relatively stable physical base against successional change and, along with the drainage patterns, are reflected in the vegetation communities. Accordingly, the final phase, the evaluation and stratification of the vegetation component of the biophysical complex, is evolved within the physical land units.

The St. Lawrence Islands study area is mapped at the land type level where landforms or their components are shown as individual units each depicting fairly homogeneous topography, moisture conditions, soil texture and parent material. Forested areas are mapped by cover types as defined by stand height, species composition, crown closure and stand condition, and non-forested lands are classified in the categories shown in Appendix C. The maps are produced at the scale of 1:10 000, except for Cedar, Milton and Stovin islands, which are mapped at the scale of 1:5 000; descriptions of various aspects of the land, vegetation and water are included in the text.

DESCRIPTION OF STUDY AREA

LOCATION AND ACCESS

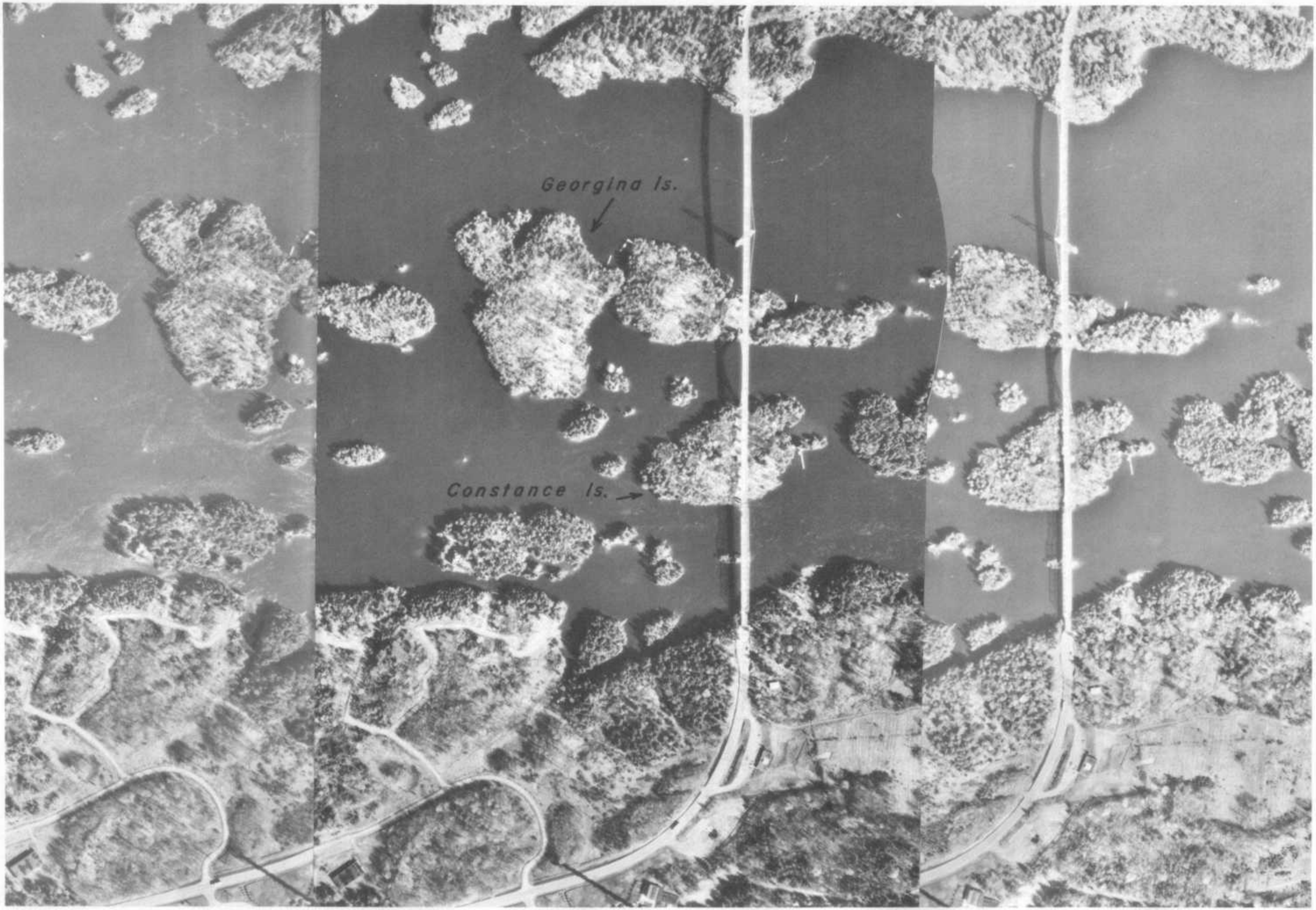
The total study area includes the St. Lawrence Islands National Park, the remainder of the Thousand Islands east of Howe Island to approximately Longitude 75°50'W and, on the mainland, the area south of the Macdonald-Cartier Freeway (Hwy. 401) between Landons Bay and the Mallorytown Road.

Park property occupies an area of only approximately 5 km^2 while the rest of the mapped area covers nearly 150 km^2 of which about 85 km^2 are water. The western half of the area is part of Front of Leeds and Lansdowne Township and the eastern half is part of Front of Escott Township, Ontario. The only islands not within these two townships are Cedar Island, Milton Island (Pittsburgh Township) and Stovin Island (Elizabethtown Township).

The area is very accessible as it is located alongside the main transportation corridor between Canada's two largest cities, Toronto and Montreal, and approximately halfway between them. Traversing the centre of the area is also one of the major bridges crossing the St. Lawrence River and providing access between Canada and the United States (Fig. 1). In addition to the three main highways, Macdonald-Cartier Freeway and Ontario provincial highways 2S and 137, the area is traversed by numerous, excellent quality, secondary roads. However, of the park property only Mallory-

*Forestry Officers, Integrated Resource Survey Program, Forest Management Institute, Canadian Forestry Service, Environment Canada, K1G 3Z6.

FIGURE 1. Stereotriplet of Ivy Lea Bridge. In the centre of the illustration are Georgina and Constance islands, part of the St. Lawrence Islands National Park.



town Landing and Hill Island can be reached by land; the rest of the park islands do not have bridge connections to the mainland.

PHYSIOGRAPHIC FEATURES

The study area is, for the most part, in the Laurentian Highlands Physiographic Region (Sanford and Grant 1975) where a narrow wedge of this region crosses the St. Lawrence River and separates the West St. Lawrence Lowland Physiographic Region from the Central St. Lawrence Lowland.

Elevations above sea level vary between about 75 m (St. Lawrence River) and 150 m (Fitzsimmons Mountain) (Map 1), but only about 10% of the area is above 105 m. In some locations along the shore are extensive areas only a metre or less above the mean river level; in total, these occupy nearly 15% of the study area.

Generally the entire area is a combination of flat or gently undulating valleys and abrupt, pronounced outcrops of mainly Precambrian granitic bedrock. These rocky outcrops are roughly rolling and heavily dissected with the shallow, predominantly till soils frequently interspaced by bare bedrock. The valleys are relatively flat or gently undulating and often consist of deep, glaciolacustrine deposits. Chapman and Putnam, 1966, place this area in their "Leeds knobs and flats" physiographic region of southern Ontario where the "knobs" represent granite outcrops and the "flats", deep clay-silt deposits. They consider the clay-silt flats as marine (Champlain Sea) in origin whereas Geological Survey of Canada (GSC) (Maps 13-1965 and 6-1970, Henderson 1970) class them as glaciolacustrine: for consistency, the GSC nomenclature for surficial geology is used throughout this report.

In the lower lying regions along the river, particularly toward the eastern half of the study area, instead of glaciolacustrine deposits the soils are frequently alluvium of more recent origin, but abrupt, rugged Precambrian bedrock outcrops are characteristic throughout these deposits as well.

Very low lying wetlands occur at frequent intervals along the shore. These consist of organic and silty muck but are often underlain, within a depth of 1 m or less, by sandy alluvium or glaciofluvial material. The most extensive of these wetlands occur in the vicinity of Cook Point and in the eastern half of Grenadier Island.

Sandy and gravelly deposits of glaciofluvial origin are present throughout and many of these are of mineable quality as evidenced by numerous gravel pits. Much of Grenadier, Tar and southern Hill islands are covered by this material; another sizeable concentration occurs westerly from the village of Ivy Lea.

Geology

The study area is within the Frontenac Axis, a narrow section of Precambrian rocks which joins the Precambrian rocks of the Canadian Shield to those of the Adirondack Mountains. At the Thousand Islands it extends over a width (southwest-northeast) of only about 40-50 km and separates the relatively flat Paleozoic strata to the northeast from similar rocks to the southwest.

Within the study area there are only very few minor occurrences of Paleozoic strata overlaying unconformably the older Precambrian rocks. These are Gordon Island, Corn Island, most of Hay Island, Huckleberry Island, and some of their intervening and adjacent islets; four or five small areas on Hill Island are also underlain by similar strata. The bedrock of these islands is part of the Potsdam Formation (Liberty 1971) consisting mainly of fine-grained quartz sandstone and siltstone with some conglomerate.

Elsewhere in the study area the bedrock is a complex of Precambrian age (Map 2). The most common rock type is a medium-grained reddish granite which covers wide areas of the mainland between Landons Bay and Grassy Point. Most of Hill Island and the islands to the west as far as Camelot Island consist of this rock. The coastal areas east of Grassy Point as well as in the vicinity of Rockport are characterized by migmatite, an intermixed unit of the preceding granite and of metamorphic gneisses. Other large occurrences of migmatite on the mainland are in the area north of Ivy Lea Bridge and near Landons Bay in the extreme west end of the study area. Much of Club Island, most of southeastern Hill Island and almost all of Grenadier Island also consist of this rock type. A white, almost pure quartzite is probably the third most common major rock formation within the area. It is particularly prevalent in the northeastern parts but frequently forms prominent ridges throughout the red granite dominated areas. White pegmatite, usually associated with marble and silicate rocks is also frequent, especially in the eastern end of the study area and on Tar Island. Except for Hay and Huckleberry islands, the Admiralty Islands group is predominated by coarse-grained syenite and related rocks. Despite the commonness of this rock type here, it does not occur elsewhere within the study area.

Generally north-northwest trending diabase dykes cut the Precambrian rocks at numerous places; within the study area they are particularly prevalent in the Admiralty Islands but infrequent east of Landons Bay. In the Raft Narrows area and locations to the east, younger fine-grained andesite dykes with a consistent northeast alignment are present.

Climate

A major influence on the climate and the local weather patterns in the upper St. Lawrence areas is its proximity to Lake Ontario. This lake, being not only of large size but also deep (over 230 m at its deepest), represents a huge heat storage capacity, both negative and positive depending on the season. In a "normal" winter only about 15% of the lake becomes ice covered and even during what would be considered a severe winter, ice cover does not usually exceed 25%; in the last century the lake was frozen over only twice.

In the winter, the nearness of such a huge (19 500 km^2) reservoir of above 0°C heat source naturally has a substantial moderating effect on the atmospheric temperatures in the vicinity. Similarly in the summer, when the water temperatures are generally cooler than the air, the lake has a notable cooling influence on its surroundings. This trend is visible, albeit not very pronounced, in the temperature figures for Kingston and Brockville (Table 1), the two localities nearest the study area for which climatic records are available. Kingston on the lake appears slightly cooler in the spring and summer and somewhat warmer during the other two seasons than Brockville which is about 75 km from the lake. The most significant difference is in the temperature extremes which are much more subdued at Kingston than at Brockville. Generally, in the spring and the fall the lake serves as an evening agent which provides a rather gradual, sometimes prolonged, transition between summers and winters; the result being a lengthened growing season and a reduction in the hazard of unexpectedly early frost. This influence of the lake is discernable in the figures of the average number of frost-free days per year. For Kingston the figure is 219 days while Brockville averages 212 frost-free days annually. The frost-free period (continuous) in the area averages 140-150 days annually with Kingston being closer to the 150 day isogram while Brockville is near the 140 day isogram. Similarly the study area has a mean annual growing season (based on mean daily temperature of 42°F or higher) between 200 and 210 days and a mean annual number of degree days

Table 1. Temperature and precipitation

	Brockville				Kingston			
Mean daily temperature °C								
Winter (Dec.-Feb.)	-7.0				-6.2			
Spring (March-May)	6.3				5.4			
Summer (June-Aug.)	19.9				19.5			
Fall (Sept.-Nov.)	9.7				9.9			
Year	7.2				7.2			
Recorded extremes °C	39.4	-38.3			36.1	-31.7		
Average no. of frost-free days per year	212				219			
Mean seasonal precipitation mm	Rain	Snow	Total*	#	Rain	Snow	Total*	#
Winter	86.8	1620	248.7	40	94.7	1306	225.3	39
Spring	193.0	366	231.0	36	183.4	308	214.1	32
Summer	236.5	0	236.5	32	217.2	0	217.2	27
Fall	233.4	190	252.2	36	228.1	143	243.4	32
Yearly total	749.7	2176	968.4	144	723.4	1757	900.0	130

*Snow is expressed as water equivalent, 10 mm of snow equals approximately 1 mm water.
#Number of days with measurable precipitation.

Source: Atmospheric Environment Service, 1975.

(above 42°F) between 3400 and 3600 (Brown 1968). Brockville is about 35 km further north than Kingston but latitudinal effect over such a minute distance is negligible compared to local climate influencing factors such as a lake the size of Lake Ontario.

The lake's large surface area allows for the evaporation of a similarly large amount of water vapour which influences atmospheric humidity which is turn often becomes translated into cloud cover. The relative humidity increase is usually less in the summer than winter; on the average the lake's contribution might amount to an increase of about 10% in the summer and as much as 30% in the winter (Richards 1969). Since relative humidity is also a function of temperature, this higher increase during the cooler seasons reflects the cold air's lack of moisture-holding capacity and not necessarily an increase in the total amount of evaporation.

Seasonal effects on cloud cover can be similarly generalized. In the winter, the moisture laden air over the relatively warm, unfrozen lake rises into the colder atmosphere causing the formation of clouds. During the warmer seasons the land areas are heated by the sun and daytime cumulus formation occurs over the land while the sky over the cooler lake remains clear.

The Thousand Islands area is subject to much of the climatic effects Lake Ontario creates not only because of its proximity to the lake but also because the lake and the study area are in alignment with the prevailing wind patterns. These tend to parallel the St. Lawrence River with a general predominance southwesterly but northeasterlies are also common, particularly in winter. The southwesterly direction of the prevailing winds is important because these winds pass over Lake Ontario immediately before entering the Thousand Island region and many of the climatic effects created by the lake can be carried into the Thousand Islands area. Also, as they pass over the lake, they pick up moisture which is then deposited in the form of rain or snow. Usually November receives the most precipitation (over 90 mm) while early spring (March-April) tends to be the driest time of year averaging slightly over 70 mm precipitation at Brockville down to about 65 mm in the western parts of the park area. Kingston receives an average of about 900 mm of precipitation (rain plus snow) and Brockville nearly 970 mm annually (Table 1); for comparison it is interesting to note that areas at the windward end of Lake Ontario average only about 800 mm.

Fog along the St. Lawrence River may be encountered at any time but tends to be more common during the late fall and winter. The major cause is the slow advection of warmer, moisture-laden air from above the unfrozen lake and river onto the colder land areas causing the moisture to condense into fog. Steam fog close to the surface of the river is frequent in the late fall and early winter before freeze up but this type of fog does not extend onto land. Radiation fog may occur at anytime but is typical in the spring and fall particularly in low-lying areas during clear, still nights when the daytime's warm and moist air becomes rapidly cooled. This type of fog is usually local in extend and topography related; it usually disappears during the day as the air becomes warmed by the sun or disturbed by a breeze.

The Thousand Islands area receives approximately 2000 hours of sunshine yearly. The sunniest months are May, June, July and August with a significant drop in the number of sunshine hours in September. December receives the least amount of bright sunshine. The increase is gradual from January through April with a substantial jump in May after which the monthly differences are moderate until September. For a more detailed study on the climate of the St. Lawrence Islands National Park, reference can be made to Lapczak, Wyllie and Lawford, 1977.

HISTORY

The Thousand Islands region was probably occupied as far back as a couple of thousand years B.C. by various ancient cultures but very little is known about them. Dating of artifact finds and other remains from various sites indicate that Iroquoian speaking Indians inhabited the area as early as 1250 A.D. The Thousand Islands and the river in general seem to have been a sort of borderland between two major factions of these peoples, the Huron and the Iroquois. The Iroquois were to the south and the Huron to the north with the river and the islands apparently largely within Huron hunting territory. It also seems plausible that others, particularly some Algonkian speaking Indians from the northeast, were in the area sporadically.

First contact between the Indians of the area and Europeans came in 1535 when Jacques Cartier ascended the St. Lawrence River to the Indian settlement called Hochelaga (on the island of Montreal) where the up-river progress of his ships was halted by rapids. The habitants of Hochelaga were apparently Hurons but this is not definite and they may have been Iroquois or even Algonkian. When Samuel de Champlain reached the location about 70 years later (1603) the village was no longer there thus giving testimony to the transitory nature of the native settlements in the St. Lawrence Valley. The Huron villages traditionally changed location every ten years or so but whether the disappearance of Hochelaga was merely a normal move or whether it was forced out by some invaders is not clear.

A decade or so after Champlain, missionary work among the Hurons was begun by the Recollet Fathers from France. Another decade and the Jesuits began to replace the Recollets and continue the work.

At this time, the trade of furs for European goods had grown substantially and competition between the Huron and the Iroquois for hunting territory increased. In the late 1630's a series of epidemics struck the Huron and their numbers were drastically reduced to something like one half of their previous strength – all this at a time when the Iroquois began planning the takeover of Huronia and their fur trade. Iroquois pressure increased and the Huron gradually withdrew westward from the St. Lawrence Valley prior to their eventual collapse and complete dispersal by 1650.

The French had made peace with the Iroquois prior to the collapse of Huronia and succeeded in carrying on the fur trade, exploration and other activities. Within the Thousand Islands region, bases were constructed at Fort Frontenac (Kingston) and La Présentation (Ogdensburg). These thrived until the fall of New France and the subsequent transfer of all of Canada to the British on the signing of the Treaty of Paris, 1763. The British then established their major base on Carleton Island.

In the mid- and late 1770's, after the war of independence in the United States, large numbers of people loyal to England fled north into Canada and the British government rewarded their loyalty with generous land grants. This contributed in a major way to the permanency of the settlement of the north shore of the St. Lawrence River and gave impetus to numerous small towns and villages in the area.

The War of 1812 was the last military conflict to involve the Thousand Islands region. From this conflict eventually evolved the location of the international boundary which winds its way through the myriad of islands in the river. As the need for the accurate location of the boundary became evident the river was surveyed in 1818. Captain Owen, in charge of the survey, named many of the islands, often after heroes, ships, etc. of the War of 1812. The actual allocation of the islands between Canada and the United States was achieved by the Porter-Barclay Treaty of 1822.

The St. Lawrence River had been used as a travel and trade route long before the arrival of the first Europeans. Trade was an important part of the early Huron economy and their familiarity with the canoe as a means of transport made the river a natural travel corridor. Similarly, when the Europeans arrived they too were quick to realize the river's potential as an access/transport route for exploration, trade and military purposes. Maps were produced and one of the early (1727) French maps makes first reference to the park region by naming the islands "Les Mille Îles", thus coining the name for this island-strewn section of the river.

The waterway was more than adequate for the volume and type of craft required by early trade but it was soon evident that improvements, such as canals around the rapids, would greatly facilitate the movement of goods. The first undertaking toward this end was by Dollier de Casson who, about 1700, began the construction of a canal at the Lachine Rapids.

As settlement increased westward, so did the traffic on the St. Lawrence; raw materials such as lumber were transported down and general merchandise and staples up. With the increase in traffic came an increase in the navigational improvements along the river. In the 19th century another factor, that of obtaining power from the river, created added need for construction of river improvements. As North America industrialized, the demand for both transport and hydro power increased dramatically and the need for major facilities along the St. Lawrence emerged. The river could be opened to ocean-going traffic and its great potential for hydro power harnessed. Years of planning and construction toward these objectives culminated in the opening of the Seaway on July 1, 1958. Direct impact on the Thousand Islands landscape was minor; no large-scale changes occurred, unlike farther down river where major dredging and flooding of lands took place. The main impacts are commerce and transportation related, but these, by redirecting local priorities, create pressures and demands on the lands and thereby can substantially affect the area's biophysical complex.

The frequent presence of sea-going vessels in themselves creates an unusual aura in the region, for many ships are much bigger than a large proportion of the islands they thread their way through. Whether this be disturbing or whether it enhances the uniqueness of the park's location depends purely on one's preferences. However, there is no question that the region is worthy of being preserved as widely as possible because it offers a rare combination of abundant natural beauty, a waterway of major importance economically and socially, and a richness in the nation's history.

RESOURCE INVENTORY

METHODOLOGY

This study is a concurrent survey of the vegetation and the physical land characteristics of the area. A major product of the survey is the mapping of present forest cover, non-forested areas, topography, soil texture, soil moisture, origin of surficial materials, open waters and microdrainage patterns.

Because of the largely private, or other non-federal, land ownership pattern in the area, authority of access was limited and this, in turn, precluded extensive groundwork. Accordingly this study relies primarily on detailed analysis of aerial photographs supplemented by limited field checks. However, the descriptions of ground flora are derived entirely from data collected in the field.

Base Maps and Aerial Photographs

Thirteen base maps (Fig. 2) at the scale of 1:10 000 (1:5 000 for Cedar, Milton and Stovin islands) were drafted from the National Topographic Series (1:25 000 maps 31B/5d, e,f; 31B/12b; 31C/1f; 31C/8a, b,h. Recent aerial photographs were used to update and add detail on roads, secondary streams and shorelines.

Aerial photographs used for this study were black and white summer photography taken August 9, 1975 at the scale of 1:10 000 (National Air Photo Library roll numbers A 40030 and A 40031). This was supplemented by black and white leaf-free photos taken May 1, 1974 at the scales of 1:8 400 and 1:20 000 (roll number A 23672). A variety of other photo coverage was also used for reference on numerous occasions.

Photo Interpretation

Prior to field work, preliminary photo-interpretation was done for the entire study area. This served to give an estimate of the complexity of types to be expected and, therefore, of the intensity of sampling required to adequately cover various conditions. After field sampling the interpretation was revised wherever sample data indicated it necessary.

For land use planning, whether park or otherwise, it is desirable to have a relatively fixed base upon which to expand. To accommodate this requirement, the physical land features were determined and delineated first; though changes are created by nature as well as caused by man, these features provide a framework which is fairly stable against successional or artificial changes. The more changeable attributes of vegetation were interpreted within this land base and subsequently superimposed upon it.

The land features were interpreted and mapped at the land type level (Lacate 1969) where each unit consists of fairly uniform topography, soil texture, similar moisture range and geomorphic origin of parent material. On a map, each such land type is described by a combination of standard symbols, numerals and alphabetic abbreviations as listed in Appendix C.

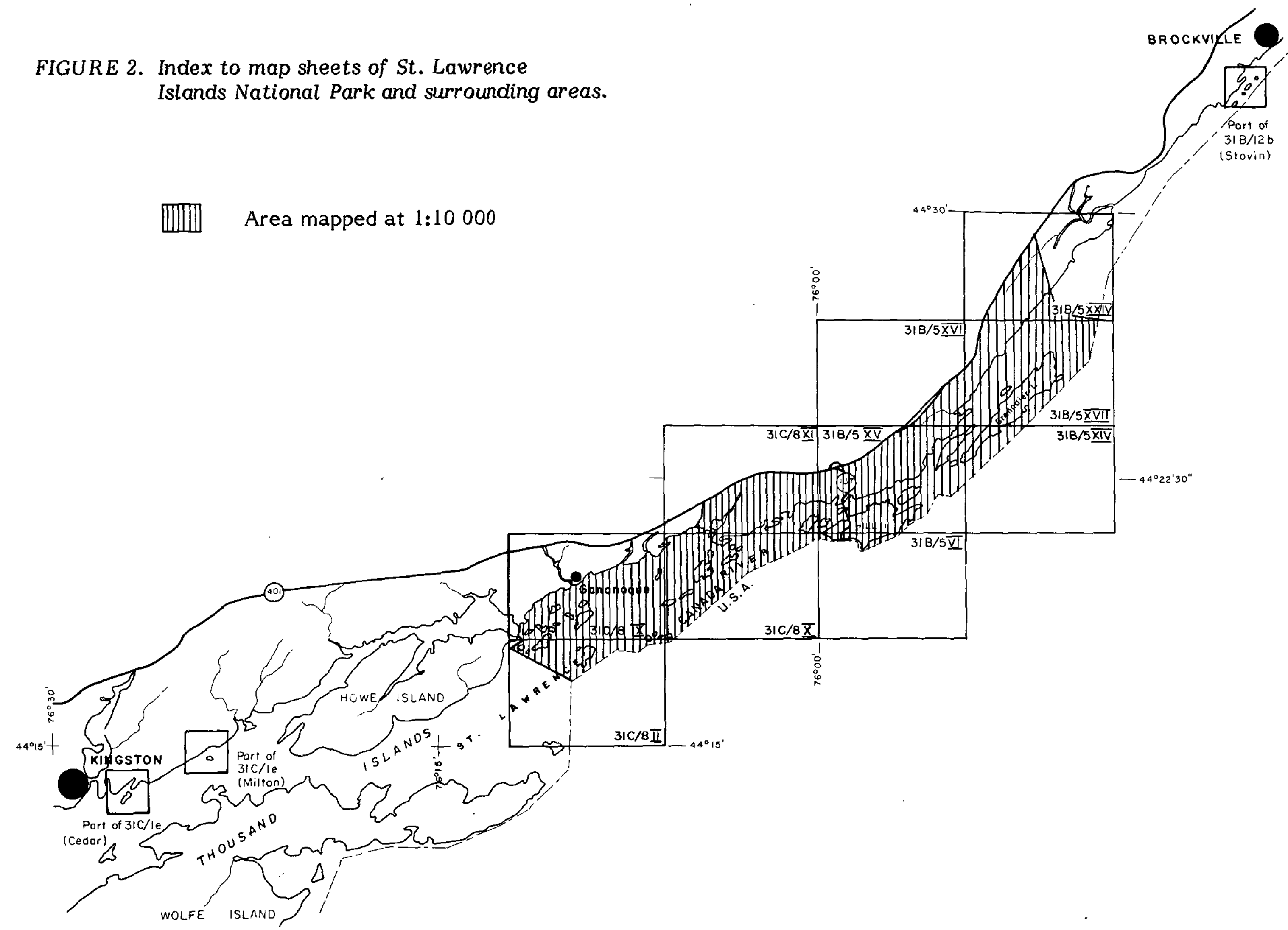
Superimposed within this land base are the forest cover and non-forest categories. Forest stands are separated according to uniformity of species composition, stand height, canopy closure and general stand condition. A sample symbol and forest cover legend are presented in Appendix C. Thirteen different non-forested categories were recognized in this survey and these are also described by appropriate symbols (Appendix C).

An illustration of land and forest typing as it appears on an interpreted photograph is shown in Figure 3. As an example, the land type at the left-centre of the photograph is described by the symbol ↗ 2 vc F/R. This represents a topographic unit which is a gentle slope in the general direction indicated by the arrow. The area is well drained (2) predominantly sandy soil (vc); the underlining of the symbol vc indicates the presence of boulders in the area. The soils are of glaciofluvial origin (F) and fairly shallow, often less than 1 m, over bedrock (/R).

Within this land type are four vegetation cover types, two of which are forested. The type designated as U2 represents upland shrub vegetation which in this case is probably sumac dominated. The U1 indicates an open area within the taller shrub and forest types and consists largely of a variety of upland grasses and herbaceous species. One of the forest types is designated as 7rOwO4,5. This depicts a forest consisting of a mature (5), predominantly a red and white oak stand (rOwO) averaging within the 18-24 m height class (7) and forming a closed canopy (4). Similarly the symbolization of the other forest stand within the land type describes its species composition and stand structure.

The entire study area was delineated and symbolically described on aerial photographs in the preceding manner. This information was then

FIGURE 2. Index to map sheets of St. Lawrence Islands National Park and surrounding areas.



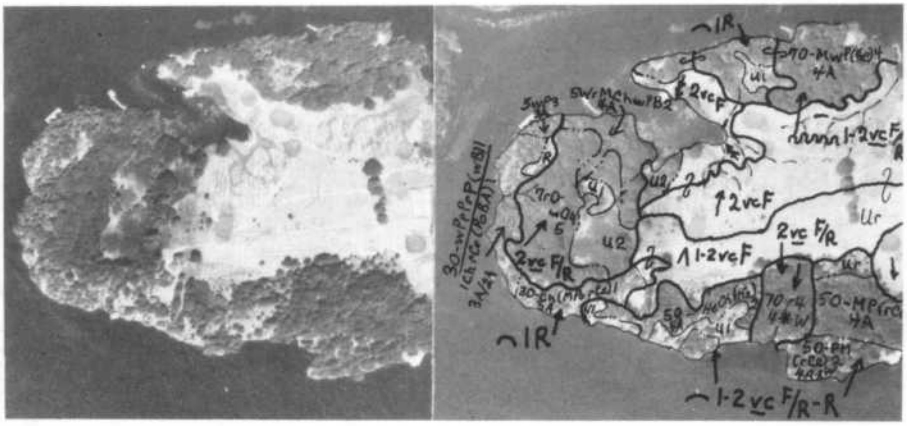


FIGURE 3. Stereogram of a typical interpreted photograph. Thick lines denote land types, thin lines vegetation types. Scale: approximately 1:10 000.

transferred onto the planimetric base maps. A sample portion of such a map as it appears in final form is shown in Figure 4.

Field Sampling

The ground sampling was done in late July and early August of 1976, with occasional added field checks on areas of specific interest.

To obtain the most comprehensive appraisal of the area's resources, field samples were taken in as many different land and vegetation types as time permitted. At the sample location, soil characteristics such as soil texture, drainage and moisture conditions, probable geomorphic origin and depth over bedrock were appraised by augering up to a depth of 1 m. Other site factors recorded were local topography, slope features, aspect and the presence/absence of boulders near the surface. In forest stands, species composition was estimated with the aid of a relascope, stand height was measured and an estimate of the crown closure made. Figure 5 illustrates a typical field tally card. Information on lower vegetation was also acquired at each site by establishing a 4 by 4 m quadrat on which each species was listed with their cover (abundance-dominance) values as modified from a Braun-Blanquet scale (Mueller-Dombois and Ellenberg 1974) (Table 2). Any species which could not be identified in the field, was denoted numerically, pressed and brought back for identification. At each lower vegetation sample location, the prevailing tree canopy composition and percent closure, amount of regeneration and shrub species with their height and percent cover were also recorded (Fig. 6). At least one colour photograph was usually taken at each plot for possible future reference.

A plant collection was made; this included those plants and shrubs not identified in the field, as well as some of the less common species. Field-identified plants common to the area were not collected nor were, in most cases, rare specimens unless they were growing in relative local abundance. In any case, to protect plant species, the collections were kept to a minimum and replications were avoided.

Identified specimens were checked by W.J. Cody, Director of the Herbarium, Agriculture Canada, Ottawa, where the collections were deposited. Mosses were identified by Dr. R. Ireland, and lichens by P.Y. Wong, both of the National Museum. Requested mosses and lichens were deposited in the National Herbarium of Canada.

Because of restricted access to non-park lands, sampling was concentrated within the park and reduced to superficial observations elsewhere. Permission to enter non-park lands did not become available until the summer of 1977, after mapping was already in its final stages. Checks on certain key areas were made at this time but the ground checking on non-park lands remained extremely meager.

Forest cover and land/soil information were collected in 63 sample locations and lower vegetation were studied on 109 quadrats. In addition, on numerous occasions appraisals were obtained along road cuts, shorelines and in other accessible areas where a specific data requirement could be easily fulfilled.

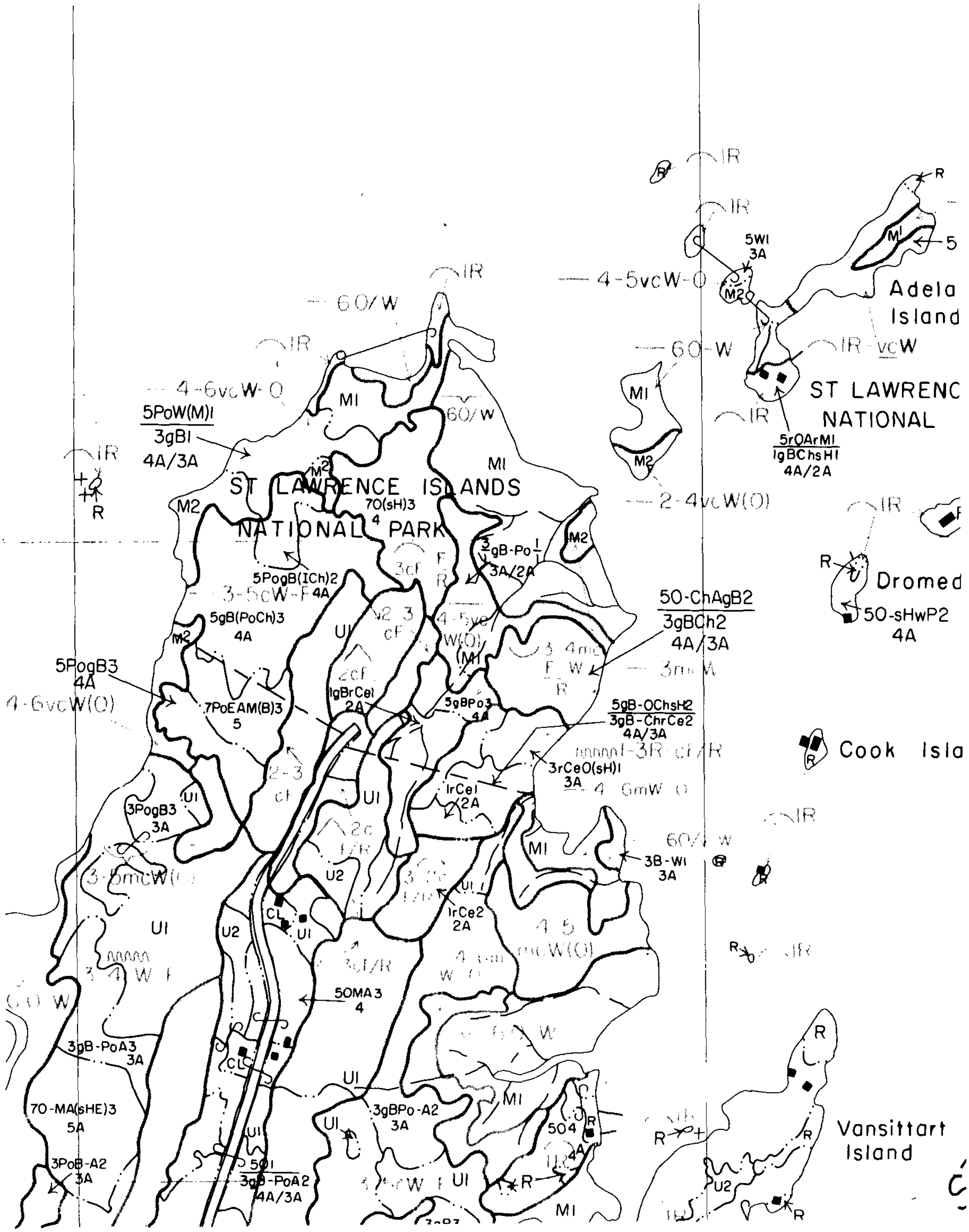


FIGURE 4. *Portion of a land and forest type map.*

Vegetation Relevé

Date 18 Aug 76 Map No 31C/8 X Air Photo No A37227-82 UTM 1621 - 1017 Line No MULC

Plot No 1 Stop No 1 Plot Size relascope

Forest Type	Land Type		
9 hM 4	1-3 msT/R	Tree Species	hM Be Bd rO He
		Basal Area	
		Height	28m
		Age	

Physiography and Edatope

Elevation:

Slope % flat Aspect —

Topographic Location: island

Microtopography

	Plot No
undulating with	1
some bare rock outcrops	2
	3
	4

Parent Material: till / rock

Soil: 1 - General

"L" (Litter) Depth	Text.	"F-H" (Humus) Depth	Text.	Plot No
½"	leaves			1
				2
				3
				4

2 - Organic Soils (Depth)

Fibric	Mesic	Humic	
			1
			2
			3
			4

Horiz.	Depth	Texture	Colour	Stones
A1				
A2	4"			
B	11"	loamy-sand		yes
C		boulders / rock		

Water Table: Absent ✓ Present

Drainage 1 - 3

Hydric Features:

	Plot No
Drainage of 1 confined	1
to bedrock outcrops	2
	3
	4

Vegetation Structure

General Physiognomy:

Vegetation Code

Stratum		Coverage	Height Range	Total
A:Tree	A1	80 %	(25 - 30 m)	85 %
	A2	15 %	(- 5 m)	
B:Shrub	B1	<5 %	(5 m - 2 m)	<5 %
	B2	- %	(< 2 m)	
C:Herbs	Ch	<5 %	(Herbaceous)	5 %
	fern ~~Cw~~	5 %	(Dwarf Shrubs)	
D:Moss	Db	+ %	(Mosses)	+ %
	Dl	%	(Lichens)	

Degree of Opening over C (herb) Layer 10 %

Ground covered by: Basal Area %

Rocks and Stones 10 % Water %

Decayed Wood + % Humus

Mineral Soil + % Others

Regeneration: Strong Moder. ✓ Weak

by: hM 8 Be 2 wA +

8 - 15' high

Nearby Water Body > 5 acres:

Distance to:

Noticeable disturbances:

slight trampling

Disturbance occurred: continuous

Species affected: herb + low shrub

FIGURE 5. Sample of a field tally card.

LESSER VEGETATION TALLY SHEET	Plot No. Mulcaster 3

Stand Structure

Layer	Avg. Ht. (feet)	Percent Coverage
Total Shrub	3m +	50-75
Tall shrub		
Short shrub		
Total Herb	sparse	
Tall herb		
Short herb		
Ground Cover		

Stand Composition

Shrub Species	Cov.
Hemlock	1
Beech	1
Basswood	1
w. Pine	1
w. Ash	1
hard maple	1
red oak	1

Stand Composition (Cont'd)

Herb Species	Cov.
Epifagus virginiana	1
Maianthemum canadense	1
Pteridium aquilinum	1
Solidago spp.	1
grass	1
Monotropa uniflora	1

Comments:

Level area by rock outcrop.

Canopy of beech, hard maple, w ash, w oak.

Sparse vege ∵ shade.

Sugar maple regen very good, as well as, beech.

FIGURE 6. Lower vegetation tally sheet.

Table 2. Plant species cover-abundance values modified from Braun-Blanquet (Mueller-Dombois and Ellenberg 1974).

1 –	few, with small cover
2 –	numerous, but less than 5% cover
3 –	any number, with 6-25% cover
4 –	any number, with 26-50% cover
5 –	any number, with 51-75% cover
6 –	any number, with greater than 75% cover

Data Processing

Each land type unit which was mapped was numbered and its UTM coordination recorded. Forest stands were similarly located by UTM with each portion of the stand falling within separate land types receiving its own UTM. Each unit was then measured for area (in hectares) by dot grid; these records are presented as Appendix D for park property. Computed areas of major land units and forest types are presented as appendices and selected summations of these are introduced within the text to illustrate relevant descriptive material.

For lower vegetation, the synthesis of the raw data follows Orloci's (1967) method of cluster analysis with computer programming, slightly modified, as presented by Jesberger and Sheard (1973). As almost all the sampling was confined to properties owned by National Parks, the plant community descriptions are representative of these and other similar areas. Conditions in parts of the mainland which are farther removed from the proximity of a major body of water and not as heavily subjected to constant disturbance would produce plant associations somewhat different from those described herein. The differences are not expected to totally prohibit the extrapolation, to these areas, of the information on plant associations as presented in this report.

The lower vegetation plant associations were not mapped and, therefore, no figures on their areal extent are presented. They are described in terms of their floristic composition and their relation to the mapped attributes of forest cover and physiography; this provides a tie between the plant associations and their possible areal extent and likelihood of occurrence within the landscape features which are mapped.

LAND BASE

Classification

Based on topography, soil and moisture characteristics, the St. Lawrence study area is classified into ecologically and environmentally significant landscape units. Because these units are based on relatively major physical land features, they form a fairly stable reference base which is little affected by natural, successional or man-induced changes; indeed they form, particularly with the inclusion of their present vegetation, an ecological framework upon which these changes can be estimated or planned.

The landscape units are mapped at the scale of 1:10 000. This, in terms of biophysical mapping, represents classification at the land type level (Lacate 1969) where areas with homogeneity of soil texture, topography, moisture and chronosequence of vegetation are separated. Land units mapped at this level of intensity provide a base which is compatible with the mapping of individual biological components such as forest stands and various non-forested vegetation types.

Soil Units

Seven major soil units are described; five of these, plus a combination of the first two, are shown in Map 3. These units are: 1. Bare rock, 2. Very shallow soils over bedrock, 3. Moderately shallow soils, 4. Glaciolacustrine, 5. Glaciofluvial, 6. Alluvium, 7. Organic. The differentiation of these units is based on factors such as depth over bedrock, texture, drainage characteristics, moisture and origin of parent material. The distribution of the area's soils according to their moisture regime are summarized in Map 4. Maps 3 and 4 are presented immediately following soil unit descriptions.

1. Bare Rock

Rock outcrops which have no or only minimal soil cover characterize the entire study area. They may occur at any elevation from the top of Fitzsimmons Mountain to the water's edge along the St. Lawrence River. They are frequent on hilltops and along steep slopes; they may occur as knolls protruding through the deep soils of a valley or as small islets which surface a few metres above the river. For the most part the outcrops consist of granitic igneous type or, various metamorphic rocks which have been smoothed and rounded by glaciations and all other erosional agents during the hundreds of millions of years of their existence.

The accumulative areal extent of bare rock is approximately 324 ha which is over 5% of the land area. On the 1:10 000 maps bare rock areas are indicated by the vegetation symbol R; the most extensive of these are also shown on Map 5. Extensive bare rock occurs along the western side of Landons Bay and in the Fitzsimmons Mountain area; elsewhere, though numerous, they are generally small and localized, often too tiny to map individually at the scale of 1:10 000 and even those mapped average less than 1/4 ha. In mapping, these latter have become incorporated within the surrounding, larger units which themselves have usually a very shallow covering of soil.

Soil is generally absent; what soil there is occurs in crevasses and minor depressions within the unit (Fig. 7). The soils are usually a mixture of coarse-textured mineral soil, which has formed from the weathering of the rock, and of organic material resulting from the decomposition of mosses and other plant life able to survive on these sites. Because of the shallowness of the soil, decomposed organic matter accounts for a high percentage of the composition and gives the soil a typical dark colour. Soil profile development is lacking.

Drainage in the form of runoff is very rapid; internal drainage is non-existent and rain water frequently collects in shallow depressions where it remains until it evaporates or is taken up by the mosses and grasses which frequent such locations.

Plant life, where present, consists of crustose lichens on the most desiccated locations. Mosses, lichens and grasses (*see* sub-association *Rhus typhina-Calamagrostis)* predominate small depressions and cracks; shrubby species such as vacciniums and ground juniper may also occur and sometimes form dense colonies (Fig. 8). Tree species are generally absent save for the odd individual, often scrubby, red cedar, oak, red maple or any one of the pines indigenous to the area (Fig. 7).

The lack of soil, locations which often are very exposed, steep slope gradients and very rapid external runoff conditions create a very specialized environment for the survival of plant communities. The vegetation, because it is growing in such marginal conditions, usually requires a long time to establish and once destroyed may be very difficult to regain. However, sites, where the preservation of a thin layer of soil is not a factor, can accommodate an almost unlimited amount of transitory use (e.g. hiking trails). Permanent or semi-permanent facilities such as buildings and campgrounds will not only increase haphazard traffic in the vicinity of such facilities and affect and perhaps destroy much of the vegetation but also these sites are incompatible with such things as waste and sewage disposal. Fill would have to be imported to provide for them and even so the lack of internal drainage and rapid runoff could create constant erosion problems which in turn may cause spillage to the surrounding area. Similarly the

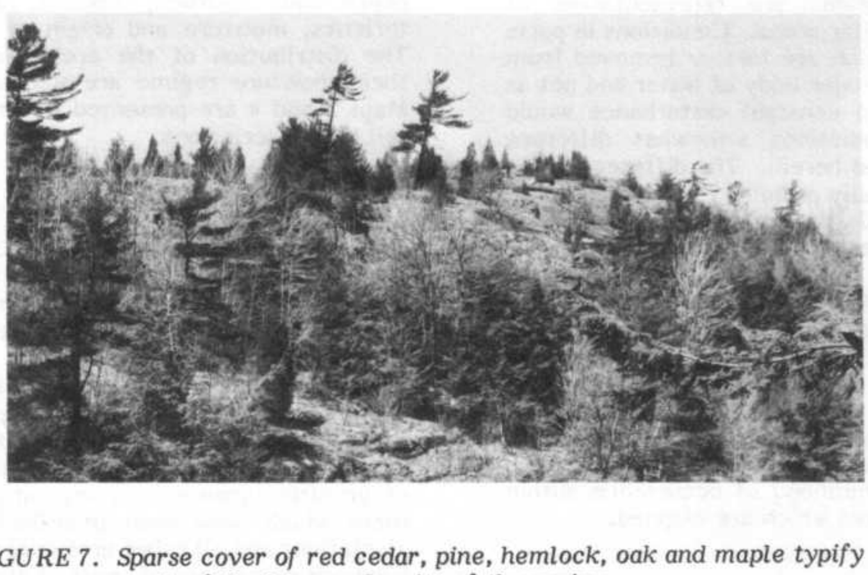


FIGURE 7. Sparse cover of red cedar, pine, hemlock, oak and maple typify much of the bare rock units of the region.

FIGURE 8. Often the only shrub present on the bedrock is ground juniper which sometimes totally covers the ground.

expense of constructing access roads to service any such facilities could be prohibitive because blasting and importation of large quantities of fill would be required.

2. Very Shallow Soils Over Bedrock

This soil unit is very common throughout the region and accounts for about 1850 ha or 30% of the land area but the average size of each unit is less than 2 ha. Like the previous one, this unit is also prevalent on slopes, hilltops and knolls with many of the islands in the river consisting entirely of this soil unit (Fig. 9). On land type maps at the scale of 1:10 000 these areas are shown by the soil symbol R.

The depth of soil can vary but generally averages less than 30 cm. Often these areas are very rocky and broken with the result that they invariably contain localized pockets, crevasses and cracks where soil has accumulated to much greater depths; similarly areas of bare rock are numerous in such terrain. These deep soils and rock outcrops are generally too small to map individually at the scale of 1:10 000 and therefore either become part of the predominantly very shallow soiled surroundings, or combine to form such a unit.

Material which over the centuries has accumulated in hollows and crevasses and the thin remnants of glacial, predominantly till, deposits are the soil base of this unit. Decomposed organic matter has become incorporated in the soils and often forms a substantial component. Boulders are usual; some are of glacial origin but many, particularly in the proximity of slopes, are rocks which have broken off the adjacent or underlying bedrock.

As this soil unit is usually associated with substantial slopes and frequent occurrence of bare rock, the drainage conditions are generally rapid. Internal drainage is often accomplished along soil-filled cracks and fissures but localized bedrock depressions without outlets do occur. Unless the moisture is taken up by the vegetation, these depressions may remain wet for considerable periods; the soil is too shallow to absorb anything but the most trivial amounts of water.

Tree and/or shrub cover are usually present. Forest stands are frequently open or semi-open as the trees seek out the spots of deeper soil. Species which are able to exist in minimal soil depths and under relatively desiccate conditions predominate. The most commonly encountered are red and white oak, red maple, white pine and eastern red cedar. Red and pitch pine are less common in the area but when present they usually occur on these sites. Numerous shrubs have adapted well to the situation; some of the most noticeable ones are juniper, sumac and vacciniums. Where soil is most meagre or practically absent, a variety of grasses, mosses and lichens characterize the lower vegetation. The vegetation sub-association *Rhus typhina - Calamagrostis* is typical on these rocky, very shallow soiled hills and knolls.

FIGURE 9. Two typical, but contrasting kinds of shorelines along the St. Lawrence River. In the foreground marshy terrain supporting dense colonies of cattails totally differs from the dry, rocky islet in the background with its sparse tree cover of white pine, oak and maple.

The variety created by the intermingling of tree cover with areas of open rock and the usual occurrence of this soil unit on hilltops and knolls gives it great potential for hiking trails and vistas. However, shallow soils and the associated easy and permanent destructability of the vegetation thereon are as much a problem here as in the previous type. Hiking trails, picnic spots and lookouts can be placed in the least susceptible locations and clearly marked; this will tend to concentrate traffic in these areas and localize any damage, as well as minimize it, provided trails, etc., are planned in areas of low sensitivity. General lack of soil and internal drainage deters the establishment of permanent facilities requiring waste disposal systems for costs of blasting service roads through bedrock, hauling in large quantities of fill and constant maintenance against its eroding away could become prohibitive.

3. Shallow Soils

The second largest of the seven soil units, this one is prevalent on about 1516 ha (25%) distributed throughout the study area with map units averaging over 4 ha in area. It is usually associated with hilly or rolling topography but also occurs on flat terrain, particularly in the few areas underlain by flat-bedded Paleozoic bedrock (e.g. Gordon Island, parts of Hill Island).

Soil depths are generally less than 1 m but unevenness of the bedrock creates localized areas much deeper as well as shallower. Bare rock outcrops occur but are less common than within the preceding soil unit.

For the most part the soils derive from a thin veneer of moderately coarse, sandy glacial till but finer-textured glaciolacustrine as well as coarser sands and gravels of glaciofluvial origin are present occasionally. On slopes, particularly lower ones, and narrow valley bottoms, coarse sometimes very bouldery, colluvium may also occur (Fig. 10). In most instances the soils contain boulders of glacial and/or colluvial origin or those formed *in situ* by the action of weathering agents on the local bedrock. Development of soil profile is not very pronounced; the surface soil is often darkest with a general brownish tinge but may vary from grey to almost black, the subsoil is generally a medium brown and the parent material tends to be the lightest in colour, again predominantly brown or yellow brown.

Drainage is generally good but as usual cannot be expected to remain uniform all across the type; depressions with imperfect, even poor, drainage occur as do rapidly drained steep sections and rocky areas.

Unless cleared artificially these areas are usually forested. There is enough micro-variation in the soil depth and moisture that almost all tree species native to the area may be found in this soil unit. The most relevant hardwoods are sugar and red maple, red and white oak, shagbark hickory and white ash; also frequent are basswood, ironwood and beech. Softwoods are somewhat less prominent than the hardwoods but white pine is frequent as is, especially on northerly and easterly aspects, hemlock. Lower vegetation is characterized by sub-associations *Aralia-Carpinus, Quercus alba – Ostrya* and *Tsuga* with the latter sub-association most often occurring on the cooler, north and east slopes.

FIGURE 10. Boulder strewn landscapes are frequent in narrow valleys between steep, rock slopes.

In general the soil unit indicates areas which are sturdy enough to allow most park-related uses. Good drainage with adequate soil over bedrock provide for good campgrounds, picnic areas, etc. and, at the same time, a suitable, solid foundation for the construction of associated utility and administrative buildings. In many spots soil cover is deep enough, or can be easily increased by moving adjacent material, to allow small-scale septic systems which might be required for serviced campgrounds or other centres of activity. Tree cover which is almost always present provide shelter as well as attractive surroundings for picnicking, camping and nature trails. Except in the steeper slope locations the soil conditions are not easily deteriorated or eroded by standard park uses; similarly, if the use is abandoned the indigenous vegetation will likely reclaim the area relatively quickly. On the negative side, this soil unit usually occurs on slopes or hilly terrain, a condition which does make much of its area susceptible to erosion if removal of the vegetation is undertaken. Campgrounds and play areas demand reasonably level ground, a commodity which is present but not overly abundant within this soil unit; similarly the frequent presence of boulders may deter the establishment of certain facilities.

This soil unit supports many stands of valuable tree species, notably oak, maple and white pine. The capability for forest is moderately good and the unit contains the bulk of the forested acreage within the study area. However, stoniness, frequent excessive slopes and often insufficient soil depth make this unit unsuitable for farming; it has practically no capability for crops or even for permanent pasture.

4. Glaciolacustrine

This soil unit forms most of the flat and gently undulating valleys which occur among the hilly Precambrian topography. The total areal extent is about 1350 ha and represents about 22% of the land area making it the third largest of the seven soil units; average map unit is approximately 4.5 ha.

Almost all the soil parent material is glaciolacustrine in origin, but also included in this unit are deep, predominantly till deposits. Although common as shallow veneer throughout the rocky Shield topography, deep tills are minor elsewhere, predominating on only about 100 ha. Through the centuries, even most of these have been augmented by other deposits, glaciolacustrine, alluvium and organic being the most usual. The tills tend to be coarser textured than soils of lacustrine origin, but both have similar, frequently mediocre drainage conditions. Tables in Appendix E separate tills and lacustrine soils, but because of its small area, Map 3 shows the former as part of this, glaciolacustrine, soil unit.

The mapped area is in the proximity of the westernmost end of ancient, postglacial Champlain Sea and it is possible that some deposits of this soil unit originated in an environment influenced by both fresh and salt water. The soils are deep, often several metres over bedrock or glacial till. The texture is a mixture of clay, silt and sand with clay accounting for up to 60% of the material, silt about a third and sand usually less than a fifth. Generally the organic content is low but may have accumulated on the surface in depressions and other imperfectly drained locations. It is grey in colour with the surface layers usually darkest becoming lighter, but often with brownish mottling, towards the bottom. Except in areas predominated by tills, boulders and stones are usually absent but may be present adjacent to rock outcrops. Though the soils are deep, these outcrops are fairly common; they often surface abruptly and are surrounded by deep soil (Fig. 11). They are also small and frequently not mappable at 1:10 000.

Drainage is usually moderate to imperfect with numerous poorly drained depressions (Fig. 11). The high clay content makes for restricted internal drainage and the flatness of the terrain slows surface runoff. Artificial drainage channels and ditching can improve conditions significantly and many of these areas presently under cultivation have extensive man-made drainage systems (Fig. 11).

Except for poorly drained and wet depressions, most land within this soil unit is or has at some time been under cultivation or pasture. Many old fields are now grazed but also many have been abandoned and are slowly reverting back to forest. The transition between this and the shallow-soiled, predominantly forested unit is typically abrupt and since fields are usually cleared right to the edge of the deep clay soils, areas within this soil unit are usually not forested. Although 22% of the lands belong to this soil group, less than 9% of the forests occur on it. On abandoned fields where trees are beginning to reestablish, the most conspicuous species is eastern red cedar (Fig. 11 and 16). Frequently encroaching on the field edges are balsam poplar, trembling and largetooth aspens, grey and white birches. Lower vegetation is much influenced by past cultivation but is characterized by the Vetch-Kentucky bluegrass plant community.

Dairy farming is important in the area and this soil unit is a central factor in its support. Not only does it provide good grazing, but the land is also suitable for related crops such as hay and silage corn. However, there are drawbacks to agriculture; mediocre internal drainage often causes excessive moisture conditions on flat and low-lying areas; the high clay content hampers workability and the general sparsity of organic and coarse-textured materials makes for reduced aeration, percolation and, in general, poor soil structure. As a result the number of potential crops is limited.

Park-related uses are similarly hampered in many locations. Campgrounds and picnic areas can become saturated and mucky during rainy periods. The soil can provide an adequate foundation for construction of service and administrative buildings but should water penetration occur it could reduce the clay's load-bearing capacity and shifting and settling of the foundation may result. Because of poor percolation properties of the soil, services such as washroom facilities for the buildings might not be able to use septic systems, necessitating the use of alternate methods. However, this soil unit contains large tracts of cleared relatively level ground and, where drainage is adequate or where suitable fill can be brought in, facilities and activities requiring open spaces can be easily accommodated. Its value for hiking trails is poor because of a lack of scenic areas, but possibilities exist for interpretative trails which demonstrate successional change from a farm field, through the various pioneer vegetation stages, to mature forest.

5. Glaciofluvial

Sandy and gravelly ice-contact parent material occur sporadically throughout the study area. Most of these appear in the form of kame deposits but low-profile esker-like ridges occur on Grenadier and Tar islands. The total extent of this soil unit is approximately 314 ha or 5% of the land area with map units averaging slightly over 3 ha in size. The most extensive occurrences are on Grenadier, Tar and Hill islands and in the proximity of the village of Ivy Lea (Map 3); elsewhere within the map area it is present in a few isolated locations.

Soil texture is coarse to very coarse, consisting of stratified sands and gravels. Boulders

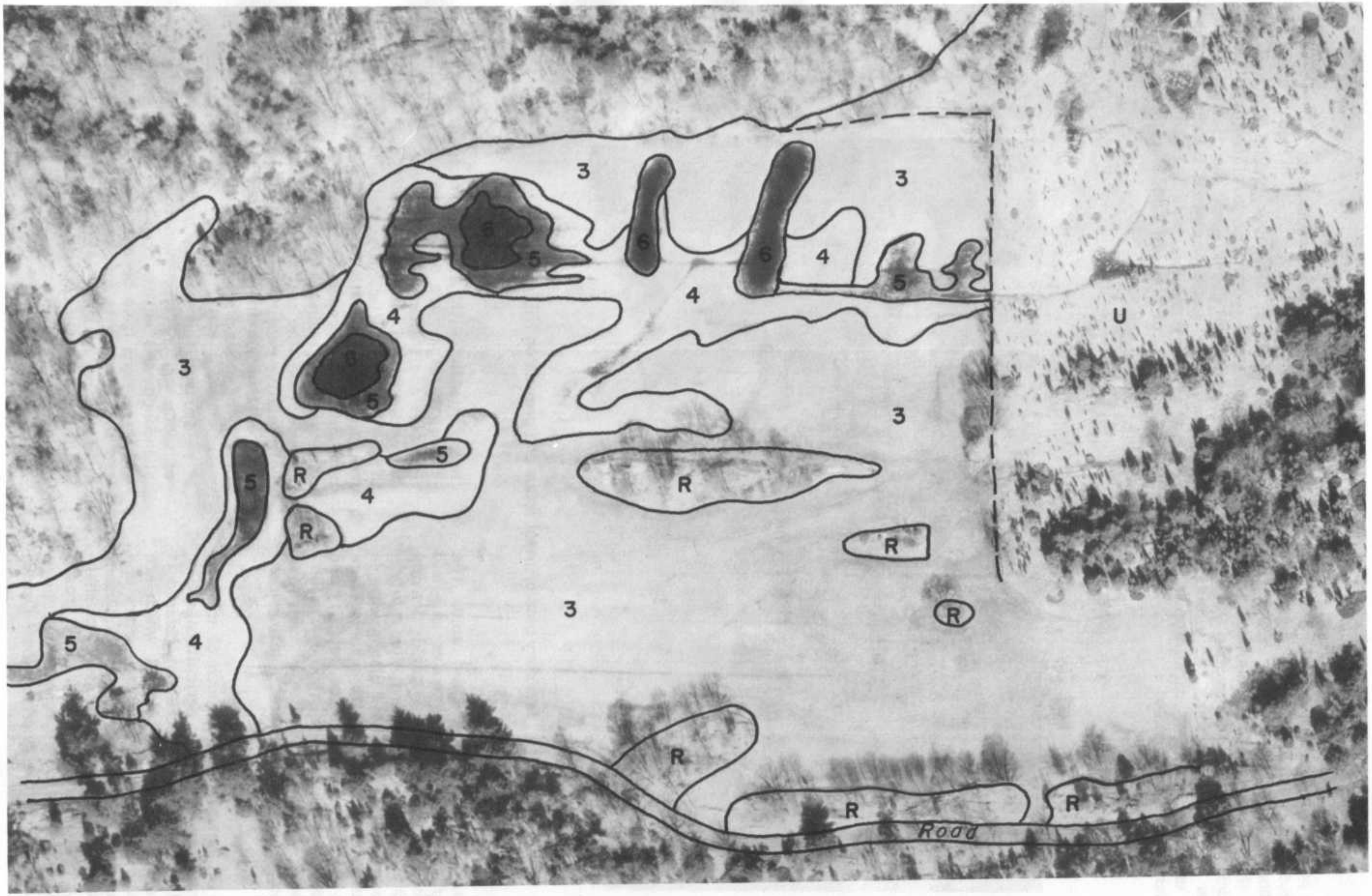


FIGURE 11. Enlargement, to an approximate scale of 1:2000, of a typical portion of a glaciolacustrine soil unit.

Numerals 3 to 6 indicate soil moisture regime as per Appendix C. Heavy soils and flat terrain result in mediocre internal drainage and slow surface runoff with the resultant pooling of waters in the slightest depressions. Some of the ditching done to minimize this are visible in the photograph. Areas marked R represent shallow-soiled rock outcrops which typically and abruptly intersperse the otherwise deep soils. Most areas with drainages 3 and 4 are being cultivated; the general area marked with the letter U has been abandoned. Throughout this latter area numerous dark specks are visible against the light grey background; these specks are eastern red cedar which frequently are the very first tree species to invade abandoned farm lands.

may not be present in some cases, but in others are numerous and complete layers consisting mainly of boulders can occur (Fig. 12). Soils formed on this parent material show podzolic characteristics with the occurrence of an ash grey leached layer in the surface soil. The subsoil (B horizon) is usually medium or dark brown becoming lighter in the C horizon.

FIGURE 12. Bouldery glaciofluvial sands and gravels on Hill Island.

Internal drainage is good, often rapid. The sands and gravels do not retain water long and rain water is percolated through quickly leaving the ground dry within a short period after rainfall. The fast movement of the water also results in increased leaching of the nutrients in the surface layers. The result is a lowered soil fertility and reduced productivity. Because of their low water-holding capacity these soils tend to be subject to drought even during normal precipitation conditions.

In the St. Lawrence area much of this soil unit has been cleared either for agricultural use or as sand and gravel pits. Where not cleared it supports fairly good stands of forest which are usually dominated by oaks, maples, poplars and birches; also frequently present, but in lesser quantities, are species such as white pine, shagbark hickory, beech and white ash. The ground vegetation is likely to be represented by plant communities similar to the *Quercus alba – Ostrya* or *Aralia-Carpinus* sub-associations.

The soils of this unit should be able to accommodate all types of park-related uses. Rapid internal drainage keeps even the flattest areas from becoming water saturated or soggy during periods of heavy precipitation. At the same time the coarseness of the soil allows it to withstand heavy traffic with a minimum of maintenance. These, therefore, are desired locations for mobile campers and trailers, parking areas, campgrounds, playgrounds and all sorts of intensive use areas. They provide sufficiently stable foundation for buildings and generally have adequate percolation and filtration properties to allow septic fields. Where the terrain is not level enough for the intended use, the soil can be moved and levelled with relative ease. Many of these sites are already cleared thus eliminating the task of disturbing or destroying areas presently in their natural state.

Parts of this soil unit are an important source of sands and gravels; numerous gravel pits, both abandoned and active, can be found within it. Other sections have been used for farming though the soil fertility is mediocre and many locations tend toward drought; within the study area very little of this soil type is presently under active cultivation.


St. Lawrence Islands National Park and environs
MAP 3
Le Parc National des Iles du St-Laurent et les environs
Miles 0 2 Miles
Metres 1000 0 1000 2000 Metres
Schematic of soil parent materials
Bare rock and very shallow soils
Moderately, shallow soils
Deep, coarse, predominantly glacio-fluvial soils
Deep, moderately fine, predominantly glacio-lacustrine soils
Alluvium
Organic
National Park
MACDONALD-CARTIER FREEWAY
GANANOQUE
HOWE ISLAND
Halsteads Bay
Thousand Islands
ST LAWRENCE RIVER
STAVE ISLAND
BOSTWICK ISLAND
Hay Island
Leek Island
Seven Pines
Camelot I.
Endymion I.
Gordon I.
Mulcaster I.
FISH ISLAND
HILL ISLAND
CLUB ISLAND
TAR ISLAND
Squaw Island
Adelaide I.
Rockport
Ivy Lea
Mallorytown Landing
Chimney Island Historic Site
CANADA
U.S.A.
4920000 m N
4910000 m N
410000 m E
420000 m E
430000 m E
440000 m
76°00'
75°50'
44°25'
44°30'
44°20'


St. Lawrence Islands National Park and environs
MAP 4
Le Parc National des Iles du St-Laurent et les environs
Miles 0 2 Miles
Metres 1000 0 1000 2000 Metres
Soil moisture regimes
Dry, rapidly drained
Well drained
Fresh, moderately well drained
Moist, imperfectly to poorly drained
Wet
National Park
MACDONALD-CARTIER FREEWAY
GANANOQUE
HOWE ISLAND
Halsteads Bay
Thousand Islands
ST LAWRENCE RIVER
STAVE ISLAND
BOSTWICK ISLAND
Hay Island
Leek Island
Seven Pines
Camelot I
Endymion I
McDonald I
Gordon I
Mulcaster
Ivy Lea
ASH ISLAND
Georgina I
Constance
CLUB ISLAND
Rockport
TAR ISLAND
Squaw Island
Adelaide I
Mallorytown Landing
Chimney Island
Historical Site
CANADA
U.S.A.
ST LAWRENCE RIVER

6. Alluvium

These consist of flood plains of modern streams whether or not they are still subjected to periodic flooding. The principal source is the St. Lawrence River and extensive alluvial deposits occur along it. The total area occupied by this soil unit is about 423 ha or 7% of the mapped land area. This acreage is concentrated in three main localities: Mallorytown Landing, Cook Point-Rockport region and Grenadier Island (Map 3).

The terrain is fairly flat or gently undulating and occupies low elevations, only slightly higher than the river. The parent material is frequently fine sandy textured with few stones or boulders. Areas of finer, silty materials also occur; these usually have mediocre drainage and often occupy localities with a high water table. This makes them ill suited for most people-oriented uses unless sufficient fill is imported, an undertaking which may be practical in many locations because these areas often occupy valuable waterfront and thereby can justify the expense. Where sandy parent material dominates, drainage is good but again in numerous instances a high water table affects the usefulness of many of these areas.

Where the water table is close to the surface and drainage fairly poor (silty soils), the forest cover is typified by white and black ash, grey and white birch, red maple, willows and poplars. Lower vegetation usually includes numerous ferns and shrubs such as alders and dogwood; the sub-association *Impatiens - Urtica* frequently describes the vegetation on these areas. On better-drained, sandy soils, but where the water table is still fairly close to the surface, characteristic tree species are grey birch, white birch and trembling aspen; grey birch sometimes forms sizeable almost pure stands (Fig. 25). Where the water table is no longer near the surface, white oak and red oak become common and can form stands averaging taller than 25 m. Other species which also frequently occupy these sites are shagbark hickory, white ash, sugar and red maple. On the ground level bracken ferns and shrubs (e.g. dogwoods, viburnums and blueberries) sometimes cover a high percentage of the ground as representatives of the *Aralia - Carpinus* or the *Quercus alba - Ostrya* sub-associations.

The coarse- and moderately coarse textured, sandy soils of this unit provide a suitable base for recreational uses. Good drainage and relative flatness of the terrain facilitates the establishment of such things as playing fields, picnic areas and campgrounds and their necessary associated facilities. The usual proximity of this unit to open water adds considerably to its usefulness in a heavily water-oriented park such as St. Lawrence Islands. However, because of its subdued relief and low elevation, this unit is not as ideal for hiking trails or scenic lookouts as the rugged and rocky hill regions. Similarly where the water table is near the surface certain limitations to the number and kinds of uses will occur. Although water-level fluctuations in the St. Lawrence are not normally excessive, some otherwise suitable areas may have reduced usefulness because of the danger of inundation due to higher spring water levels. Areas tending towards more medium-textured, silty soils may also have limitations very similar to those encountered with the lacustrine soils of the previous unit – increased tendency toward wetness and muckiness, particularly in low-lying areas. Notwithstanding the preceding limitations, much of this soil unit has reasonably good carrying capacity for most medium and light intensity activities which may occur in a park environment.

7. Organic Soils

This soil unit occurs throughout the study area with the total extent of lands mapped as predominantly organic being approximately 234 ha or 4% of the land area. Much of this is in the form of small isolated depressions and low-lying areas less than 1 ha in size, but extensive organic marshlands covering several hectares also occur, notably on Grenadier Island and between Cook Point and Highway 2S.

When there is no or only restricted outflow, hollows within a predominantly bedrock complex frequently become filled with decomposed organic material, but may be underlain in depth by other deposits, particularly glacial tills. The soils may be deep but with the water table very close to the surface and open water frequently present.

In more subdued topography, such as broad valleys, organic soils have formed by the gradual accumulation of organic material in poorly drained depressions. The organic layer is generally much shallower and contains more mineral soil than the preceding, bedrock environment. Runoff as well as seepage from the surrounding higher ground carries a certain amount of mineral soil which becomes incorporated within the organic material. The relatively subdued relief creates shallower hollows than the more rugged Precambrian topography and consequently the organic layers filling these hollows will be thinner. Similarly, shoreline marshes generally overlay areas of very low topographic relief and the organic layer often is not very deep and may contain substantial silty alluvium particularly if the area floods occasionally. In the inland valleys the underlaying mineral soil is usually moderately to fairly fine textured lacustrine silts and clays, whereas the organic soils along the shoreline sometimes cover much coarser, sandy-textured alluvium.

Vegetation is variable on these areas and is a function of the stage of development of the organic unit. Aquatic vegetation (e.g. water lilies) is usually followed by a stage dominated by cattails which give way to hydrophytic shrubs (e.g. alders) and eventually trees such as willows, poplars, birches, red maple, white ash, black ash and white elm (Fig. 13). Plant communities typical of organic soils are represented by the cattail arrow-head sub-association (Fig. 21).

The constant wetness and the poor load-bearing capacity of this soil unit precludes it from many uses. Construction of buildings or roads require either (a) large amounts of fill which is costly and may require constant maintenance because of the instability of the underlaying organic material, or (b) the very costly undertaking of first dredging out the organic layer and then filling. However, areas where undertakings of this magnitude might be justified would be certain shoreline locations where valuable waterfront property was required. In many locations, dredging to provide harbour facilities or access canals through low-lying waterfront marshes is a feasible and often more practical alternative than bringing in fill and building over the marsh in order to reach the water's edge.

In general this unit serves best as wilderness or buffer zones. Some parts of it are rich in interesting flora, water fowl (particularly shoreline marshes) and other bird and animal life. Hiking trails, with boardwalks where necessary, to observe various marsh wildlife, environments and successional stages would be a very worthwhile facility on these areas.

VEGETATION

Present forest cover, non-forested plant communities and other land use categories are mapped at the scale of 1:10 000 (1:5 000 for Cedar, Milton and Stovin islands) and superimposed on land type and planimetric information. These maps are presented as Appendix A; a composite at the scale of 1:50 000 is attached (Map 5). Vegetation is described in terms of forest cover, including nine major and/or distinct forest species groups, and lower vegetation as defined by plant community associations.

Of the total study area (14720 ha) about 3440 ha are forested; this represents about 56% of the land area. Table 3 summarizes the areal extent of the major vegetation/land use classes within the study area. These categories are shown on the attached summary map at the scale of 1:50 000 (Map 5).

FIGURE 13. Typical vegetation succession along marshy section of the St. Lawrence River proceeds from cattail, rush and reed grass communities through shrub (e.g. alder, willows) stages to forests dominated by birches and poplars.

Table 3. Vegetation/land use class areas

	Hectares		% of Land	% of Total
Forested	3440		56	23
Upland herbs/grasses		723	12	
Upland shrubs		325	5	
Bare rock		324	5	
Urban/recreational		122	2	
Cropland		356	6	
Gravel pits and quarries		21	< 1	
Roads		276	4	
Other cleared land		101	2	
Flooded land		7	< 1	
Marsh sedges/herbs		295	5	
Marsh shrubs		160	3	
Total non-forested land	2710		44	19
Total land	6510			42
Water	8570			58
Total area	14720			

Forest Description

The study area straddles two sections of Rowe's Great Lakes-St. Lawrence Forest Region, the L.1 – Huron-Ontario section and the L.4 – Middle Ottawa section. The first extends from Lake Ontario to the Gananoque area and the latter covers the areas downriver from there.

Within the study area, forested lands occupy about 3440 ha (Table 3). As evident from Table 4 following, softwood (all conifers) stands are only a very small minority of the forest cover in the area while hardwoods (all deciduous trees except larch) and mixedwoods share it in nearly equal proportions.

A great number of tree species are indigenous to the region. Many of these are sporadic in occurrence and at best form only minor components of forest stands; others are very prolific and can dominate large areas. Particularly common are red oak, white oak, white pine, red maple, sugar maple, hemlock, white ash, shagbark hickory, white birch, grey birch, large-tooth aspen, and trembling aspen, while at the other end of the scale are butternut, white spruce, red spruce, basswood and bitternut hickory.

Table 4. Major forest cover type areas

Cover Type	Hectares	Percent
Softwoods	107	3
Mixedwoods	1811	53
Hardwoods	1522	44
Total forested	3440	100

With a total of over 40 tree species in the area, innumerable stand compositions are possible. However, many of the species are such that they seldom, if ever, provide more than a very minor addition to a stand. Most notable examples of these are basswood and black cherry; both are numerous throughout the area but neither forms pure stands and almost always occur as scattered individuals accounting for only a minor percent within a cover type. Typical locations for both species are well-to moderately well drained slopes and valleys where they are frequently associated with maples, oaks, beech and white ash. Other species which usually occur in a similar minor capacity include blue beech, butternut, rock elm, red elm, red ash, mountain ash, and red pine. Most of these species inherently exist, like the basswood and black cherry, singly or only in small groups within a cover type dominated by other species. Red pine, on the other hand, is capable of dominating sizeable stands and in many regions does just that, but along the upper St. Lawrence, it always appears in a minor capacity and is usually accompanied by white pine, hemlock, pitch pine, red oak and/or red maple on the dry, rocky locations.

Some other tree species occur only on rare occasions and, although most are very prominent and commonplace in other regions, they make only a token, if any, appearance in the St. Lawrence Islands area. These consist of the typically more northern conifers of white spruce, black spruce, balsam fir and larch, as well as, the usually more eastern red spruce. One stand where red spruce is fairly prominent appears in the Fitzsimmons Mountain region (Fig. 14); some white spruce may also occur in this stand, but elsewhere these two species are almost nonexistent. Although the area is within the range of the other three conifers, none were encountered by the field crew.

A species which is very commonplace, but at the same time, unique in that within Canada it occurs only in the Thousand Islands region, is pitch pine. Dry, exposed locations which often have only a thin veneer of soil are typical sites for this pine which characterizes many of the rocky islands and hilltops throughout the area. On such areas it is usually associated with open and sparsely canopied stands where ample direct sunlight reaches the ground. Accordingly, wherever there is enough soil among the bare rock outcrops, ground vegetation is plentiful and characterized by reed and oat grasses along with typical xeric site shrubs such as vacciniums, juniper and sumac. In some locations the pine is numerous enough to be a major cover type component and on occasion does form small pure stands (Fig. 15), but although frequent, it is usually found in a minor role to white pine, red maple and/or red oak.

Beech, yellow birch, ironwood, eastern red cedar and eastern white cedar are other very common species, but again, more often than not occur in a minor capacity within a number of cover types. Beech, yellow birch and ironwood are most frequently associated with well-shaded stands on good, moderately drained sites, but ironwood is also

FIGURE 14. Red spruce, accompanied by hemlock, red maple and yellow birch, makes a unique appearance in a marshy depression in the northwestern part of the study area.

FIGURE 15. Pitch pine stands are typically very thin canopied and allow ample direct light to the ground.

encountered on shallow, drier soils and yellow birch is often present in moist, imperfectly drained locations. Sometimes beech forms mature stands with red oak and sugar maple and may include white ash and shagbark hickory. These stands represent conditions approaching a climax stage on mesic sites. If undisturbed they may progress further by a gradual reduction in the amount of oak and a proportionally higher representation of sugar maple and beech. However, at present maple/beech-dominated stands are a very minor type, a situation which seems to suggest that further succession from oak/maple-dominated stands toward maple-beech types may be very localized and site specific.

Yellow birch is usually associated with maples, oaks and hemlock on a wide range of sites. Red maple is the most common associate in the wettest areas, oaks and sugar maple on mesic sites and hemlock on the shallow, rocky slopes. In a few locations yellow birch is fairly numerous, but usually it appears only as a minor component. However, it is fairly capable of sustaining itself under a closed canopy and, therefore, like the beech may gradually increase its presence in close-canopied, undisturbed tolerant hardwood stands.

Ironwood, although plentiful, is consistently relegated to the role of a minor species. It may be abundant locally but more usually is present haphazardly through a stand. It does not grow very large and, therefore, even when present in quantity is seldom considered as a major stand component as it cannot compete with the oaks, maples and pine in a mature canopy. However, being tolerant of shade it is able to survive under a closed canopy and often forms a substantial portion of the understory in stands occupying moderately well to well-drained sites.

Both of the conifers, eastern red cedar and white cedar, are small trees, usually less than 10 m, although on occasion white cedar exceeds 15 m in height. Both are also very adaptable and can occur on a great variety of site conditions; white cedar in particular can be found on dry, rock knolls with minimal soil depths, as well as in wet, swampy lowlands. Similarly, the red cedar occurs from the driest bedrock sites (Fig. 7) to somewhat imperfectly drained, lacustrine flats, but generally does not extend its range to the wetter areas. It is often one of the first species to invade abandoned farmlands and in this capacity is very noticeable throughout the area (Fig. 11 and 16). However, this invasion is usually in the form of widely spaced individuals, not sufficient to classify as forest, i.e. at least 10% crown closure, and in mapping, most of these areas are designated as upland grass and/or shrub. Similarly, in most other situations both the eastern red and white cedar do not occur

FIGURE 16. Eastern red cedar is often the first tree species to invade abandoned farm lands.

in adequate quantity to qualify as the main cover type. Each has a tendency to grow in clumps and, as such, can sometimes totally occupy small areas, but in most instances these are not large enough to map independently and consequently become incorporated into the surrounding, more dominant cover type. Areas where white cedar prevails total less than 15 ha and the total acreage for eastern red cedar is very similar. In almost all cases these are sparsely stocked, open stands where tree heights rarely exceed 10 m and are often less than five.

Forest Species Groups

The dominant tree species within the Thousand Islands region are oaks, maples, white ash, shagbark hickory, poplars, white birch, grey birch, white pine and hemlock. These, in various combinations with one another occur on over 90% of the forested lands in the area. A great many species combinations in various proportions are possible and do occur. However, there is a tendency toward recurring patterns of species combinations and consequently many different stands can usually be grouped under one major type. These forest types, or species groups, are formed by grouping forest stands according to their predominant tree species, i.e., stands consisting of a similar major component (species which account for at least 50% of stand canopy closure) are in one group irrespective of their minor species. For example, a predominantly maple-oak stand containing beech and ironwood is placed in the same group (in this case maple-oak) as an oak-maple stand whose minor species might be basswood and black cherry. In this study nine such species groups are recognized, they and their areas are listed in Table 5 and each is subsequently described.

Table 5. Forest area by species group

Cover type group	Hectares	% of forest
1. White pine	54	1.6
2. White pine-hemlock	33	1.0
3. Maple-oak-white pine	930	27.0
4. White pine-hemlock-oak-maple	790	23.0
5. Oak	120	3.5
6. Maple-oak	325	9.5
7. Maple-oak-hickory-ash	811	23.6
8. Poplar-birch	208	6.0
9. Ash-red maple	68	1.9
Others	101	2.9
Total forested area	3440	100.0

1. **White pine.** A very common and noticeable tree species of the region, white pine, however, does not form large pure stands in the area. Forests consisting predominantly of white pine represent one of the smaller cover types, occupying only slightly more than 50 ha or about 1 1/2% of the forested area. Individual stands are also usually very small, seldom exceeding 2 ha in area and often are less than one.

White pine is present on a great variety of sites ranging from dry, very shallow soiled rocky outcrops (Fig. 17) to moist, somewhat imperfectly drained deep lacustrine deposits. Typically the stands grow on slopes and hilltops with shallow, medium coarse till soils, most of which are well drained or dry, but on deep soils this cover type tends to occupy moister and even imperfectly drained locations.

FIGURE 17. A typical small stand of white pine on a dry, shallow-soiled, rocky point.

The predominant species, white pine, is usually accompanied by a number of other tree species and truly pure white pine stands are infrequent. On the dry and shallow sites the most common associates are pitch pine, oaks and eastern red cedar; the latter is also frequent on deep soils, particularly in young, fairly open grown pine stands which sometimes encroach on old abandoned fields. White birch and both red and sugar maple can be encountered throughout the range of sites occupied by the cover type; grey birch may also occur, but tends to be restricted to the moderately well drained or moister deep soils rather than on the shallow, dry sites. Eastern white cedar is another frequent component in the cover type and may be present on any site. Hemlock is often present on slopes and hilltops, especially on the cooler easterly and northerly facing exposures. Other tree species also common to this cover type include white ash and poplars, particularly largetooth aspen and trembling aspen. These latter three may occur on any site, but tend to be indicative of deep, moist conditions. In addition, numerous others may occur, but are comparatively infrequent; for the most part, these consist of red pine, ironwood, black cherry, bur oak and shagbark hickory.

2. **White pine-hemlock.** At about 33 ha and accounting for less than 1% of the forest cover, this species group is the smallest included in Table 5. The total acreage is composed of many individual stands, many of which are less than a hectare in size. In addition there are numerous other tiny occurrences throughout the area, but these are usually too small to warrant mapping individually at the scale used for this study and, therefore, have become incorporated with larger types, particularly white pine-hemlock-oak-maple.

In the St. Lawrence region, white pine-hemlock stands occur most usually on rapidly to well-drained, shallow till over bedrock, but can also occupy less well drained bedrock depressions. Typically, throughout the area hemlock shows a marked preference for northerly and easterly facing slopes and cool depressional valleys. Accordingly, this cover type, as well as other types containing substantial proportions of hemlock, is encountered on these north and east slopes more than on other aspects.

The two major tree species are eastern white pine and eastern hemlock. On occasion, over small areas, hemlock forms very dense canopies preventing other species from establishing within the stand; in these situations the ground is usually devoid of all plant growth save a few bryophytes on rocks and fallen tree trunks (Fig. 30). Usually, however, a number of other tree species form a minor stand component within white pine-hemlock cover type. Most frequent are red oak, red maple, white birch, poplars and eastern white cedar. All of these can occur throughout the sites supporting the cover type with the oak, maple and cedar showing a slightly higher incidence on the drier locations than do the birch and poplars. Many other species, such as white ash, ironwood, beech, yellow birch and sugar maple, may also occur, but are usually much less prominent.

3. **Maple-oak-white pine.** Forest stands where the predominant species are maples, oaks and white pine are the most common type. They occupy approximately 920 ha and account for over one-quarter of the forested area. As in the previous types this total is still made up of numerous small stands many of which are less than 1 ha in size. However, a few stands covering more than 10 ha do occur.

Characteristic sites are dry and well-drained shallow till soils over bedrock (Fig. 9). In many instances soils are very shallow with trees growing in slight depressions or crevasses wherever an adequate covering of soil exists; here the treed areas are often interspersed with openings of bare rock or sparse growth of plants adapted to xeric conditions.

The main tree species of the cover type are white pine, red oak and red maple. Numerous others may occur with the most common being white oak, bur oak, white ash, basswood and sugar maple on the fresher sites and, on the drier and more exposed locations, pitch pine, red pine and eastern red cedar.

Moderate amounts of regeneration are frequently present. Most often represented are red maple, sugar maple, red oak, white pine and white ash and occasionally beech. This may indicate that the major cover type species will be able to maintain their prominence within the type. Increased amounts of sugar maple and white ash may be a possibility in future stands, particularly on the better sites. Where present stands form a full canopy, tolerant species like sugar maple are particularly favoured and, at the same time, white pine may have more difficulty and eventually be reduced to a lesser role. Thus the likelihood exists that on the better sites a gradual shift in the forest cover composition will take place toward more tolerant hardwood types such as oak-maple-ash and eventually maybe even a maple-beech type with the oak becoming of secondary quantity.

4. **White pine-hemlock-oak-maple.** With hemlock as an additional major stand component, white pine, oak and maple form another large forest cover type. Nearly 800 ha and representing approximately 23% of the forest, this cover type is the third largest within the study area. As in the preceding type a few stands larger than 10 ha do occur but the bulk of the total area is made up of much smaller stands; the average stand size for the entire cover type is approximately 2 to 3 ha.

Over 90% of the stands in this cover type occur on bedrock-dominated landscapes (Appendix F), which, for the most part, have only a shallow covering of soil. Generally the soils are formed on moderately coarse to coarse-textured, well-drained sandy tills. Bare rock outcrops with no soil are common, but also depressions with deeper soils frequently intersperse these areas. The cover type shows a marked preference for north- and east-facing slopes and shorelines, a characteristic related to the prominence of hemlock within the type.

The predominant tree species are white pine, hemlock, red oak and red maple. Although usually present the maple is sometimes very sparsely represented making some stands primarily a pine-hemlock-oak type and similarly in other instances oak may be somewhat weak. Other tree species frequently include white ash, white birch, trembling aspen and largetooth aspen. These four are least common on the driest and the shallowest areas, whereas others, pitch pine and eastern red cedar in particular, are more noticeable in the latter locations than elsewhere within the type. Eastern white cedar is also a very typical minor component and appears to be equally well represented regardless of site. Another minor species often present is shagbark hickory. This species tends to prefer the fresher locations with deeper soils and, when present within a landscape dominated by rock and thin soils, it is generally confined to areas where adequate soil is present, usually in depressional locations among the rock outcrops.

Regeneration within the type can vary from moderate to nil. The latter is especially typical in those parts of a stand which are heavily dominated by hemlock. There, a very dense crown canopy often totally shades the ground giving very little opportunity for tree seedlings or for any other plants to establish; except for few mosses clinging to rocks and rotting tree trunks, the ground can be totally devoid of plants (Fig. 30). Where some light penetrates to ground level typical regenerating species are hemlock, sugar maple, red maple and occasionally white ash, beech, ironwood and white cedar. With increased availability of light the oaks and white pine begin to make a substantial showing and, at the same time, the incidence of hemlock tends to decrease.

The implications are that in the densest, hemlock-dominated areas, secondary growth will be delayed until the overstory begins to thin out somewhat and allows some regeneration to establish; this regeneration will likely be again dominated by hemlock. This, coupled with the presence of hemlock regeneration in other well-shaded parts of the type, may indicate a gradual increase in the dominance of hemlock. However, in these latter areas other shade tolerant species such as maple, ash, beech and hickory are also able to establish and under suitable site conditions outcompete the hemlock. In more open areas red oak, white oak, white pine, red maple and sugar maple usually show higher presence of seedlings than does hemlock. This combination may eventually lead to increased numbers of white oak and sugar maple in the mature canopy which presently is more often represented by red oak and red maple. Similarly, hemlock may decrease in numbers on these areas particularly when they occur on the southerly and westerly facing exposures. The cooler microclimate prevailing on the north and east aspects may have a compensating effect favourable to hemlock which, otherwise, in the more open stands might be outcompeted by white pine and the hardwoods.

5. Oak. Within the study area, oak forests cover approximately 120 ha or 3.5% of the forested lands.

Almost all of the type occurs on moderately well or better drained locations. The soils may be shallow tills over bedrock or deep coarse-textured sandy material, frequently of glaciofluvial or alluvial origin. The cover type also occurs on areas typified by bare rock outcrops and very meagre soil cover; here the oak seek out depressional locations which have gathered enough soil and moisture to enable the trees to sustain themselves.

Generally the most numerous species is red oak, followed by white oak; bur oak may be occasionally present but is much less common than the other two. Minor species often present among the oak include white ash, shagbark hickory, basswood, poplars and sugar maple on the more mesic sites; here grey birch also makes a frequent appearance, but is almost always confined to the understory. On the shallow, dry soils, red maple, white pine and even pitch pine are the more typical associates.

The great variety in the quality and physiography of oak stands is very striking between different sites. On well-drained, deep soils, stands averaging 25-30 m in height are common. In these, the trees usually form a full canopy with large, spready crowns; the tree trunks are free of branches for a considerable height above ground and diameters at breast height can be in excess of 80 cm. Often there is no understory and the stands have a cleared, park-like appearance except that a dense cover of shrubs, sometimes to a height of 2 m or more, is a frequent occurrence. At the other extreme of sites occupied by the oak cover type, stand conditions and appearance are very different. Trees grow in depressions and crevasses between bare rock outcrops and usually form open, very thin canopied stands. Individual trees are often less than 10 m high, branchy and twisted, apparently struggling to survive in their exposed and desiccated locations.

Both, red and white oak regeneration are usually present although often few in numbers; in stands with heavy shrub growth, regeneration can be very sparse or absent over a large portion of the stand. Other seedlings most often present include red maple, sugar maple and white pine; the pine is most prominent on the rocky and dry locations and the sugar maple on the better sites, whereas red maple can be expected throughout the type. This suggests that on the more barren areas red maple and white pine may eventually become part of the main stand and that on the mesic locations a shift toward a maple-oak cover type is a possibility.

6. Maple-oak. Forest stands dominated by the maples and the oaks occupy approximately 320 ha and account for nearly 10% of the forested lands. As is typical of the forests of the region, this total is again made up of numerous very small stands most of which are less than 2 ha in area, and many less than one.

Maple-oak stands are most common on well-drained coarse to moderately coarse textured sandy and loamy soils. They often grow where the soil is fairly shallow over bedrock but also usual are locations with deep or at least moderate (1/2 m) amounts of soil covering the bedrock; bouldery till slopes and well-drained bottomlands are typical topographic locations.

The dominating species consist of sugar maple, red maple, red oak and white oak. Sugar maple is usually confined to mesic, deep soils; the others are common also on the more marginal sites. On the mesic areas the associate species are most often white ash, shagbark hickory, beech, ironwood, basswood and black cherry; in the slightly lower lying, moist locations, largetooth aspen, white and grey birches are sometimes numerous, the two birches usually being more prominent in the understory than in the main canopy. Two conifer species, white pine and hemlock, are also present on occasion. These are most prominent on the shallow, bouldery till slopes, but with the hemlock often confined to north and east aspects.

As with the oak, this cover type can also produce majestic stands approaching 30 m in height and consisting of large diameter, clean-boled trees. These trees tend to be widely spaced, but have large spready crowns and usually cut off direct sunlight to the ground. However, the crowns are often thin and this coupled with the lack of lower branches allows considerable light to diffuse through. As a result, in many areas, particularly if a few breaks in the canopy are also present, dense shrub growth, 1 to 2 m high, may occur. Where the canopy closure is dense and the interior of the stand relatively dark, the ground is often clean with only light shrub growth.

Regeneration is usually present but is seldom very abundant. In the well-shaded stands sugar maple, beech, ironwood and white ash are prominent with lesser numbers of oak, while in areas receiving better lighting, the oaks become more noticeable. Other regeneration sometimes present include red maple, basswood, shagbark hickory and white pine. The pine are common on the open drier areas whereas basswood and hickory prefer mesic, deeper soils and red maple may occur in both areas. In dense stands, the predominance of sugar maple seedlings suggest that, barring significant disturbance, these stands may in time change into a more tolerant hardwood type (e.g. maple-beech) with oak only as a minor component. Where somewhat more light is available to the ground, the cover type may be able to maintain its present composition on the moderately well drained, deep soils; on the shallow, dry locations, white pine may eventually gain sufficiently to become one of the major stand components.

7. Maple-oak-hickory-ash. Second largest within the study area, this cover type accounts for over 800 ha or nearly one-quarter of the forested lands.

For the most part the cover type occurs on well- to moderately well drained areas. Commonly the soils are formed on moderately deep, coarse till overlying bedrock. The cover type can also occur on dry areas with only a thin veneer of soil, as well as on deep deposits, usually with good drainage characteristics, but imperfect and even poor moisture conditions are also possible, albeit infrequent.

Because of the wide range of site conditions, this cover type is characterized by a proliferation of tree species. The most consistent of these, and hence the name for the group, are sugar maple, red maple, red oak, white oak, shagbark hickory and white ash. More often than not, all of these are not present in any one stand and at other times some are present only in very small quantities. Similarly other species may on occasion make a major contribution to the stand composition. Most commonly these include bur oak, trembling aspen, largetooth aspen, white pine, white birch, grey birch, yellow birch, beech, basswood and ironwood. In addition, most other species of the region can occur but, although they can sometimes be locally abundant, are usually sporadic.

Not only does the variety of species indicate that the cover type occurs on a wide range of sites, but also, the local abundance of certain species often defines the site conditions at that location. On a typical, average site for the cover type, the maples and the oaks tend to be in the majority with the ash and hickory in a somewhat lesser role; more likely minor species would be basswood and beech. An abundance of white ash often suggests low-lying areas, possibly with a high water table or impaired drainage due to heavier soils than elsewhere in the stand. Similarly the presence of minor species such as the poplars and the birches also suggests locales with abundant moisture; grey birch often also signifies coarse-textured soils (sands), even in relatively wet areas. Likewise when substantial amounts of white pine are present within the cover type it usually implies good drainage, fairly shallow, or else, coarse-textured soils.

Regeneration is usually present but often only in small numbers. As with the mature stands, many different species may occur, but the primary cover type species are most usual; particularly common are the maples and the oaks with hickory and ash being somewhat less frequent. Others most consistent, but usually only in small numbers, are basswood, beech and ironwood. Because of its ability to regenerate in quantity under a closed canopy, beech may eventually increase sufficiently to become a major component in a future overstory. Basswood, however, is not a prolific species and will never be present in such quantities as to dominate stand composition; ironwood does not grow large enough to ever compete in the mature main canopy. On the wetter sites the oaks and hickory may in time give way to more red maple and ash-oriented stands. Poplars and birches may also show a gradual increase in these areas as long as ample openness is maintained; once a closed canopy develops these species will likely disappear. On rapidly drained, shallow sites white pine regeneration sometimes makes a fair showing, especially if the overstory does not form a closed canopy, and in such areas the pine may become a major stand component. However, these areas account for a very minor portion and represent borderline conditions for the maple-oak-hickory-ash type; on the more characteristic, mesic sites, any existing pine component will probably disappear in time. Instead, the major cover type species will likely maintain their prominence for some time and possibly change gradually toward an even more tolerant hardwood type, i.e. less oak and more sugar maple and beech.

8. **Poplar-birch.** Forest stands, characterized by poplars and birches, account for approximately 200 ha or slightly under 6% of the forested area.

Typically these stands occur on moist or somewhat imperfectly drained locations. The soils tend to be medium textured, often glaciolacustrine or alluvial in origin, and even organic soils are possible; sandy loams, loamy and silty near-surface soils are common although the substrate may be coarser textured, especially along shorelines where high silt or organic content top soil is often underlain by sandy alluvium. Sometimes the cover type exists on sloping terrain with fairly shallow covering of soil over bedrock, but more typical are relatively flat areas with deep soils. The poplar-birch is primarily a pioneer type and is generally one of the first to reforest old fields and other open areas. It is also one of the first successional forest stages along low-lying shorelines (Fig. 13) and other marshy areas.

The prime components of the type are trembling aspen, largetooth aspen, balsam poplar, white birch and grey birch. Usually all do not occur together in the same stand and frequently only two of them are present. Other species, most commonly encountered within the type, are white ash, black ash, white elm, red maple, sugar maple, red oak, bur oak, white oak and white pine. The ashes along with elm and red maple are most usual in the moister locations whereas sugar maple, oaks and pine are more prominent on the better drained areas. In many instances these minor species, particularly the oaks, maples and pine, are residuals that occupied the area prior to some disturbance which opened up the site permitting poplars and birches to take over. Where poplar-birch appear as a pioneer type on abandoned farmland, red cedar is sometimes a noticeable associate, particularly along the type's fringe areas.

Generally the pattern of regeneration within the stands differ markedly from that of other cover types in that here most of it consists of species other than those which dominate the main canopy. Most common regeneration are white ash and red maple. A number of others include, in addition to the weak poplar and birch regeneration, sugar maple, black ash, basswood, hickory, white cedar, hemlock and white pine. The persistent weakness of the poplar and birch regeneration indicates the pioneer nature of these stands; in most locations they are not likely to last much more than a generation unless some disturbance again creates conditions favouring these fast-growing, light-demanding species. The replacement stands will vary according to prevailing site conditions. The wettest areas will likely abound in white and black ash, red maple and may, in places, include white elm, white cedar and hemlock. Somewhat drier sites will progress toward a more tolerant hardwood composition with species such as sugar maple, hickory, white ash, basswood, beech and hemlock eventually being prominent in the main canopy. White pine, maples and oaks are most likely to gain prominence on the drier sites.

9. **Ash-red maple.** The ash-red maple is one of the smaller cover types in the area occupying less than 70 ha or approximately 2% of the forested land.

This cover type can be encountered on many different land types within the region but, typically it occupies moist or wettish locations. Silty, medium-textured glaciolacustrine deposits or recent alluvium are typical parent materials but coarser loamy and sandy soils are also frequent; organic soils may also support this cover type but often these are underlain by sandy-textured substrata within a metre of the surface. On hilly and rocky landscapes this cover type tends to occupy depressions and other low areas which collect ample moisture but many of these are localized and, at mapping scale, too small to separate from the ambient forest (Fig. 18).

A number of tree species may be abundant and are often present in sufficient quantity to be considered part of the predominant crown cover. However, the characteristic trees are white ash, black ash and red maple with the most typical associates being white birch, grey birch, yellow birch, largetooth aspen, trembling aspen and white elm. The elm is usually indicative of heavier soils and moisture rich locations, whereas grey birch often suggests sandy substrata, although ample moisture may be present because of a high water table. Yellow birch, aspen and white birch can appear on most sites occupied by this cover type.

A thick growth of shrubs, grasses, sedges and herbaceous plants is characteristic and, consequently, tree regeneration has difficulty getting established. In some stands moderate numbers of seedlings are present but usually regeneration is weak. The main cover type species of red maple and both ashes are the most numerous. Other species are weakly represented, especially in the wetter areas; the better drained locations support some tolerant hardwood seedlings, but these are also few in numbers. However, where closed canopies develop these species may gradually increase and slowly alter stand composition to include more species such as beech, basswood, hickory, yellow birch and sugar maple. On the

FIGURE 18. An ash-red maple cover type occupying a small, poorly drained depression within a predominantly dry, bedrock landscape.

wetter areas it appears that the ashes and red maple will be able to maintain their prominence in the near future and, in effect, may represent an edaphically controlled climax type which may not change much unless a significant change in site conditions takes place.

Forest Succession

A forest is not a static entity which will unchangingly maintain its status unless altered artificially or by a catastrophic event like a forest fire. Instead, it is changing continuously, but usually very gradually and effects of the process are often discernible only in terms of generations rather than a few years. If left undisturbed a forest composition will tend to change with each succeeding stand containing new species or different proportions of species than the preceding generation. This progress will continue until a situation is reached where the species in the mature stand are such that they can regenerate themselves to the virtual exclusion of any additional species. The stand will then perpetuate itself and is considered to have reached its climax state. This condition, however, is seldom achieved because innumerable disturbances and variations in site and climatic factors are constantly creating opportunities for disrupting the progress towards such a climax and, should a climax state be reached, for destabilizing it. Long-term predictions assume minimal interference with those factors which influence successional processes and, therefore, should be considered more as potential than concrete future events.

For the short term, the next generation or two, interpolation of future stand composition and conditions is more practical and reliable. Given the silvicultural requirements of a species and the existing site characteristics, an indication is obtained regarding that species' likelihood of success in the area. The abundance of existing regenerating is a most important indicator of the next stand composition. Should the regeneration consist of the same species as the main canopy and, especially if, in addition, the site factors meet the needs of these species, the forest may be nearing a climax stage. However this apparent climax can be destabilized by the effect the species themselves have on the site and the microclimate. For example, a prolonged occupancy by one group of species may eventually deplete the site of some vital nutrient making it less and less suitable to these species and, thereby, allowing a different group with different needs to successfully compete and gradually take over the location. Similarly many other vegetation-induced changes to the site can occur and cause an apparent climax type forest to change and to begin a new progression toward a different climax. Thus the occurrence of a true perpetual monoclimax is often a theoretical entity or so far removed (in time) from an existing forest type that planning towards it becomes impractical. The real value of knowledge of this climax and of the possible routes to it, is that it gives an indication of the developmental stage and the potential stability of existing forest types and the possible direction their near future development will take.

The preceding descriptions for the nine forest species groups suggest possible successional developments which some of them may undergo in the immediate future. Since each of these groups includes a great variety of stands with many different species combinations, succession could proceed in a multitude of directions and, therefore, the trends suggested for a cover type serve as a summation for medial types. References are usually made to the influence of a particular species within the cover type and these can sometimes be useful in appraising the successional direction individual stands may take, i.e. because two stands contain different proportions of species (possibly as a result of some difference in site conditions) their successional progress may follow separate paths even though they both belong to the same cover type group.

Figure 19 is a schematic summation of possible successional trends in some of the area's characteristic forest types. Included are only selected species groups for the purpose of illustrating typical trends. Many other species combinations occur in the area and, in most instances, so do numerous interim successional stages. Three general land types are considered; rapidly drained bedrock and very thin soiled outcrops, well to moderately drained deep or moderate soils, and wetlands.

On the bedrock sites the pioneer vegetation is typically reed grasses, vacciniums, ground juniper (Fig. 8), sumac and generally corresponds to the *Rhus typhina-Calamagrostis* lower vegetation subassociation (Fig. 22). Some of the first trees on such areas are eastern red cedar and white cedar which usually occur in small clumps or as scattered individuals on the bare bedrock. Whenever some soil exists, pines and hemlock are quick to take hold, followed by oaks and maples (mostly red maple). On these shallow-soiled, dry areas, white pine, oaks and maples in various combinations appear able to sustain themselves from one generation to the next; hemlock is another significant member of these sites, especially on north and east aspects, but is often left to a lesser role on other

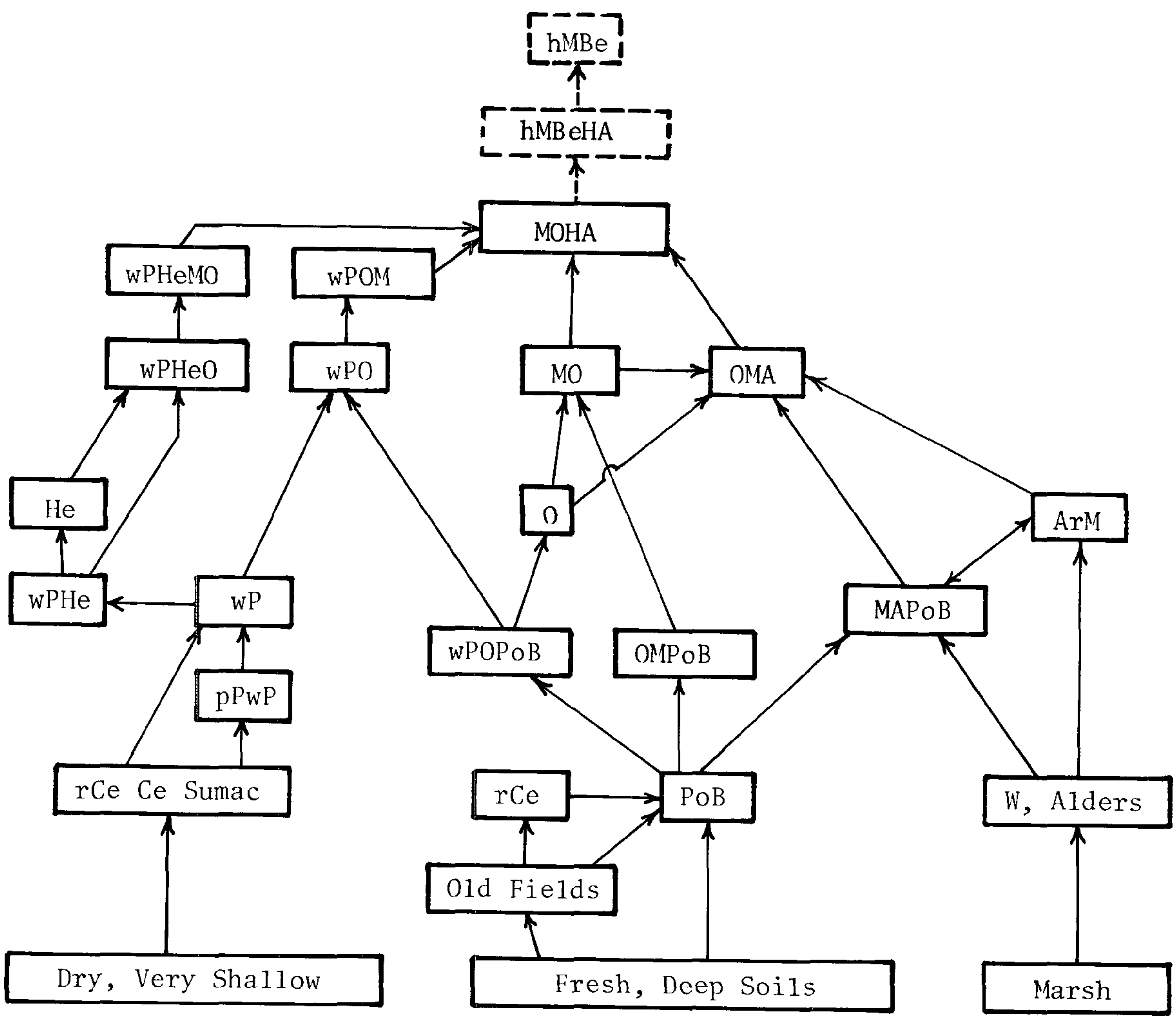


FIGURE 19. Schematic of possible forest succession for selected cover types. Species abbreviations from Appendix C.

areas. These white pine-oak-maple and, on the cooler exposures, white pine-hemlock-maple-oak forest types may be physiographic climax types which are likely to maintain their position of dominance until site conditions gradually change allowing other species groupings to supersede them, or until a disturbance accomplishes the same, usually causing a regressive step to an earlier successional stage, e.g. a forest fire could very easily set the progression right back to the reed grass and vaccinium stage.

Fresher sites with moderate or deep soil cover, including most abandoned farm lands in the region, usually are first invaded by white and grey birch, trembling aspen, largetooth aspen, balsam poplar and eastern red cedar, the latter being particularly noticeable on old fields (Fig. 11 and 16). In the shelter of the poplars and birches, other species, such as white pine, oaks and maples, are able to establish and eventually take over the site. More shade tolerant hardwoods will enter gradually and the forest cover seems to stabilize with a maple, oak, hickory, white ash composition. At that stage, species composition of the regeneration appears to be in proportion to that of the mature stand and therefore the stands may be able to perpetuate themselves, at least for the immediate future. It is possible that the oaks may be gradually replaced, particularly in fully shaded stands, by more shade tolerant species such as sugar maple and beech. However, at present sugar maple beech-dominated stands are very few. It may be, that in a readily accessible region such as this, the forests are subjected to sufficient disturbances to allow oak to maintain a prominent place on these mesic sites and to curtail successional progress beyond the maple-oak-hickory-ash stage. Accordingly in Figure 19, cover types with a sugar maple-beech dominance are shown by broken lines indicating them only as a potential next stage rather than a major existing entity.

Marshes, the third main site group, generally develop through shrub, alder and willow stages until sufficient soil buildup has occurred to allow poplars, birches (Fig. 13), ashes and red maple to establish; white elm is also a frequent component of these wet areas, but usually does not occur in sufficient quantity to dominate stand composition. Eventually red maple, white and black ash tend to outlast the poplars and birches and, as long as the site remains wet, predominate both, the canopy and the regeneration. The ash-red maple types, therefore, appear to be another edaphically controlled climax forest, requiring a significant site alteration to progress further. However, should moisture conditions moderate somewhat, sugar maple, hickory and oak are able to compete successfully while black ash tends to become less frequent. Thus, the ash-red maple also may eventually progress toward a similar maple-oak-hickory-white ash climax type as do the other forests of the area. In some locations, for example the stand in Figure 18, this could happen in the foreseeable future, but more often a substantial amelioration of site conditions is necessary and the time required to attain this change is long and likely beyond plans based on present land use priorities.

Figure 19 and related discussions on forest succession assume relatively disturbance-free conditions throughout the cycle. A minor disturbance, such as partial opening of the canopy may also cause a small regressive step where some of the earlier pioneer species reinvade the openings, but which will again be replaced in the next generation. On the other hand, a catastrophic event like a fire can set a near climax forest back many generations to an early pioneer stage. Thus the amounts and types of disturbances and the ability of various species to cope with these, will have a marked effect on the direction stand development will take. In a heavily used region such as the Thousand Islands, disturbance is often constant and many forest stands probably regress periodically instead of moving steadily toward a climax type.

Plant Community Classification

Introduction

The plant communities of the park were surveyed to determine their plant groupings (associations/sub-associations). This information generates an understanding of the fundamental ecological processes in the area and can be related to community dynamics and successional trends. By knowing these resources, management of the communities and their environment become possible.

The most important objective in an ecological approach to plant resources is to determine whether recurring groups (sub-associations) of plant species exist, can they be classified and, if so, are the classes ecologically significant and natural.

As with most vegetation studies, a decision must be made as to which classification system should be used. The answer to this is the vegetation itself. The natural groups of some vegetation types are more easily determined by one system of classification than another, while with others, most systems will work effectively. Thus, the system which should be used is the one which will produce the most natural groupings and the most ecologically significant information. Unfortunately, unless one has extensive *a priori* knowledge of the vegetation of the study area, the method best suited may not be apparent beforehand. One of the most frequently used is the Braun-Blanquet method (Mueller-Dombois and

Ellenberg 1974) the two main criteria of which require that relatively natural (undisturbed) areas be examined, and that a relatively low number of sample plots and species be examined. The analysis of large numbers of these make the time and effort required to determine vegetation classes, by rearranging the association table, prohibitive. In this project the size of the analysis (109 plots with 96 species) and significant human disturbance throughout the park contravene the criteria of this system and consequently the approach used was a more "mathematical" classification. Another reason why this was done was that the mathematical approach to analysis relies less on the investigator's *a priori* knowledge of the study area, and it also tends to limit bias considerably in the analysis.

The method which proved to be most natural was Orloci's (1967) agglomerative polythetic cluster analysis, which was modified from Jesberger and Sheard (1972). A cluster method was expected to be used, as it is best adapted to large, somewhat dissimilar data, while ordination programmes need small homogeneous stands to be effective in producing relevant ecological information. Other methods tried and proven unacceptable were Orloci's method using original cover-abundance values, a modified Beals' (1960) ordination with both original and standardized cover-abundance values. Beals' ordination was also used on the final associations produced from the cluster analysis, but due to lack of homogeneity, proved uninformative.

For the analysis, field plot notes were completed and plant specimens not identified in the field were identified and verified. Cover-abundance values for species in each plot were transferred from these plot notes to a sorting table. Where a species was present, its cover-abundance values were transformed to a value of 1, and the absence of a species was valued at 0 (zero). Species which occurred on less than four sample plots were eliminated from the analysis; although some of these are important because of their rarity in the park, they are too erratic to be an aid in community classification, but are included in the species checklist (Appendix H). A total of 96 species were examined in a total of 109 sample plots. The plot information was coded on computer cards and the program run on an IBM 360 computer.

Orloci's method is based on grouping sample plots on their affinity to each other rather than their dissimilarities. The basis for clustering any two plots or groups of plots is that they must be more similar to each other than to any other remaining plot or group of plots in the analysis. In this program, more than two samples may be linked at any one cycle, with the linked samples then forming a class equivalent to one sample, ready to be linked to any similar remaining sample or samples in the next cycle. The visual representation of this linking of sample plots is produced in the form of a dendrogram (Appendix G). The dendrogram is the graphic summary of the analysis and a two-dimensional representation of the relationships between the sub-associations which in reality are multi-dimensional relationships; the dendrogram should be imagined as a hanging mobile with each cluster (sub-association) able to turn and be closer or farther in a third dimension than the dendrogram shows. This mobile, because of its movement, is able to express changes in environmental parameters and their effects upon clustering distance (similarity).

The Association Table

An association table is generally related to the Braun-Blanquet (1932) method of community classification. Here the table is not derived from that type of analysis but from a cluster analysis and is the matrix representation of the dendrogram. Clusters (sub-associations) have been rearranged within the associations for a clearer representation of these communities. This rearrangement does not affect the information, as the type relationships are not altered, but merely shifted for visual purposes. Examining the table (Appendix G), the nine sub-associations produced are listed along the top. The naming of the associations and sub-associations is simplified from Braun-Blanquet, but the identification and classification of the characteristic, differential and companion species are all done by standard Braun-Blanquet methods (Mueller-Dombois and Ellenberg 1974). Within each sub-association all sample plots are numerically listed and their basic plot information accompanies them. Each plot can be located by referring to Appendix I, which gives the original plot number, plot location and UTM grid coordinates for their location on each island or the mainland. The vertical axis is comprised of the species used in the classification and are grouped as to characteristic, differential, shared differential and companion species.

The sub-associations are represented by their characteristic and differential species, and to a degree by their shared characteristic and differential species. Characteristic species are those which have high cover-abundance and presence values in a defined sub-association, while a differential species is one which is restricted to a small number of sub-associations, and shared characteristic and differential species are ones which are characteristic or differential within some other sub-association. Companion species are ones which occur in a large number of stands and hold no affinity to any one association or sub-association. For this study, a species is differential if if occurs in a sub-association at least 50% of the time and characteristic if it is almost exclusively restricted to, or has high cover-abundance values in its sub-association.

The association table, by its arrangement, enables one to easily determine the floristic composition of each sub-association. All sample plots within a sub-association are not totally similar floristically. An abundance of variation exists; however, the plots within each sub-association are more similar to each other than to those outside the type. The variations reflect the natural evolutionary plasticity and community disturbance, particularly by human factors, in any area and especially in a heavily used area such as St. Lawrence Islands National Park.

Plant Community Descriptions

The sub-associations or plant communities in St. Lawrence Islands National Park are listed below; their composition as determined from the cluster analysis is shown by the association table. In this section, the sub-associations are described floristically, in terms of their species composition and their cover-abundance conditions, edaphically, and also by other important ecological considerations.

Vegetation Associations and Their Sub-associations

A. *Vicia-Rhus typhina-Typha* Association
   Sub-associations:
   1. *Vicia-Poa pratensis* (Vetch with Kentucky bluegrass)
   2. *Typha-Sagittaria* (Cattails with arrow-head)
   3. *Rhus typhina-Calamagrostis* (Sumac with reed grass)

B. *Impatiens* Association
   Sub-associations:
   1. *Impatiens-Urtica* (Jewel weed and nettles)
   2. *Impatiens-Parthenocissus* (Jewel weed and virginia creeper)
   3. *Ribes-Circaea* (Currants and enchanter's nightshade)

C. *Aralia* Association
   Sub-associations:
   1. *Aralia-Carpinus* (Spikenard and blue beech)
   2. *Quercus alba-Ostrya* (White oak – ironwood)
   3. *Tsuga* (Hemlock)

A1. *Vicia-Poa pratensis* **sub-association** (Vetch with Kentucky bluegrass). This sub-association represents old-field areas and within the park occurs at Mallorytown Landing, on Grenadier Island (on each of the central, eastern and western sections), Beaurivage, Cedar and Thartway (Leek) islands. Usually classified as U_1 and U_2 on forest cover type maps, it is the largest of the non-forested sub-associations. The old fields in the park are characterized by an absence of trees and typical old field flora of such species as goldenrod, milkweed, aster and numerous grasses which occur with a high degree of presence and high cover-abundance values (Fig. 20), while others such as cow vetch and Canada thistle have lower cover-abundance values but are type specific.

The sub-association is generally a layer of herbaceous vegetation, casually encroached by sporadically occurring trees or shrubs from the surrounding forests. The occurrence of shrubs and trees such as meadow sweet, raspberry, dogwood, red cedar (Fig. 16), birches and poplars indicates the beginning of forestation of these lands and the slow process of secondary succession with this sub-association representing an early stage. As more trees and shrubs become established, the shade-intolerant old-field plant community will give way to a more shade-tolerant woodland-like species composition.

The sub-association occurs on lands that have been opened and the forest cover removed; in the park most of these areas indicate previous human land use, especially farming and cottages. Generally it exists on deep soils formed on moderately coarse to medium textured, sandy and loamy, materials with good to moderate, occasionally imperfect drainage. It is also present on old clearings on other soil types, as for example, on Beaurivage, Cedar and the west end of Grenadier islands where the soils are shallow and rapidly drained.

Floristically, the sub-association is composed of the following groupings.

Differential species

Vicia cracca
Poa pratensis

Characteristic species

Phleum pratense
Agropyron repens
Cirsium arvense
Asclepias syriaca
Aster novae-angliae

Shared differential species

(i) with sub-association *Rhus typhina-Calamagrostis*

FIGURE 20. Extremely thick growth of goldenrods, asters and grasses characterize many of the abandoned farm fields in the park.

Rosa sp.
Fragaria virginiana
Hypericum perforatum

(ii) with sub-associations *Rhus typhina-Calamagrostis* and *Typha-Sagittaria*

Juncus tenuis
Agrostis tenuis
Lythrum salicaria
Rumex crispus

Companion species restricted to associations *Vicia-Rhus typhina-Typha* and *Impatiens*

Urtica dioica
Rhus radicans
Equisetum hyemale
Solanum dulcamara
Lycopus americanus
Pyrus malus
Oxalis stricta
Convolvulus arvensis
Geum canadense
Lactuca biennis

Companion species restricted to associations *Vicia-Rhus typhina-Typha* and *Aralia*

Convolvulus sepium
Achillea millefolium
Poa compressa
Pinus strobus

Companion species

Vitis riparia
Onoclea sensibilis
Aster sp.
Maianthemum canadense
Pteridium aquilinum
Amelanchier arborea
Acer saccharum
Solidago canadensis
Spiraea latifolia
Solidago sp.
Rubus sp.
Cornus racemosa
Galium circaezans
Ranunculus acris
Acer rubrum
Carex sp.
Galium asprellum
Quercus borealis
Populus tremuloides

(Plus other species not used in the cluster analysis)

Regenerating species (in decreasing order of importance

Rhus typhina
Populus tremuloides
Quercus borealis
Pinus strobus

Acer rubrum
Cornus racemosa
Acer saccharum

A2. *Typha-Sagittaria* (cattails with arrow-head). *Typha-Sagittaria* is the sub-association occurring on marshy alluvium around many of the islands and mainland shores. These are also areas of emerging vegetation which have accumulated a quantity of organic material about their roots and over the years formed a surface soil rich in organic matter; however, in many locations this rate of soil accumulation and the makeup of the depositions can be greatly influenced by wave action and spring flooding.

Along the outermost edge of the community, broad-leaved arrow-heads, water lilies and pickerel-weed form floating colonies on the water. Proceeding towards the shore, cattails, the dominant species of the sub-association, form dense colonies and occur with great abundance and high cover values (Fig. 21). It is here where a slow, gradual extension of the shoreline takes place as the living *Typha* roots and their previous years' roots and stems with their accumulated silty and organic matter provide better rooting areas for species which are not truly littoral, as well as, a micro-habitat which is more stable and more sheltered from wave action. Here, moisture-loving species such as reed grass, rushes, water plantain, blue flag, bindweed, touch-me-not, bulrush and others become established. Some of these do not appear outside marshy areas, are relatively few in occurrence and, therefore, have been excluded from the association table. These, nevertheless appear in the plant check list (Appendix H). Such species include *Polygonum natans*, *P. coccineum*, *Lemna minor*, *L. trisulca*, *Sparganium americanum*, *S. chlorocarpum*, *S. eurycarpum*, *Butomus umbellatus*, *Sagittaria graminea*, *Thelypteris palustris*, *Sium suave*, *Verbena hastata* and others.

As these marsh areas allow organic and silty matter to build up, and the soils become more insulated against the river's effects, trees begin to invade. Species such as alders, willows, black ash, birches and poplars (Fig. 13) are among the first to become established. Thus the ecological succession continues with less water-loving species such as bugle-weed, scullcap, sour dock and reed grasses becoming rooted and, eventually, when the soil is no longer saturated and afforestation is more advanced, rushes, bent-grass, hair-grass, bracken fern and Canada goldenrod invade and establish themselves. This latter process can be seen in the drier parts of the sub-association, such as sample plots 2, 52 and 63 (Association Table).

The floristic composition of the sub-association, as described here, is a combination of the

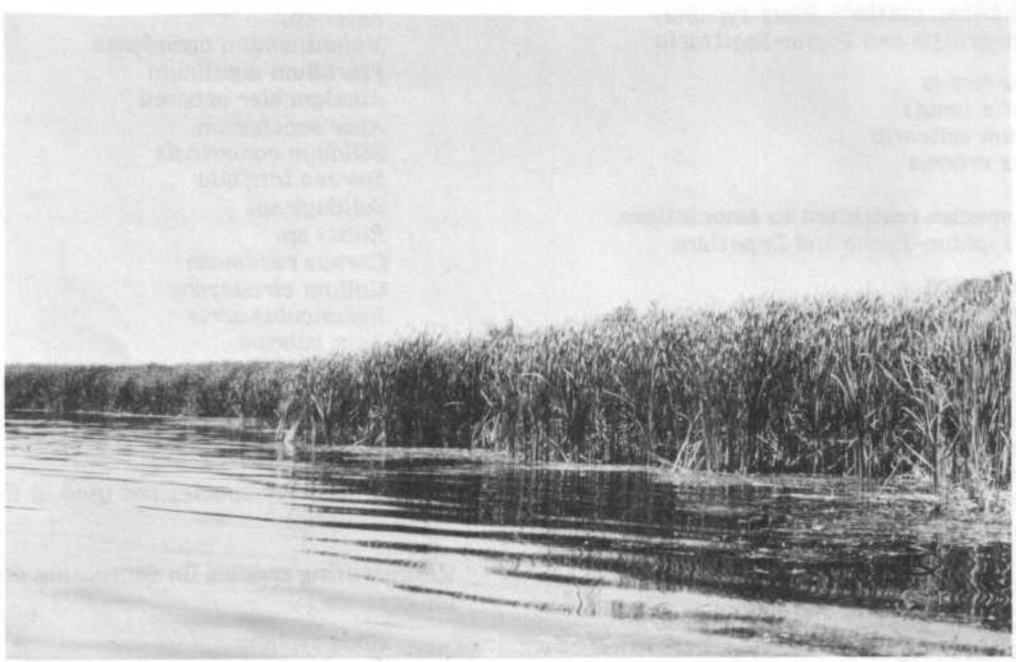


FIGURE 21. Cattails sometimes form dense, extensive colonies along the St. Lawrence River.

drier (later stage) and true (wet) marshes. Of the two, the drier marsh species tend to be proportionally more numerous because they include many species which are also present on other sites and thus have a sufficiently high total occurrence to be included in the cluster analysis. The true marsh species, on the other hand, are restricted to very specific sites and show only in samples taken on these sites. Because of the relatively few number of samples (7) within this sub-association, some of the less prolific true marsh species do not occur in the minimum number of samples (4) to be included in the cluster analysis and, therefore, in the assocaition table. Therefore, the following floristic composition, based on the association table, is likely incomplete in places, particularly with respect to true marsh species.

Differential species

Sagittaria latifolia
Typha latifolia

Characteristic species

Phalaris arundinacea
Alisma plantago-aquatica

Shared differential and characteristic species

(i) with sub-association *Rhus typhina-Calamagrostis*

Calamagrostis canadensis

(ii) with sub-associations *Rhus typhina-Calamagrostis* and *Vicia*

Poa pratensis
Juncus tenuis
Agrostis tenuis
Lythrum salicaria
Rumex crispus
Polygonum convolvulus

Companion species restricted to associations *Vicia-Rhus-typhina-Typha* and *Impatiens*

Solanum dulcamara
Lycopus americanus
Stachys hispida
Scutellaria galericulata
Alnus rugosa

Companion species restricted to associations *Vicia-Rhus typhina-Typha* and *Aralia*

Deschampsia flexuosa

Companion species

Fraxinus nigra
Sambucus canadensis
Impatiens biflora
Onoclea sensibilis
Sambucus pubens
Pteridium aquilinum
Solidago canadensis
Spiraea latifolia
Rubus sp.
Galium circaezans
Acer rubrum
Lysimachia ciliata
Betula populifolia
Ilex verticillata
Carya ovata

A3. *Rhus typhina-Calamagrostis* (sumac with reed grass). This sub-association occurs on disturbed, open locations with shallow, excessively drained soils and usually with exposed bedrock present. In such areas the heat of summer combined with the relatively rapid drainage often result in very desiccated sites and stressful conditions for plant growth. However, a number of species have adapted to these situations and are able to thrive quite well. Typically abundant are reed grasses, oat grasses and shrubs (Fig. 22), particularly sumac, junipers and blueberry. Other species frequently encountered include bluegrass, bindweed, St. John's-wort, raspberry, black and choke cherries.

Tree cover may or may not be present; if present, it generally forms a sparse canopy allowing abundant light to reach the ground (Fig. 23). The tree species most commonly present are oaks, shagbark hickory, white ash, maples, white pine and, less frequently, basswood.

The shallowness and dryness of these sites combined with a relatively high degree of human disturbance severely restricts the variety of species and the existing community is likely to be perpetuated unless marked change occurs in the conditions noted. In the short term the possibility of change will be related to the intensity of human use; a substantial increase will further deteriorate the site eliminating some of the present species but perhaps allowing some new ones to establish. Removal of human disturbance would not significantly alter the tree species composition because the other limiting factors of shallow soils and rapid drainage conditions would still deter the introduction of most other species. Tree regeneration most likely to endure under present conditions consist of hardy species such as oaks, maples, white ash and pines. However, reduced disturbance may permit an increase in the quantity of the present tree cover causing a change in light availability to the ground and more stable moisture conditions, two factors certain to alter the ground species composition and probably shift it towards plant communities such as those within the *Aralia* vegetation association.

Floristically the sub-association consists of:

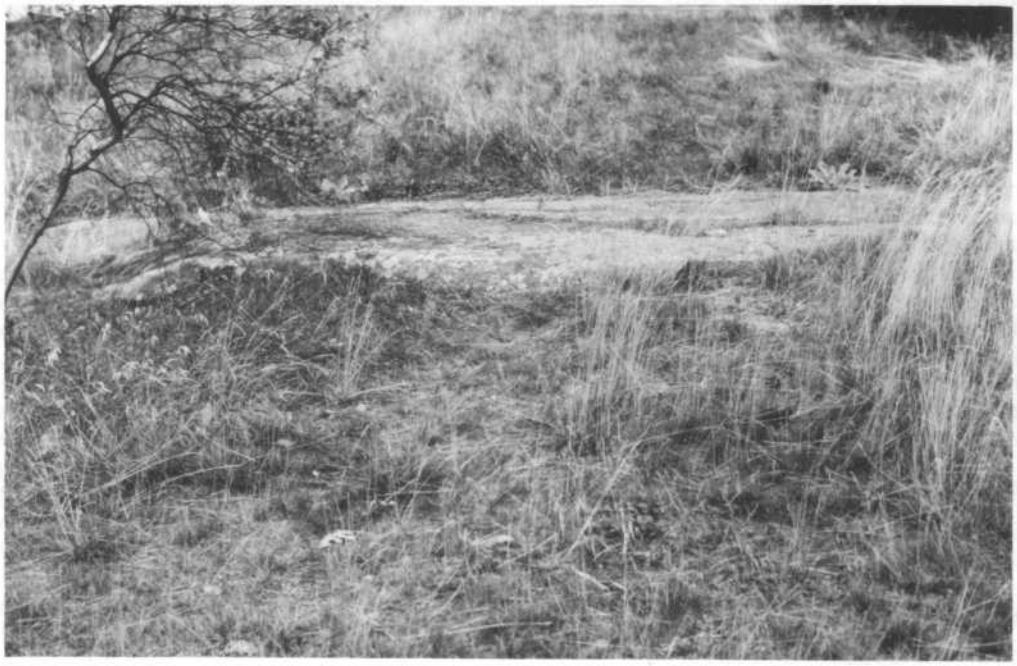


FIGURE 22. Very shallow soils, supporting a pioneer community of grasses and shrubs.

FIGURE 23. Sparse-canopied stands of the Rhus typhina-Calamagrostis sub-association permit plentiful light to the ground thus allowing grasses, sumac and abundant other vegetation to thrive.

Differential species

No species were found

Characteristic species

Rhus typhina
Calamagrostis canadensis
Juniperus communis
Danthonia spicata

Shared differential and characteristic species

(i) with sub-association *Vicia-Poa pratensis*

Poa pratensis
Phleum pratense
Agropyron repens
Asclepias syriaca
Rosa sp.
Fragaria virginiana
Hypericum perforatum

(ii) with sub-association *Typha-Sagittaria*

Polygonum convolvulus

(iii) with sub-associations *Vicia-Poa pratensis* and *Typha-Sagittaria*

Juncus tenuis
Agrostis tenuis
Lythrum salicaria
Rumex crispus

Companion species restricted to associations *Vicia-Rhus typhina-Typha* and *Impatiens*

Solanum dulcamara
Pyrus malus
Oxalis stricta
Convolvulus arvensis
Geum canadense
Lactuca biennis
Alnus rugosa

Companion species restricted to associations *Vicia-Rhus typhina-Typha* and *Aralia*

Achillea millefolium
Poa compressa
Pinus strobus
Deschampsia flexuosa
Vaccinium angustifolium
Thuja occidentalis

Companion species

Urtica dioica
Fraxinus nigra
Ribes sp.
Vitis riparia
Galium triflorum
Ostrya virginiana
Tsuga canadensis
Sambucus pubescens
Aster sp.
Rubus odoratus
Pteridium aquilinum
Maianthemum canadense
Solidago canadensis
Solidago sp.
Rubus sp.
Cornus racemosa
Carex sp.
Galium asprellum
Quercus borealis
Lysimachia ciliata
Betula populifolia
Carya ovata
Prunus serotina
Polygonatum pubescens
Prunus virginiana
Tilia americana
Aster cordifolius
Viburnum lentago
Viburnum rafinesquianum
Fraxinus americana
Dryopteris marginalis
Celastrus scandens
Geranium robertianum

Regenerating species (in decreasing order of importance)

Quercus borealis
Prunus serotina
Prunus virginiana
Pinus strobus
Fraxinus americana
Carya ovata
Thuja occidentalis
Tilia americana
Acer saccharum
Ostrya virginiana

B1. *Impatiens-Urtica* (jewel-weed and nettles). The *Impatiens-Urtica* sub-association occurs on moist to imperfectly drained, fairly open sites that have generally moderate to deep soils; the micro-topography is usually flat or slightly undulating with slope gradients not sufficient to appreciably influence soil moisture or drainage conditions.

The ground vegetation reflects the prevailing moist, open conditions of the site as indicated by the prevalence of jewel-weed and nettles (Fig. 24) along with numerous ferns such as sensitive fern, wood ferns, royal ferns and marsh fern, as well as herbs and shrubs like meadow rue, currants, raspberries, dogwood, serviceberry, elderberry, nannyberry, sumac and others. Alder are also often present in some of the especially wet areas.

Most of these areas seem to have been previously disturbed in one way or another creating the existing open canopy conditions which, in turn, allows for the preponderance of weeds and shrubs and does not favour tree regeneration. This situation will exist until the canopy closes sufficiently to reduce the amount of available light,

FIGURE 24. Dense ground flora, including a proliferation of tall nettles, of an Impatiens-Urtica community.

thereby permitting the more shade-tolerant tree species to compete against the ferns and shrubs. The present canopy varies from mixtures of white birch, black cherry, shagbark hickory, red oak and white pine stands to fairly pure stands of black ash, grey birch or balsam poplar. Once, more shade-tolerant tree species begin to get established in increasing numbers, it will signify a reduction in the availability of light to the ground and gradually create a change in the lower vegetation. A possible next stage in this succession can be toward plant communities similar to the *Impatiens-Parthenocissus* sub-association.

Floristically the sub-association is composed of:

Differential species

None were found

Characteristic species

Urtica dioica

Shared differential and characteristic species

Fraxinus nigra
Ribes sp.
Vitis riparia
Impatiens biflora
Onoclea sensibilis
Sambucus pubens
Aster sp.
Circaea quadrisulcata
Rubus odoratus
Rhus radicans
Parthenocissus quinquefolia

Companion species restricted to associations *Vicia-Rhus typhina-Typha* and *Impatiens*

Solanum dulcamara
Convolvulus arvensis
Geum canadense
Stachys hispida
Scutellaria galericulata
Alnus rugosa

Companion species restricted to associations *Impatiens* and *Aralia*

Dryopteris cristata
Viola sp.
Pyrola elliptica
Podophyllum peltatum
Amelanchier arborea
Streptopus roseus

Companion species

Lythrum salicaria
Rhus typhina
Rumex crispus

Alisma plantago-aquatica
Polygonum convolvulus
Calamagrostis canadensis
Poa compressa
Solidago canadensis
Spiraea latifolia
Solidago sp.
Rubus sp.
Cornus racemosa
Acer rubrum
Carex sp.
Galium asprellum
Populus tremuloides
Lysimachia ciliata
Betula populifolia
Prunus serotina
Tilia americana
Aster cordifolius
Viburnum lentago
Fraxinus americana

Regenerating species (in decreasing order of importance)

Betula populifolia
Populus tremuloides
Acer rubrum
Prunus serotina
Tilia americana
Fraxinus nigra
Fraxinus americana

B2. *Impatiens-Parthenocissus* (jewel-weed and Virginia creeper). This type of plant community frequently occupies areas of moderately coarse to coarse- (sandy-loam, loamy sand) textured soils with medium to somewhat imperfect drainage conditions. Generally these sites tend to be slightly drier than those of the preceding (B1) sub-association but the topographic relief is very similar, both being predominantly flat with only minor undulations and gradients.

The tree canopy is usually of moderate density which not only permits the penetration of some direct light but also provides substantial shading of the ground. The species composition of the tree canopy is very variable and ranges from almost pure stands of poplars and birches (Fig. 25) to mixtures of red oak, red maple, black ash, shagbark hickory and other, minor components. However, in general, red oak, black ash and grey birch occur fairly consistently in this sub-association, with the birch very often restricted to the sub-canopy.

A moisture-loving woodland flora of jack-in-the-pulpit, baneberry, bedstraw, meadow rue, hog-peanut and avens characterize this sub-association as compared to the more shade-intolerant species of *Impatiens-Urtica* sub-association. Here the denser canopy closure has also an effect in reducing the numbers of plants on the ground, their coverage and diversity of species. Shrubs such as elderberries and sumac are lower in cover, abundance and presence values than in the previous type; the same is true for the ferns of this sub-association. On the other hand, individual plant communities within this sub-association are often

FIGURE 25. An almost pure stand of young grey birch with dense ground vegetation of an Impatiens-Parthenocissus sub-association.

dominated (high cover values) by one or two of its species (Fig. 26) in one location and by different species in another place; particularly competitive in this respect appear to be the goldenrods, sensitive fern, raspberries and currants.

Floristically, the sub-association is composed of:

Differential species

Equisetum hyemale

Characteristic species

Fraxinus nigra

Shared differential and characteristic species

Urtica dioica
Actaea alba
Ribes sp.
Vitis riparia
Galium triflorum
Sambucus canadensis
Impatiens biflora
Onoclea sensibilis
Sambucus pubens
Aster sp.
Circaea quadrisulcata
Rhus radicans
Parthenocissus quinquefolia
Arisaema triphyllum

Companion species restricted to association *Vicia-Rhus typhina-Typha*

Solanum dulcamara
Lycopus americanus
Pyrus malus
Oxalis stricta
Convolvulus arvensis
Geum canadense
Lactuca biennis
Stachys hispida

FIGURE 26. An Impatiens-Parthenocissus community heavily dominated by jewel-weed.

Scutellaria galericulata
Alnus rugosa

Companion species restricted to associations *Impatiens* and *Aralia*

Dryopteris cristata
Viola sp.
Pyrola elliptica
Podophyllum peltatum
Amelanchier arborea
Streptopus roseus
Smilax herbacea
Betula papyrifera
Amphicarpa bracteata
Trillium sp.
Prenanthes altissima

Companion species

Poa pratensis
Calamagrostis canadensis
Quercus alba
Maianthemum canadense
Pteridium aquilinum
Solidago canadensis
Spiraea latifolia
Rubus sp.
Cornus racemosa
Galium circaezans
Acer rubrum
Carex sp.
Galium asprellum
Quercus borealis
Populus tremuloides
Lysimachia ciliata
Ilex verticillata
Carya ovata
Prunus serotina
Polygonatum pubescens
Prunus virginiana
Tilia americana
Viburnum lentago
Viburnum rafinesquianum
Fraxinus americana
Celastrus scandens

Regenerating species (in decreasing order of importance)

Carya ovata
Fraxinus nigra
Acer rubrum
Quercus borealis
Quercus alba
Prunus serotina
Prunus virginiana
Betula papyrifera
Populus tremuloides
Tilia americana
Fraxinus americana

B3. *Ribes-Circaea* (currants and enchanter's nightshade). The sub-association occurs on fresh sites of moderately coarse textured sandy-loamy soils. As is typical throughout the *Impatiens* association, topographic relief is generally subdued and without substantial slope gradients or other abrupt terrain variations.

The physiognomy of the forest stands is generally different from that of B1 and B2 in that here the tree heights within the stands tend to be very diverse whereas in the others more or less one-storied stands are characteristic. In this sub-association the moderately dense canopy often combines a tall, 15 to 20+ m, upper story with a second story of tolerant hardwoods. The upper canopy may be composed of such species as red oak, sugar maple, white pine and occasionally shagbark hickory, basswood, white ash and black cherry.

The shrub layer is often dominated by raspberries, serviceberries, chokecherry and dogwood with the ground flora frequently represented by touch-me-not, goldenrods, asters, spikenard, sensitive fern and enchanter's nightshade. Among these is substantial tree regeneration, particularly of sugar maple, white ash, chokecherry, basswood, and others as indicated under the heading "Regenerating species".

Floristic composition of this sub-association is as follows:

Differential species

Actaea alba

Characteristic species

Ribes sp.
Vitis riparia
Galium triflorum
Sambucus canadensis

Shared differential and characteristic species

Fraxinus nigra
Impatiens biflora
Onoclea sensibilis
Sambucus pubens
Aster sp.
Circaea quadrisulcata
Rubus odoratus
Rhus radicans
Parthenocissus quinquefolia
Arisaema triphyllum

Companion species restricted to association *Vicia-Rhus typhina-Typha*

Solanum dulcamara
Pyrus malus
Oxalis stricta

Stachys hispida
Scutellaria galericulata

Companion species restricted to associations *Impatiens* and *Aralia*

Dryopteris cristata
Viola sp.
Podophyllum peltatum
Amelanchier arborea
Streptopus roseus
Betula papyrifera
Trillium sp.
Prenanthes altissima
Acer saccharum

Companion species

Aralia racemosa
Juniperus communis
Rhus typhina
Hypericum perforatum
Calamagrostis canadensis
Carpinus caroliniana
Viburnum acerifolium
Ostrya virginiana
Pteridium aquilinum
Solidago canadensis
Spiraea latifolia
Solidago sp.
Rubus sp.
Cornus racemosa
Galium circaezans
Ranunculus acris
Acer rubrum
Carex sp.
Galium asprellum
Quercus borealis
Lysimachia ciliata
Betula populifolia
Carya ovata
Prunus serotina
Polygonatum pubescens
Prunus virginiana
Tilia americana
Aster cordifolius
Viburnum lentago
Fraxinus americana
Dryopteris marginalis
Geranium robertianum

Regenerating species (in decreasing order of importance)
Re

Acer saccharum
Fraxinus americana
Prunus virginiana
Tilia americana
Prunus serotina
Ostrya virginiana
Fraxinus nigra
Carpinus caroliniana
Acer rubrum
Carya ovata
Betula papyrifera

C1. *Aralia-Carpinus* (spikenard and blue-beech). This type of plant community prefers moderately well drained and dry locations; the soils are usually fairly coarse textured and often shallow over bedrock. Many of these areas have been and are subjected to severe disturbance by trampling, particularly on the smaller, heavily used islands.

Commonly the sub-association occurs under an oak, maple, white pine, ash canopy which has high cover values and can provide full shade to the ground. The occurrence of other tree species, especially shagbark hickory, basswood, birches and black cherry is also frequent, albeit usually scattered among the predominant species, but in certain locations may be present as a major stand component.

Shrubs in this sub-association can play an important role, as, for example, blue beech which occurs regularly and, because of its tendency to grow in clumps, with some abundance (Fig. 27).

FIGURE 27. Abundant undergrowth of blue-beech is a frequent characteristic of an Aralia-Carpinus plant community.

Others, because of their high competitive ability once established, can dominate a stand very quickly and such is the case here on occasion with raspberries, winterberry and dogwoods. Wherever this dominance occurs it results in a marked reduction in the numbers of other species, especially ground flora. In any case, the low availability of light on the ground does not usually permit an abundant lower vegetation. However, spikenard, a typical woodland species which tends to have wide distribution in well-shaded locations, does extremely well in this community. Other important species are the woodland goldenrods, asters, blueberries and the shared differential species, bracken fern and lily-of-the-valley, although the latter two do not occur with the frequency or abundance they do in the *Quercus alba-Ostrya* or *Tsuga* sub-associations.

Tree species regeneration in this sub-association is, as would be expected, dominated by shade-tolerant species such as sugar maple, red oak, beech, black cherry and basswood (Fig. 28) with other species occurring sporadically.

This sub-association is floristically composed as follows:

Differential species

Carpinus caroliniana

Characteristic species

Fagus grandifolia

Shared differential and characteristic species

Pteridium aquilinum
Aralia racemosa
Maianthemum canadense

Companion species restricted to associations *Vicia-Rhus typhina-Typha* and *Aralia*

Achillea millefolium
Poa compressa
Pinus strobus
Deschampsia flexuosa
Vaccinium angustifolium
Thuja occidentalis

Companion species restricted to associations *Impatiens* and *Aralia*

Amelanchier arborea
Streptopus roseus
Trillium sp.
Acer saccharum

Companion species

Circaea quadrisulcata
Poa pratensis
Aster novae-angliae

FIGURE 28. Abundant red and white oak regeneration is typical among the ground flora of Aralia-Carpinus communities.

Hypericum perforatum
Calamagrostis canadensis
Impatiens biflora
Aster sp.
Solidago sp.
Rubus sp.
Cornus racemosa
Ranunculus acris
Acer rubrum
Carex sp.
Quercus borealis
Betula populifolia
Carya ovata
Prunus serotina
Polygonatum pubescens
Prunus virginiana
Tilia americana
Aster cordifolius
Viburnum lentago
Viburnum rafinesquianum
Fraxinus americana
Dryopteris marginalis
Celastrus scandens
Geranium robertianum

Regenerating species (in decreasing order of importance)

Quercus borealis
Acer saccharum
Carpinus caroliniana
Fagus grandifolia
Tilia americana
Prunus serotina
Carya ovata
Fraxinus americana
Thuja occidentalis
Acer rubrum
Betula populifolia
Pinus strobus

C2. *Quercus alba-Ostrya* (white oak-ironwood). This sub-association typically occurs on the well-drained, shallow tills which occupy much of the rolling terrains and slopes of the area. Moderately coarse to coarse-textured, bouldery, loamy and sandy soils are usually associated with this plant community but it can also occur on finer soils and less well drained areas.

The trees tend to form almost total canopy cover. Typically stand composition consists of white and red oak and white pine but it can vary and stands of hemlock, pitch pine or poplars were encountered with this sub-association. Sugar maple and red maple usually have a minor role in the overstory but are important regeneration species. White oak, although not occurring in large numbers, are almost always present and very characteristic of this community, not only in the overstory but also in the sapling and seedling stages. Ironwood, being a hardy shade-tolerant species, also competes well under the closed canopy and is often abundant.

In addition to white oak and ironwood, species which typify this sub-association include the shrubs maple-leaf viburnum and wintergreen, the latter of which was encountered only once outside the sub-association. Other shrubs most commonly present are raspberries, blueberries and other viburnums but, in general, shrubs do not play as important a role here as in other sub-associations. Instead, the ground flora usually dominates wherever sufficient light is able to penetrate the tree canopy. Important plants in this respect are asters, spikenard, bracken ferns, lily-of-the-valley, goldenrods and cow-wheat (Fig. 29). Solomon's seal, a companion species, occurs regularly here but only sporadically elsewhere. Similarly, the violet family reaches its highest presence values here and forms an important component of this sub-association.

Generally regeneration of tree species is very good, especially that of red oak, white oak, sugar maple, red maple, black cherry and ironwood.

The following is the floristic description of the sub-association:

Differential species

Quercus alba

Characteristic species

Ostrya virginiana
Viburnum acerifolium
Gaultheria procumbens

Shared differential and characteristic species

Fagus grandifolia
Tsuga canadensis
Pteridium aquilinum
Aralia racemosa
Maianthemum canadense

Companion species restricted to associations *Vicia-Rhus typhina-Typha* and *Aralia*

Dryopteris cristata
Viola sp.
Pyrola elliptica
Podophyllum peltatum
Amelanchier arborea
Streptopus roseus
Smilax herbacea
Betula papyrifera
Amphicarpa bracteata
Trillium sp.
Prenanthes altissima
Acer saccharum

Companion species restricted to associations *Impatiens* and *Aralia*

Achillea millefolium

FIGURE 29. Dry sites with numerous bracken ferns, spikenard and maple, oak, white pine seedlings characterize the Quercus alba-Ostrya sub-association.

Poa compressa
Pinus strobus
Vaccinium angustifolium

Companion species

Impatiens biflora
Ribes sp.
Fraxinus nigra
Parthenocissus quinquefolia
Vitis riparia
Arisaema triphyllum
Rubus odoratus
Solidago canadensis
Spiraea latifolia
Solidago sp.
Rubus sp.
Galium circaezans
Ranunculus acris
Acer rubrum
Carex sp.
Galium asprellum
Quercus borealis
Populus tremuloides
Lysimachia ciliata
Betula populifolia
Ilex verticillata
Carya ovata
Prunus serotina
Polygonatum pubescens
Prunus virginiana
Tilia americana
Aster cordifolius
Viburnum lentago
Fraxinus americana
Dryopteris marginalis

Regenerating species (in decreasing order of importance)

Quercus borealis
Quercus alba
Acer saccharum
Acer rubrum
Prunus serotina
Ostrya virginiana
Pinus strobus
Betula populifolia
Carya ovata
Tsuga canadensis
Tilia americana
Betula papyrifera
Fagus grandifolia
Fraxinus americana
Fraxinus nigra
Populus tremuloides

C3. *Tsuga* (hemlock). Typical locations for this plant community are well-drained, shallow-soiled, often rocky, slopes, particularly those with an easterly/northerly aspect. Because of this aspect and also because the hemlock tree cover is frequently very dense, thoroughly shading the ground, the sites tend to be cool and fresh despite rapid drainage conditions.

It is because of this shading, frequently by almost pure hemlock, that very sparse ground vegetation is characteristic of the type (Fig. 30). Not only is the vegetation sparse but the species diversity is also low; the only species which seem to occur with regularity are lily-of-the-valley, woodferns, spikenard and some sedges.

Eastern hemlock is the characteristic, and often sole, tree species; others most likely to be encountered are sugar maple, beech, white birch, white pine, white and black ash. Tree regeneration is usually minimal with only hemlock, white cedar, white ash and sugar maple being of any significance.

Floristically the sub-association is composed of:

Differential species

None were found

Characteristic species

Tsuga canadensis

Shared differential and characteristic species

Fagus grandifolia
Gaultheria procumbens
Pteridium aquilinum
Aralia racemosa
Maianthemum canadense

Companion species restricted to associations *Vicia-Rhus typhina-Typha* and *Aralia*

Convolvulus sepium
Vaccinium angustifolium
Thuja occidentalis

Companion species restricted to associations *Impatiens* and *Aralia*

Dryopteris cristata
Betula papyrifera
Trillium sp.
Acer saccharum

Companion species

Agrostis tenuis
Juniperus communis
Danthonia spicata
Sambucus pubens
Ribes sp.
Fraxinus nigra

FIGURE 30. Forest floor almost devoid of ground flora is a frequent occurrence under dense hemlock canopies.

Onoclea sensibilis
Rubus sp.
Carex sp.
Prunus serotina
Polygonatum pubescens
Fraxinus americana
Dryopteris marginalis

Regenerating species (in decreasing order of importance)

Tsuga canadensis
Thuja occidentalis
Fraxinus americana
Acer saccharum
Betula papyrifera
Fagus grandifolia
Fraxinus nigra
Prunus serotina

Lower Vegetation Successional Trends

To analyze, understand and project successional trends within an area require that the plant communities and their relationships must be known, but to completely analyze these trends it would be necessary to sample, in their different stages of development, every sub-association throughout the area. This is an impossible task as only those communities that are present now, can be sampled. Where these fit in the successional hierarchy must, therefore, be interpolated on the basis of the information these existing communities themselves provide. From these data it may also be possible to deduce the occurrence of missing (i.e. not encountered in sampling) subtypes, particularly if the data are sorted into some format (e.g. Association Table, Appendix G) which brings out the affinity of the different species to one another and, perhaps as well, relates them to specific site factors.

The first step in succession is a pioneer plant community which invades open unoccupied areas of land. In St. Lawrence Islands National Park the unoccupied areas can be classified into three broad types: (a) bedrock and very shallow soils, (b) deep soil deposits, and (c) shorelines, with each site representing different edaphic and aerial conditions. The flow chart (Fig. 31) schematically demonstrates the normal and possible trends in succession of plant communities that develop on the three different substrates.

One of the first plant community types to enter bedrock landscapes is *Rhus typhina - Calamagrostis* sub-association. This sub-association occurs on the open exposed bedrock with almost no soil, save for a very few isolated very shallow pockets. This, however, is not the true pioneer type on these areas as primary moss and lichen communities usually precede this stage and the *Rhus typhina-Calamagrostis* is an advanced stage of this pioneer community. As the sub-association develops, soil is gradually accumulated around the vegetation and seedlings of various species are able to get established and develop as directed by the prevailing ecological conditions. The *Tsuga* sub-association, will usually form on the north-facing, cool slopes and depressional valleys. Hemlock seedlings are able to grow well here and eventually totally dominate the site as mature trees. On more southerly exposures, where the microclimate is generally hotter, especially in summer, the corresponding community type which will develop is the *Quercus alba - Ostrya* sub-association. The predominant canopy species is red oak, which is generally reduced in height and girth from those occurring on mesic sites. Both these communities develop on sites with very little soil; where some soil has accumulated and formed a shallow layer, a third sub-association is possible. This is the *Aralia-Carpinus* community, whose canopy of white and red oak, white pine and white ash produces a well-shaded ground community dominated by spikenard and blue-beech. The sites dominated by this latter community are not as dry as the *Quercus alba - Ostrya* type, and because there is more soil, produce a ground community of more complexity. It is possible that the *Aralia - Carpinus* sub-association, given the opportunity of a moderately fresh site on a minimal amount of soil, may develop into a drier variation of the *Impatiens - Parthenocissus* community.

Deeper soils tend to have fresher moisture conditions and provide a more favourable medium for plant and tree growth. The pioneer communities on these sites are the weed sub-associations characterized by the *Vicia - Poa pratensis* type. This is the dominant weed community of the park and occurs on these sites without tree cover. Eventually, through competition from surrounding areas, this community will evolve into the *Ribes-Circaea* sub-association and ultimately into the *Impatiens-Parthenocissus* community. On somewhat wetter sites, the development of the weed community is towards the *Impatiens-Urtica* sub-association which itself may eventually progress to an *Impatiens-Parthenocissus* type.

The third original development condition consists of wet areas along the shores of the islands and mainland. The shoreline community of *Typha-Sagittaria* that presently exists gradually extends itself into the water, occupying more area, and accumulates more and more soil around its roots. This soil buildup eventually provides rooting zones for water-loving trees and the area gradually evolves into the *Impatiens-Urtica* sub-association which develops on very damp sites. Should these sites become drier the *Impatiens-Urtica* sub-association may in time give way to an *Impatiens - Parthenocissus* community.

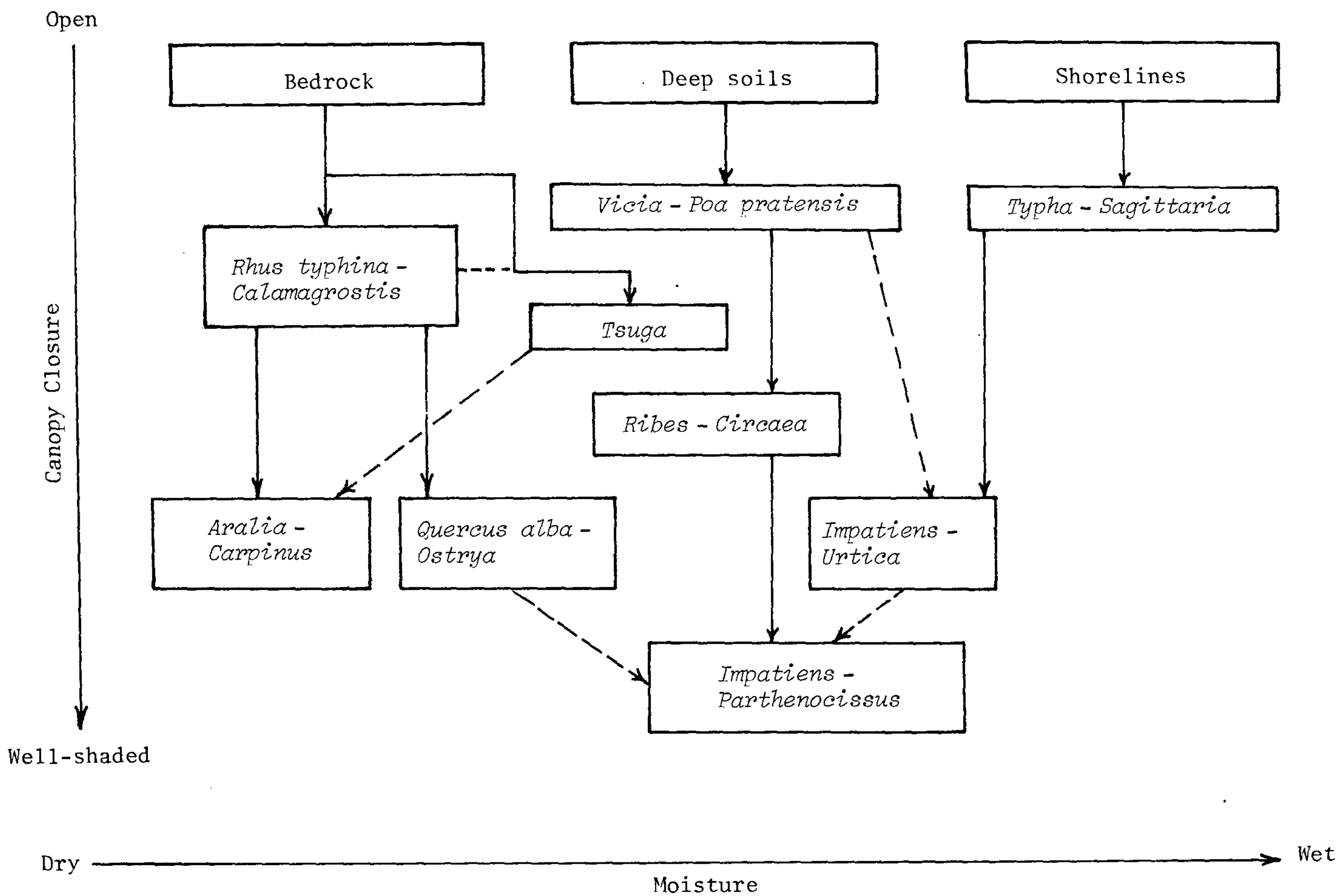


FIGURE 31. A schematic diagram of possible successional trends of lower vegetation plant communities. Solid lines represent normal succession while broken lines indicate possible trends.

RIVERS

As the Wisconsin glacier gradually receded from southern Ontario a large ice contact lake, known as Lake Iroquois, formed in the Lake Ontario basin. At this time, some 12.5 thousand years ago, the St. Lawrence valley was still blocked by ice and the drainage to the sea was through an outlet at Rome, New York, into the Hudson River. The ice retreated further and a new outlet opened through the Champlain valley into the Hudson River. The waters in the Ontario basin, called Lake Frontenac at this stage, drained through the Champlain valley until the lake level lowered to that of the outlet and stabilized; the lake so formed is known as Lake Fort Ann. Finally the ice moved north of the St. Lawrence valley and Lake Fort Ann drained along it leaving a small low-level lake, called Admiralty Lake, in the Ontario basin. As the St. Lawrence valley opened it not only allowed drainage out but also because the land had been depressed by the glacier let the ocean in and formed the Champlain Sea. The sea extended up to Brockville and possibly further inland when at its maximum. The land rebounded quickly and by about 9.5 thousand years ago the sea had receded from eastern Ontario. As the land rose in the St. Lawrence valley the Ontario basin began filling and Admiralty Lake (which covered only the easternmost part of the basin) expanded becoming Lake Ontario. At the same time, the St. Lawrence River began establishing its present channel through the rebounding valley, a channel which today drains a total of nearly 1.2 million km^2.

Within the Thousand Islands region the river channel width varies considerably from one location to the next. Disregarding very small islands, its width at the western end of the study area is nearly 5 km between Gananoque and Grindstone Island and another 3 km between Grindstone and the United States mainland. This total width of 8 km narrows very quickly and becomes only about 1 1/4 km at the Ivy Lea Bridge (Fig. 1). Here again the total width is split into two main channels. On the Canadian side, Raft Narrows which is about 3/4 km and Upper Narrows on the American side which is less than 1/2 km wide. There is also a third channel (along which the international boundary is located) between Hill and Wellesley islands but this is less than 100 m wide in places. After this constricted area the river again widens and is over 6 km at Mallorytown Landing near the eastern end of the study area.

Through the Thousand Islands the depth of water in the channels is also extremely variable (Map 6). Extensive shallows (less than 2 m) occur throughout the Admiralty Islands group at the western end of the map area. Similarly towards the eastern end, most of the nearly 2 km wide channel between Grenadier Island and the Canadian mainland is not only very shallow but also contains extensive weed beds. The deepest sections occur in the vicinity of the Ivy Lea Bridge. Here, in the Raft Narrows for a distance of about 4 km easterly from the bridge, depths are in excess of 45 m with soundings down to below 70 m; similar depths occur also in the Upper Narrows on the American side. In this area the river apparently flows over a substantial underwater ledge (Greggs and Gorman 1975) and the change from moderate depths to very deep is abrupt. In the Raft Narrows the change occurs very near the bridge, for mid-channel soundings upstream from it do not exceed 25-30 m. This sudden drop in the river floor, combined with the almost as abrupt narrowing of the channel, creates strong currents which swirl among the numerous small islands in the vicinity. Though extreme depth occurs both in the Raft and the Upper narrows, the third passage (between Hill and Wellesley islands) through this section is uniformly very shallow, mostly less than 2 m, with only a very small portion slightly deeper than 6 m.

Seasonal water level fluctuations are a normal occurrence along the St. Lawrence River. On the average, the water levels are the lowest in late fall to mid-winter. They begin to rise in late February-early March and climb steadily, usually cresting sometime in June, after which a continuous decline takes place until the levels again stabilize for the three to four months beginning early November. During this cycle the variation, between the high and the low monthly mean, averages slightly more than 1/2 m. The mean water levels from one year to the next can also vary considerably but not so excessively as to create major flood threats. The water discharge (m^3/s) varies cyclically as do the water levels with a total mean flow through the area averaging 6000-7000 m^3/s with recorded extremes of over 9000 and below 4000 m^3/s (Survey and Mapping Branch 1958, 1973).

The mainland portion of the map area contains a few very small ponds but no lakes. Almost one half (slightly more than 20 km^2) of it is drained by numerous small creeks and man-made ditches which run more or less directly into the St. Lawrence. Usually they drain only their immediate vicinity and do not form sizeable watersheds. However, the remaining half of the area can be divided into five small watersheds (Map 7). The most extensive is that of LaRue Creek which drains a total of about 8.1 km^2; the second largest area drains easterly into Jones Creek and covers almost 5 km^2. In the western end, two small streams, Beaver Meadow Creek and Knights Creek, drain about 150 ha and 420 ha respectively; in addition approximately 380 ha drain into Landons Bay.

Much of the easternmost end drains via Mud and Polly creeks into Jones Creek which itself is outside the map area. However, both these creeks are very small, more like ditches, and completely overgrown with weeds; they have no boating or other water-oriented recreational potential whatsoever.

To the west is the LaRue Creek watershed which drains two separate sections within the study area. An area east of Highway 137 drains north across Highway 401 and joins LaRue Creek outside the map area. In this section the primary drainage is along tiny, ditch-size rivulets which warrant only a culvert at road crossings. Most are overgrown with grasses and sedges and impassable with any type of boat. The second area, between LaRue Mills and Highway 401, is covered by LaRue Creek itself. Below the old mill dam, this stream runs in a bouldery and rocky gorge and generally does not exceed 10 m in width. It is shallow and boating is not possible in the section between the dam and the Thousand Islands Parkway. Above the mill dam is an attractive, widening of the stream (mill pond); about 1/2 km long; the water is dark but not turbid and relatively algae free. It has a good rocky or wooded shoreline with only minor marshy sections. Beyond the mill pond the creek again narrows and passes through a rocky section, but further up becomes a weedy meandering stream extending to beyond Highway 401.

Beaver Meadow Creek drains only about 1 1/2 km within the map area. Near its outlet to the St. Lawrence it flows along a narrow, rocky and bouldery v-shaped gorge. Though fast flowing even in late summer it is completely impassable with any kind of boat; it is so narrow and bouldery that it can be walked across almost anywhere. Further up where the terrain levels, the flow channel becomes a meandering ditch heavy with aquatic vegetation, grasses and sedges. The water is dark with an oily film on the surface and, in mid- to late summer, algae are abundant. There are some signs of beaver activity in the area just south of Highway 401.

Near its outlet, Knights Creek is a very slow-moving, dark-watered stream with a high algae content. Water lilies and other aquatics are numerous and low-lying shorelines, dominated by cattails, sedges and grasses, are common but high, dry ground also sometimes extends to the water's edge. The creek is passable by canoe or rowboat within a kilometre or so from its outlet but soon thereafter narrows to an impassable ditch containing very little water, particularly in the latter part of summer.

At the Thousand Islands Parkway the shoreline of Landons Bay is generally rocky and sharply defined but this changes fairly soon and, by the time the bay narrows to about one half of its original width, most of the eastern shore consists of cattails and marshy terrain. Aquatics, particularly water lilies, are common throughout the bay and some, but not extensive, algae buildup occurs along the shores. Small outboards can navigate in the bay, but towards late summer weediness may pose some problems, while rowboats and canoes will have no difficulty proceeding right to the end of the bay. Most of the narrow part of the bay runs in a deep gorge bound on both sides by shear rock cliffs. At the end of the bay the incoming rivulet runs in a shallow, very bouldery creek bed, totally unnavigable, which eventually spills over a low rock ledge into the bay (Fig. 32). Further up, the creek channel becomes a series of marshy beaver ponds which are fed by a twisty and turbid rivulet having an open flow of only 2-3 m wide and the rest of the channel overgrown with grasses and sedges.

The moderate coarseness of a large portion of the soils and the predominantly rocky nature of the landscape through which the St. Lawrence River passes, combined with the presence of a vast settling basin upstream (Lake Ontario) has resulted in clean, clear waters for centuries. The level and flow-rate fluctuations create a flushing action sufficient to periodically clear out stagnated areas or even moderate concentrations of pollutants. Thus, as land clearing expanded and livestock increased, runoff, which carried with it more and more fine soil particles and dissolved animal waste, at first, had little noticeable effect on the water quality. However, towns and villages multiplied and many of these discharged untreated sewage directly into the river and, compounded with rapid industrial expansion and almost indiscriminate use of domestic solvents, the amount of foreign matter in the water began to increase rapidly. As pollutants took noticeable hold the cause was no longer entirely local; effects of the numerous industrialized centres all along the system began to be felt.

The nearness of the Thousand Islands to Lake Ontario creates a situation where the quality of the lake's water dictates the quality around the Thousand Islands; compared to the hugh flow rate in the St. Lawrence, relatively minute amounts of additional water enter it between the lake and the study area. The lake is not considered very polluted at its outlet to the St. Lawrence; its potability is questionable, but its suitability for recreational activities, such as swimming, is still acceptable. At the same time the largeness of the river, the complexity of its currents and variety of shoreline characteristics precludes one overall measure of water quality. Tests and studies are necessary for each location before a meaningful estimate of the water's suitability for a specific purpose can be obtained. Data collected for Lake Ontario may be adequate for sections in the mainstream of the river but, along the shore, in the

FIGURE 32. Rivulet entering Landons Bay spills over a rocky ledge making passage beyond the end of the bay impossible by any type of boat.

bays and inlets, the water tends to be less transient and, therefore, more susceptible to local sources of pollutants. The heavy weediness and apparently high algae populations, as previously noted for some of the creek outlets, are often an indication of excessive amounts of dissolvents in the water. With the increase in pollutants come increased bacterial populations causing a health hazard and possibly reduced oxygen content in the water and making it less suitable for fish and other aquatic life. Fortunately initial steps in various forms, from local improvements to international agreements, are being taken to stop and hopefully reverse the deteriorating trend. However, this is still in a very primeval state and, for a successful and lasting cleanup, much progress is yet to be made.

INTERPRETATION AND APPLICATION OF DATA

Basic land and vegetation data are an essential requirement for meaningful land use planning. It is also necessary that these data be interpreted in their correct perspective; it would be conjecture to plan in more detail than are represented by the data and, conversely, a waste of information if their full potential went unrealized. This task of interpretation is particularly demanding when the data are symbolized and presented according to a preset, standardized format. It is obvious that in such a case the symbol rarely describes the delineated area fully or exactly as it is; in most instances, to achieve the latter, long detailed descriptions would be necessary. Conversely the symbolization cannot be considered as an oversimplification which depicts only the most obvious attribute of the area.

The mapping in this survey, as in any biophysical study, emphasizes patterns of landscape and vegetation features. Rather than giving an absolute description of every detail within the delineated boundary, these patterns represent land and forest characteristics which typify the area. This information provides basic data for the formulation of general planning policies. In addition, by combining relevant segments of the data numerically and/or graphically, more specific problems can also be appraised according to their biological and physical requirements.

Within a given climatic area the biological productivity is very much influenced by the physical properties of the landscape. This is particularly true where disturbance is at a minimum, but in a heavily utilized area, such as along the St. Lawrence, artificial deterrents as well as stimulants frequently have an effect and sometimes override natural factors. Landscape features which are especially influential are soil moisture/-drainage, topography, soil texture and, in an area such as this where rock outcrops are commonplace, soil depth over bedrock. These have a significant effect, firstly, in determining the kind of vegetation which will occupy a location and, secondly, on the vigour and abundance of that vegetation.

These landscape characteristics are apparent on biophysical maps produced at the land type level and in this way the maps reflect the biological potential of the area.

When existing vegetation is mapped and superimposed on the land features, the rating of landscapes for biological capability is made yet more effective. In some instances and for certain characteristics this can be appraised almost directly from the mapped information. For example, the capacity of a particular landscape unit to support forest is frequently indicated directly by the forest cover type as mapped for that land unit. When the land unit is non-forested, contains immature forest, is in a heavily disturbed location or otherwise supports stands not developed to their fullest, an estimate of its full potential can be deduced by comparing it with similar land units supporting fully stocked, mature and healthy stands. Similarly areas most likely suited for various birds and other wildlife can be extracted by locating land-vegetation complexes which best fulfill the animal's needs for food, shelter and space. For this purpose biophysical maps give data by land types (shelter, space) and vegetation (food, shelter). Appraisals can thus be made for numerous other biological disciplines and, by grouping all landscape complexes which contain the appropriate criteria, an estimate of the total extent of the best, or if desired, the worst areas can be compiled and located.

Mapping of topographic and soil characteristics at the land type level gives an indication of the terrain's engineering properties. Soil compactability is related to grain size which, in mapping, is reflected by the texture classes; an indication of internal drainage and moisture-holding properties can be deduced by combining texture with the data on such items as moisture regime, gradient, soil depth over bedrock and origin of parent material. These same data are also useful in determining where to locate roads, probable problems which might be encountered during construction as well as the potential maintenance requirements. Topography, moisture, soil texture and depth are all useful categories to note in planning campgrounds, playing fields and many other intensive use applications. Similarly, initial appraisals of an area's suitability for numerous other construction-related projects can be obtained by analyzing the applicable land type information.

In a recreation-oriented environment like the Thousand Islands region, great importance must be placed on its intrinsic natural beauty. Much of the development within the region will centre around as well as rely on that theme; this applies whether the development is connected with public parks or private tourist facilities. It is therefore desirable that the aesthetics of the region are not ignored in planning but, instead, are exploited whenever possible. Vistas, picnic areas, hiking trails and numerous other leisure time uses can be planned to enhance and to take best advantage of the area's scenic value. Generally scenery showing diversity and contrasts will provide a much more attractive setting than a location lacking in variety. In this respect land type mapping brings out topographic features, slope gradients, water courses, and patterns of forest cover, non-forested vegetation and rock outcrops all of which are useful indicators of a location's aesthetic potential.

Combinations of criteria can be extracted from the mapped data and these used to locate the most likely areas for the intended use. For example, locations having the necessary engineering properties to support an intensive use facility such as a major campground can be scrutinized for their aesthetic value and thereby the potentially suitable areas located. In this way biophysical maps can be utilized to the fullest wherever the important requirements of a proposed undertaking can be determined and listed beforehand and the maps used to locate those areas which fulfill the requirements. When the mapped data are not detailed enough to provide a full answer, and they often are not, the mapping serves as a foundation for additional studies by directing attention to areas warranting more detailed work and thereby eliminating much extraneous searching.

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APPENDICES

APPENDIX A

MAPS AND OVERLAYS

Ten map sheets at the scale 1:10 000 and three map sheets at 1:5 000 showing:

- planimetry/micro-drainage
- forest cover/land type composite

Transparent overlays for the above maps, showing:

- land types
- forest types

Submitted under separate cover to Parks Canada, Ontario Region, Cornwall, Ontario.

APPENDIX B

UNITS OF MEASUREMENT AND CONVERSION FACTORS

1 inch	=	2.54 cm (centimetres)
1 foot	=	30.45 cm (centimetres)
1 square foot	=	0.093 m^2 (square metres)
1 acre	=	0.405 ha (hectares)
1 mile	=	1.609 km (kilometres)
1 square mile	=	2.59 km^2 (square kilometres)

1 cm	=	0.39 inches
1 m	=	3.28 feet
1 m^2	=	10.76 square feet
1 ha	=	2.47 acres
1 km	=	0.62 miles
1 km^2	=	0.386 square miles

APPENDIX C

LAND AND FOREST CLASSIFICATION SYSTEMS

LAND TYPE LEGEND

SAMPLE SYMBOL

Drainage Class 2 (well drained) describing ≥50% and Drainage Class 4 (imperfectly drained) describing ≥ 20% of the Land type.

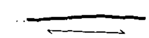
Rolling topography, describing 80% or more of the Land Type.

ʍʍʍ 2 – 4 vc $\frac{T\text{-}F}{R}$ (O)

Till and Glacio-Fluvial Materials averaging less than 1 metre in depth over bedrock with T (Till) comprising ≥ 50% of the Land Type; F – (Glacio-fluvial) < 50% of the Land Type; and with (O) – (Organic) comprising approximately 10% of the Land type or significantly dissecting it.

Predominantly very coarse textured surficial materials.

Land type line
Joins similar land types



LOCAL TOPOGRAPHY

SYMBOL	DESCRIPTION
	Knob, ridge or high hill
	Hill
	Knoll
	Elevated flat or plateau
	Elevated rolling plain or dissected hill
	Elevated plateau with eroded channel(s)
	Undulating, rolling
	High rolling
	Rough, highly dissected
	Trough or steep valley
	Depressional valley with steep sides
	Depression or valley
	Depressional valley with eroded channel(s)
	Depressed flat
	Depressed flat with eroded channel(s)
	Flat
	Flat with eroded channel(s)
	Cliff or bluff
	Scarp or terrace

SLOPES

Simple	Complex	Gradient in percent
		1-10
		11-30
		31-60
		61-100
		100+

DRAINAGE CLASSES

SYMBOL	DESCRIPTION
1	Rapidly drained
2	Well drained
3	Moderately-well drained
4	Imperfectly drained
5	Poorly drained
6	Very poorly drained

TEXTURE CLASSES

SYMBOL	DESCRIPTION
vc	Very coarse: gravel, coarse sand
c	Coarse: sand, loamy sand
mc	Moderately coarse: sandy loam, fine sandy loam
m	Medium: very fine sandy loam, loam, silt loam, silt
mf	Moderately fine: sandy clay loam, clay loam, silty clay loam
f	Fine: sandy clay, silty clay
vf	Very fine: 60% clay

Note: Symbol underlined (i.e. mc) refers to the presence of boulders.

ORIGIN OF SURFICIAL MATERIAL

SYMBOL	DESCRIPTION
T	Till
F	Glacio-fluvial
L	Glacio-lacustrine
W	Waterlaid
A	Aeolian
C	Colluvial
M	Marine
O	Organic
R	Bedrock
X	Unclassified

Note: T/R represents <3' till over bedrock.

Note: DRAINAGE

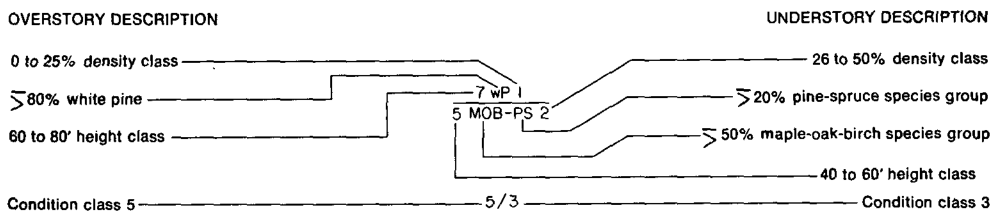
a) A single Drainage class describes 80% or more of the Land Type.
b) Two consecutive Drainage Classes (ie: 2-3) combined describe 80% or more of the Land Type with the first being dominant.
c) Two non-consecutive Drainage Classes (ie: 3-5) combined describe 70% or more of the Land Type with the first Drainage Class describing ≥ 50% and the second ≥ 20% of the Land Type.
d) <10% of a Land Type area may be any other Drainage Class.

Note: SURFICIAL MATERIAL

a) A single Material alone (or alone over bedrock or other Material) describes ≥ 80% of the Land Type.
b) Two Materials separated by a hyphen combined describe ≥ 80% of the Land Type with the first representing ≥ 50%.
c) A Material occurring in brackets at the end of the symbol represents approximately 10% of the Land Type and significantly dissects the Land Type.
d) When bedrock is ≥ 80% and a texture and material follow in brackets, the bracketed portion significantly influences the character of the Land Type, making up < 20%.

FOREST LEGEND

SAMPLE SYMBOL



( ) indicates species occurring sporadically within the stand
⚹ indicates species which occur primarely along the shoreline

Vegetation type line ....
Joins similar vegetation ....

FOREST SPECIES AND LAND USE SYMBOLS

SYMBOL	COMMON NAME
P	Pine
wP	Eastern white pine
pP	Pitch pine
rP	Red pine
sP	Scots pine
L	Larch
S	Spruce
He	Eastern hemlock
F	Balsam fir
Ce	Eastern white cedar
rCe	Eastern red cedar
UI	Upland herbs & grasses
U2	Upland shrubs
M I	Marshland sedges & herbs
M2	Marshland shrubs
M3	Sphagnum bog
M4	Floating vegetation
FL	Flooded land
R	Rock
Ur	Urban or recreational
Ag	Cropland
GP	Gravel pit
Q	Quarry
CL	Other cleared land

SYMBOL	COMMON NAME
W	Willow
Po	Poplar, Aspen
Bu	Butternut
H	Hickory
sH	Shagbark hickory
bH	Bitternut hickory
I	Ironwood
Bl	Blue – beech
B	Birch
yB	Yellow birch
wB	White birch
gB	Grey birch
Be	Beech
O	Oak
wO	White oak
rO	Red oak
E	Elm
Ch	Cherry
M	Maple
hM	Hard maple
rM	Soft maple
Bd	Basswood
A	Ash

CONDITION CLASSES

SYMBOL	CLASS DESCRIPTION
1	Regeneration following a disturbance, <10 years, height class 1
2	Young, normal growth, 11 to 30 years, height class 1 or 3
3	Young to mature, normal growth, 31 to 60 years, height class 3 or 5
4	Mature, good growth, healthy, 61 to 80 years, height class 5 or 7
5	Mature, good growth, healthy, 81+ years, height class 5 to 11

SYMBOL	CLASS DESCRIPTION
1A	No regeneration following a disturbance
2A	Young, retarded growth due to poor site and/or over-stocking, height class 1 or 3
3A	Young to mature, retarded growth due to poor site and/or overstocking, height class 3 or 5
4A	Forest cover affected by exposure, shallow soils, exposed bedrock, and/or other site factors. Height class 5 to 7
5A	Overmature, showing signs of decadence, height class 5 to 11

HEIGHT CLASSES

SYMBOL	HEIGHT feet	HEIGHT metres
1	< 20	< 6
3	21-40	6-12
5	41-60	12-18
7	61-80	18-24
9	81-100	24-30
11	101+	30+

DENSITY CLASSES

SYMBOL	PERCENTAGE CROWN CLOSURE
1	< 25
2	25-50
3	51-75
4	> 75

APPENDIX D

AREA COMPILATION SHEETS FOR PARK PROPERTIES

- Area compilation sheets for St. Lawrence Islands National Park showing areas, in hectares, of individual map units with U.T.M. designations which locate the southwesterly corner of each map unit.*
- Forested vs. non-forested land area summary sheet for major park holdings.

St. Lawrence Islands National Park
Area Summaries for Major Park Entities

Island Name	N.T.S. Map Number	Area in hectares Forested	Non-forested	Total
Cedar	Part of 31C/1e	5.4	3.5	8.9
Milton	Part of 31C/1e	2.6	0.6	3.2
Aubrey	31C/8 II	5.3	1.0	6.3
Mermaid	31C/8 II	0.9	0.8	1.7
Beaurivage	31C/8 IX	2.5	2.6	5.1
Lindsay	31C/8 IX	3.8	0.4	4.2
McDonald	31C/8 IX	10.1	5.3	15.4
Leek	31C/8 II	37.5	4.5	42.0
Hay	31C/8 IX	3.6	20.2	23.8
Camelot	31C/8 II and IX	8.3	2.0	10.3
Endymion	31C/8 IX and X	5.3	1.1	6.4
Gordon	31C/8 IX	7.1	0.8	7.9
Mulcaster	31C/8 X	5.8	0.6	6.4
Hill	31B/5 VI and XV	106.3	56.2	162.5
Georgina	31B/5 XV	9.5	0.6	10.1
Constance	31B/5 XV	3.2	0.3	3.5
Grenadier West	31B/5 XV	3.9	0.9	4.8
Grenadier Centre	31B/5 XVII	33.3	41.1	74.4
Grenadier East	31B/5 XVII	18.7	14.4	33.1
Grenadier (total)	31B/5 XV and XVII	55.9	56.4	112.3
Squaw	31B/5 XVII	1.3	9.5	10.8
Adelaide	31B/5 XVII	1.9	0.8	2.7
Stovin	Part of 31B/12b	2.6	1.2	3.8
Mallorytown Landing	31B/5 XXIV	23.4	14.6	38.0

*Submitted under separate cover to Parks Canada, Ontario Region.

APPENDIX E

AREA SUMMARIES FOR SOIL UNITS

St. Lawrence National Park and Surroundings
Areas of Major Soil Units

Soil units	Hectares	%
Bare rock	324	5.3
Very shallow soil (R)	1850	30.1
Shallow soils (/R)	1516	24.6
Total soil cover < 1 m	3690	60.0
Predominantly till (T)	104	1.7
Predominantly glaciolacustrine (L)	1250	20.3
Predominantly glaciofluvial (F)	314	5.1
Predominantly alluvial (W)	423	6.9
Predominantly organic (O)	234	3.8
Total soil cover > 1 m	2325	37.8
Unclassified (X)	135	2.2
Total land area	6150	100.0

Areas, in Hectares, of Major Soil Units
by Predominant Moisture Conditions

Soil type		Moisture regime 1	2	3	4	5	6	Total	%
Bare rock and very shallow over bedrock	(R)	1085	1083	5	-	1	-	2174	34
Shallow over rock	(/R)	60	1071	357	28	-	-	1516	26
Glaciolacustrine	(L)	-	20	847	216	167	-	1250	20
Glaciofluvial	(F)	49	183	51	31	-	-	314	5
Till	(T)	-	4	51	25	24	-	104	2
Alluvial	(W)	-	13	157	197	56	-	423	7
Organic	(O)	-	-	-	-	31	203	234	4
Unclassified	(X)	135	-	-	-	-	-	135	2
Total		1329	2374	1468	497	279	203	6150	100
%		22	39	24	8	4	3	100	

Area by Soil Drainage Classes

Drainage class		Area (ha)	%
	1	1134	
	1-2	195	
Rapidly drained		1329	22
	1-3	1193	
	2	231	
	2-1	84	
	2-3	135	
	3-1	731	
Well drained		2374	38
	2-4	91	
	3	772	
	3-2	204	
	3-4	380	
	4-2	21	
Moderately drained		1468	24
	3-5	272	
	4	86	
	4-3	59	
	4-5	80	
Imperfectly drained		497	8
	4-6	241	
	5	16	
	5-6	22	
Poorly drained		279	5
	6	202	
	6-5	1	
Wet		203	3
Total		6150	100

APPENDIX F

AREA SUMMARIES FOR FOREST COVER TYPES

St. Lawrence Islands National Park and Surrounding Areas
Forest Areas, in Hectares, by Soil Units

Forest cover type	Shallow soils	Predominantly deep (> 1 m) soils					Totals
		Till	Lacustrine	Fluvial	Alluvial	Organic	
wP	24	2	28	-	-	-	54
wPHe	31	-	2	-	-	-	33
wP-OM	857	15	37	10	7	4	930
wPHe-MO	739	13	31	6	-	1	790
O	106	1	-	9	4	-	120
MO	262	-	23	22	18	-	325
MOHA	721	17	41	13	18	1	811
PoB	51	4	45	24	83	1	208
ArM	21	1	16	7	19	4	68
Others	63	14	10	2	8	4	101
Totals	2875	67	233	93	157	15	3440
%	83.6	1.9	6.8	2.7	4.6	0.4	100.0

Species abbreviations from Appendix C

St. Lawrence Islands National Park and Surrounding Areas
Forest Areas, in Hectares, by Moisture Regimes

Forest cover type	Dry	Well drained	Moderately drained	Imperfectly drained	Poorly drained	Wet	Totals
wP	7	8	16	19	4	-	54
%	13.0	14.8	29.6	35.2	7.4	-	100.0
wPHe	11	16	6	-	-	-	33
%	33.3	48.5	18.2	-	-	-	100.0
wP-OM	264	548	77	20	21	-	930
%	28.4	58.9	8.3	2.2	2.2	-	100.0
wPHe-MO	194	525	58	6	6	1	790
%	24.6	66.4	7.3	0.8	0.8	0.1	100.0
O	38	64	17	1	-	-	120
%	31.6	53.3	14.1	1.0	-	-	100.0
MO	101	151	65	7	1	-	325
%	31.1	46.5	20.0	2.1	0.3	-	100.0
MOHA	172	494	111	17	16	1	811
%	21.2	60.9	13.7	2.1	2.0	0.1	100.0
PoB	15	35	45	97	15	1	208
%	7.2	16.8	21.6	46.7	7.2	0.5	100.0
ArM	3	21	8	22	12	2	68
%	4.4	30.9	11.8	32.4	17.6	2.9	100.0
Others	36	24	18	6	17	-	101
%	35.7	23.8	17.8	5.9	16.8	-	100.0
Totals	841	1886	421	195	92	5	3440
%	24.5	54.8	12.2	5.7	2.7	0.1	100.0

Species abbreviations from Appendix C

St. Lawrence Islands National Park and Surrounding Areas
Forest Areas, in Hectares, by Soil Units and Drainage Classes

	Shallow soils				Predominantly deep (> 1 m) soils: Till				Lacustrine				Fluvial				Alluvial				Organic		Totals
Drainage	**1**	**2**	**3**	**4**	**2**	**3**	**4**	**5**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**2**	**3**	**4**	**5**	**5**	**6**	
Forest cover type																							
wP	7	8	8	1	-	-	2	-	-	8	16	4	-	-	-	-	-	-	-	-	-	-	54
wPHe	11	16	4	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	33
wP-OM	264	537	50	6	-	6	2	7	1	18	8	10	-	9	-	1	1	3	3	-	4	-	930
wPHe-MO	192	517	30	-	-	11	2	-	6	15	4	6	2	2	2	-	-	-	-	-	-	1	790
O	37	61	8	-	-	1	-	-	-	-	-	-	1	3	5	-	-	3	1	-	-	-	120
MO	98	136	28	-	-	-	-	-	-	18	5	-	3	13	6	-	2	13	2	1	-	-	325
MOHA	171	485	64	1	2	10	3	2	1	24	2	14	1	6	4	2	-	9	9	-	-	1	811
PoB	12	34	4	1	-	2	2	-	-	21	18	6	3	1	6	14	-	12	62	9	-	1	208
ArM	3	14	1	3	-	-	1	-	-	2	4	10	-	6	-	1	1	5	13	-	2	2	68
Others	36	21	6	-	-	-	1	13	-	7	3	-	-	2	-	-	1	5	2	-	4	-	101
Totals	831	1829	203	12	2	30	13	22	8	115	60	50	10	42	23	18	5	50	92	10	10	5	3440
%	24.2	53.2	5.9	.3	.1	.9	.4	.6	.2	3.3	1.7	1.5	.3	1.2	.7	.5	.1	1.5	2.7	.3	.3	.1	100.0

Drainage codes and species abbreviations from Appendix C

APPENDIX G

PLANT COMMUNITY DENDROGRAM AND ASSOCIATION TABLE

G-1. A hierarchical classification of sub-associations presented in the form of a dendrogram demonstrating relationships resulting from cluster analysis of 109 ground vegetation samples on various islands and the mainland in St. Lawrence Islands National Park. Relationships are measured on the vertical scale in percent dissimilarity. The numbers along the bottom represent original field sample numbers (Appendix I).

G-2. Association table showing floristic composition of plant communities.

APPENDIX H

A CHECKLIST OF PLANTS FOUND IN ST. LAWRENCE ISLANDS NATIONAL PARK AND SURROUNDING AREAS

VASCULAR PLANTS[1]

LYCOPODIACEAE	
Lycopodium lucidulum Michx.	shining clubmoss
EQUISETACEAE	
**Equisetum hyemale* L.	scouring rush
Equisetum pratense Ehrh.	meadow horsetail
Equisetum sylvaticum L.	woodland horsetail
OPHIOGLOSSACEAE	
Botrychium virginianum (L.) Sw.	rattlesnake fern
OSMUNDACEAE	
Osmunda claytoniana L.	interrupted fern
Osmunda regalis L.	royal fern
POLYPODIACEAE	
Athyrium filix-femina (L.) Roth.	lady fern
**Dryopteris austriaca* var. *spinulosa* (Muell.) Fiori	spinulose woodfern
Dryopteris cristata (L.) Gray	crested woodfern
**Dryopteris marginalis* (L.) Gray	marginal shield fern
**Onoclea sensibilis* L.	sensitive fern
Polypodium vulgare L.	polypody
**Pteridium aquilinum* (L.) Kuhn.	bracken
Thelypteris palustris Schott.	marsh fern
TAXACEAE	
Taxus canadensis Marsh.	ground hemlock
PINACEAE	
Picea glauca (Moench.) Voss	white spruce
Picea rubens Sarg.	red spruce
Pinus resinosa Ait.	red pine
Pinus rigida Mill.	pitch pine
**Pinus strobus* L.	white pine
Pinus sylvestris L.	scotch pine
**Tsuga canadensis* (L.) Carr.	hemlock

[1] Vascular plant names are according to Gleason and Cronquist's "Manual of vascular plants", while the names of the mosses are in accordance with Crum, Steere and Anderson (1973), and lichens with Hale and Culberson (1970).

*Plants which appear on the Association Table.

CUPRESSACEAE	
**Juniperus communis* L.	ground juniper
Juniperus virginiana L.	red cedar
**Thuja occidentalis* L.	eastern white cedar
TYPHACEAE	
**Typha latifolia* L.	cattail
SPARGANIACEAE	
Sparganium americanum Nutt.	bur reed
Sparganium chlorocarpum Rydb.	bur reed
Sparganium eurycarpum Engelm.	bur reed
ALISMATACEAE	
**Alisma plantago-aquatica* L.	water plantain
Alisma subcordatum Raf.	subcordate water-plantain
Sagittaria graminea Michx.	grass-leaved arrow-head
**Sagittaria latifolia* Willd.	broad-leaved arrow-head
BUTOMACEAE	
Butomus umbellatus L.	flowering rush
HYDROCHARITACEAE	
Hydrocharis morsus-ranae L.	european frog's bit
GRAMINEAE	
**Agropyron repens* (L.) Beauv.	quack grass
Agropyron trachycaulum var. *glaucum* (Pease & Moore) Malte.	wheat grass
Agrostis hyemalis (Walt.) BSP.	tickle grass
Agrostis hyemalis var. *tenuis* (Tuckerm.) Gl.	tickle grass
Agrostis stolonifera L.	creeping bent-grass
**Agrostis tenuis* Sibth.	Rhode Island bent-grass
Andropogon gerardi Vitm.	beard grass
**Calamagrostis canadensis* (Michx.) Beauv.	bluejoint
Calamagrostis inexpansa Gray	contracted reed grass
Danthonia compressa Aust.	compressed wild oat grass
**Danthonia spicata* (L.) Beauv.	wild oat grass
**Deschampsia flexuosa* (L.) Trin.	hair grass
Festuca ovina L.	sheep fescue
Glyceria canadensis (Michx.) Trin.	rattlesnake grass
Glyceria grandis S. Wats.	manna grass
Glyceria striata (Lam.) Hitchc.	manna grass
Hystrix patula Moench.	bottle-brush grass
Leersia oryzoides (L.) Sw.	cut-grass
Oryzopsis asperifolia Michx.	rice grass
Panicum spp.	panic grass
Panicum philadelphicum Bernh.	panic grass
**Phalaris arundinacea* L.	canary reed grass
**Phleum pratense* L.	timothy
**Poa compressa* L.	Canada bluegrass
Poa interior Rydb.	bluegrass
**Poa pratensis* L.	Kentucky bluegrass
Poa trivialis L.	rough meadow grass
CYPERACEAE	
**Carex* spp.	sedge
Carex annectens (Bickn.) Bickn.	
Carex comosa Boott.	

Carex crinita Lam.	
Carex cristatella Britt.	
Carex deweyana Schw.	
Carex gracillima Schw.	
Carex laxiflora Lam.	
Carex lurida Wahl.	
Carex pensylvanica Lam.	
Carex projecta Mackenzie	
Carex pseudo-cyperus L.	
Carex retroflexa var. *retroflexa* Muhl.	
Carex scoparia Schk.	
Carex tribuloides Wahl.	
Carex tuckermani Boott.	
Cyperus filiculmis Vahl.	galingale
Cyperus strigosus L.	galingale
Eleocharis acicularis (L.) R. & S.	spike rush
Eleocharis obtusa (Willd.) Schutt.	spike rush
Scirpus acutus Muhl.	hardstem bulrush
Scirpus atrovirens Willd.	bulrush
Scirpus cyperinus (L.) Kunth.	wool grass

ARACEAE

Acorus calamus L.	sweet flag
**Arisaema triphyllum* (L.) Schott.	jack-in-the-pulpit

LEMNACEAE

Lemna minor L.	duckweed
Lemna trisulca L.	duckweed

PONTEDERIACEAE

Pontederia cordata L.	pickerel-weed

JUNCACEAE

Juncus spp.	rush
Juncus effusus L.	rush
**Juncus tenuis* Willd.	path rush

LILIACEAE

**Maianthemum canadense* Desf.	wild lily of the valley
**Polygonatum pubescens* (Willd.) Pursh.	solomon's seal
**Smilax herbacea* L.	carrion flower
Smilacina racemosa (L.) Desf.	false solomon's seal
Smilacina stellata (L.) Desf.	false solomon's seal
**Streptopus roseus* Michx.	twisted-stalk
**Trillium* spp.	trillium

IRIDACEAE

Iris versicolor L.	blue flag

SALICACEAE

Populus balsamifera L.	balsam poplar
Populus grandidentata Michx.	large-tooth aspen
**Populus tremuloides* Michx.	trembling aspen
Salix spp.	willow
Salix discolor Muhl.	pussy willow
Salix fragilis L.	cracked willow

JUGLANDACEAE	
Carya cordiformis (Wang.) K. Koch.	bitternut
**Carya ovata* (Mill.) K. Koch.	shagbark hickory
Juglans cinerea L.	butternut
BETULACEAE	
**Alnus rugosa* (Du Roi) Spreng.	speckled alder
Betula lutea Michx.	yellow birch
**Betula papyrifera* Marsh.	white birch
**Betula populifolia* Marsh.	gray birch
**Carpinus caroliniana* Walt.	blue beech
Corylus cornuta Marsh.	hazel
**Ostrya virginiana* (Mill.) K. Koch.	ironwood
FAGACEAE	
**Fagus grandifolia* Ehrh.	beech
**Quercus alba* L.	white oak
**Quercus borealis* L.	red oak
Quercus macrocarpa Michx.	bur oak
ULMACEAE	
Ulmus americana L.	American elm
URTICACEAE	
Laportea canadensis (L.) Wedd.	wood-nettle
**Urtica dioica* L.	stinging nettle
POLYGONACEAE	
Polygonum spp.	
Polygonum coccineum Muhl.	water smartweed
**Polygonum convolvulus* L.	black bindweed
Polygonum natans Eat.	water smartweed
Polygonum punctatum Ell.	smartweed
Polygonum scandens L.	false buckwheat
Rumex acetosella L.	sheep sorrel
Rumex crispus L.	sour dock
CARYOPHYLLACEAE	
Cerastium vulgatum L.	mouse-ear chickweed
Saponaria officinalis L.	bouncing-Bet
Stellaria graminea L.	common stickwort
NYMPHAEACEAE	
Nuphar variegatum Engelm.	bull-head lily
Nymphaea odorata Ait.	water lily
RANUNCULACEAE	
**Actaea alba* (L.) Mill.	white baneberry
Actaea rubra (Ait.) Willd.	red baneberry
Anemone canadensis L.	Canada anemone
Coptis trifolia (L.) Salisb.	goldthread
Hepatica acutiloba DC.	hepatica
**Ranunculus acris* L.	buttercup
Thalictrum dioicum L.	meadow rue
Thalictrum polygamum Muhl.	tall meadow rue

BERBERIDACEAE

Caulophyllum thalictroides (L.) Michx.	blue cohosh
**Podophyllum peltatum* L.	mayapple

PAPAVERACEAE

Sanguinaria canadensis L.	bloodroot

CRUCIFERAE

Berteroa incana (L.) DC.	hoary alyssum
Cardamine pensylvanica Muhl.	bitter cress
Lepidium virginicum L.	pepper grass
Sisymbrium officinale var. *officinale* (L.) Scop.	hedge mustard

CRASSULACEAE

Penthorum sedoides L.	ditch stone crop
Sedum sarmentosum Bunge	stone crop
Sedum telephium L.	live-forever

SAXIFRAGACEAE

**Ribes* spp.	currant
Ribes cynosbati L.	dogberry
Saxifraga virginiensis Michx.	early saxifrage

ROSACEAE

Agrimonia gryposepala Wallr.	agrimony
**Amelanchier arborea* (Michx. f.) Fern.	serviceberry
Amelanchier laevis Wieg.	serviceberry
Aronia melanocarpa (Michx.) Ell.	black chokecherry
Crataegus spp.	hawthorn
**Fragaria virginiana* Duchesne	wild strawberry
**Geum canadense* Jacq.	white avens
Potentilla anserina L.	silverweed
Potentilla norvegica L.	rough cinquefoil
Potentilla recta L.	rough-fruited cinquefoil
Potentilla simplex Michx.	cinquefoil
Prunus pensylvanica L. f.	pin cherry
**Prunus serotina* Ehrh.	black cherry
**Prunus virginiana* L.	chokecherry
**Pyrus malus* L.	apple
**Rosa* spp.	wild rose
**Rubus* spp.	raspberry
Rubus allegheniensis Porter	common blackberry
**Rubus odoratus* L.	flowering raspberry
Rubus strigosus Michx.	red raspberry
Spiraea alba Du Roi	meadow-sweet
**Spiraea latifolia* (Ait.) Borkh.	meadow-sweet
Spiraea tomentosa L.	hardhack

FABACEAE

**Amphicarpa bracteata* (L.) Fern.	hog-peanut
Desmodium canadense (L.) DC.	show tick-trefoil
Desmodium glutinosum (Muhl.) Wood	pointed-leaved tick-trefoil
Trifolium pratense L.	red clover
Trifolium procumbens L.	hop clover
Trifolium repens L.	white clover
**Vicia cracca* L.	cow vetch

OXALIDACEAE

**Oxalis stricta* L.	hellow wood-sorrel

GERANIACEAE	
**Geranium robertianum* L.	herb Robert
ANACARDIACEAE	
Rhus aromatica Ait.	fragrant sumac
**Rhus radicans* L.	poison ivy
**Rhus typhina* L.	staghorn sumac
AQUIFOLIACEAE	
**Ilex verticillata* (L.) Gray	common winterberry
Ilex verticillata var. *verticillata* (L.) Gray	common winterberry
CELASTRACEAE	
**Celastrus scandens* L.	bittersweet
ACERACEAE	
Acer negundo L.	Manitoba maple
Acer pensylvanicum L.	striped maple
**Acer rubrum* L.	red maple
Acer saccharinum L.	silver maple
**Acer saccharum* Marsh.	sugar maple
BALSAMINACEAE	
**Impatiens biflora* Walt.	touch-me-not
RHAMNACEAE	
Rhamnus catharticus L.	buckthorn
VITACEAE	
**Parthenocissus quinquefolia* (L.) Planch.	virginia creeper
**Vitis riparia* Michx.	riverbank grape
TILIACEAE	
**Tilia americana* L.	basswood
HYPERICACEAE	
Hypericum boreale (Britt.) Bickn.	northern St. John's-wort
**Hypericum perforatum* L.	perforated St. John's-wort
Hypericum punctatum Lam.	spotted St. John's-wort
VIOLACEAE	
**Viola* spp.	violet
LYTHRACEAE	
**Lythrum salicaria* L.	purple loosestrife
ONAGRACEAE	
**Circaea quadrisulcata* (Maxim) Franch & Sav.	enchanter's nightshade
Epilobium glandulosum Lehm.	willow herb
Epilobium hirsutum L.	willow herb
Oenothera biennis L.	evening primrose
Oenothera pilosella Raf.	sundrops
ARALIACEAE	
Aralia hispida Vent.	bristly sarsparilla
**Aralia racemosa* L.	spikenard

UMBELLIFERAE	
Angelica atropurpurea L.	angelica
Cryptotaenia canadensis (L.) DC.	honewort
Heracleum lanatum Michx.	cow-parsnip
Osmorhiza claytoni (Michx.) Clarke	sweet cicely
Osmorhiza longistylis (Torr.) DC.	long styled sweet cicely
Sanicula gregaria Bickn.	black snakeroot
Sium suave Walt.	water parsnip
CORNACEAE	
Cornus alternifolia L.f.	alternate-leaved dogwood
**Cornus racemosa* Lam.	red-panicle dogwood
Cornus rugosa Lam.	roundleaf dogwood
Cornus stolonifera Michx.	red osier dogwood
ERICACEAE	
Gaultheria hispidula (L.) Muhl.	creeping snowberry
**Gaultheria procumbens* L.	wintergreen
Gaylussacia baccata (Wang) K. Koch.	black huckleberry
Gaylussacia frondosa (L.) T. & G.	dangleberry
Monotropa uniflora L.	Indian pipe
**Pyrola elliptica* Nutt.	shinleaf
**Vaccinium angustifolium* Ait.	blueberry
Vaccinium stamineum L.	deerberry
PRIMULACEAE	
**Lysimachia ciliata* L.	fringed loosestrife
Lysimachia terrestris (L.) BSP.	yellow loosestrife
Trientalis borealis Raf.	starflower
OLEACEAE	
**Fraxinus americana* L.	white ash
**Fraxinus nigra* Marsh.	black ash
Syringa vulgaris L.	lilac
APOCYNACEAE	
Apocynum androsaemifolium L.	dogbane
Apocynum sibiricum Jacq.	Indian hemp
ASCLEPIADACEAE	
Asclepias incarnata L.	swamp milkweed
**Asclepias syriaca* L.	common milkweed
CONVOLVULACEAE	
**Convolvulus arvensis* L.	bindweed
**Convolvulus sepium* L.	hedge bindweed
Cuscuta gronovii Willd.	dodder
BORAGINACEAE	
Myosotis scorpioides L.	forget-me-not
VERBENACEAE	
Verbena hastata L.	blue vervain
LABIATAE	
Lamium aplexicaule L.	hen bit
Lycopus americanus Muhl.	bugleweed

**Lycopus uniflorus* Michx.	bugleweed
Mentha arvensis L.	wild mint
Mentha piperita L.	peppermint
Monarda fistulosa L.	wild bergamot
Nepeta cataria L.	catnip
Prunella vulgaris L.	self-heal
Pycnanthemum virginianum (L.) Durand & Jackson	mountain mint
Satureja vulgaris (L.) Fritsch.	wild basil
**Scutellaria galericulata* L.	skullcap
Scutellaria lateriflora L.	mad-dog skullcap
**Stachys hispida* Pursh.	rough hedge nettle
Teucrium canadense L.	germander

SOLANACEAE

Physalis heterophylla Nees.	gound cherry
Solanum dulcamara L.	bittersweet

SCROPHULARIACEAE

Linaria vulgaris Hill.	butter and eggs
Melampyrum lineare Desr.	cow-wheat
Mimulus ringens L.	monkey flower
Scrophularia lanceolata Pursh.	figwort
Verbascum thapsus L.	mullein

OROBANCHACEAE

Epifagus virginiana (L.) Bart.	beech-drops

PHRYMACEAE

Phryma leptostachya L.	lopseed

PLANTAGINACEAE

Plantago major L.	common plantain

RUBIACEAE

Cephalanthus occidentalis L.	buttonbush
**Galium asprellum* Michx.	rough bedstraw
**Galium circaezans* Michx.	white wild licorice (bedstraw)
**Galium triflorum* Michx.	fragrant bedstraw
Mitchella repens L.	partridge berry

CAPRIFOLIACEAE

Diervilla lonicera Mill.	bush honeysuckle
Lonicera canadensis Marsh.	Canada honeysuckle
Lonicera dioica L.	mountain honeysuckle
Lonicera tatarica L.	tartarian honeysuckle
**Sambucus canadensis* L.	black elderberry
**Sambucus pubens* Michx.	red elderberry
**Viburnum acerifolium* L.	maple leaf viburnum
**Viburnum lentago* L.	nannyberry
**Viburnum rafinesquianum* Schult.	shortstalk arrowwood

CAMPANULACEAE

Campanula aparinoides Pursh.	marsh bellflower
Triodanis perfoliata (L.) Nieuwl. (*Specularia perfoliata* (L.) A.D.C.)	venus' looking glass

COMPOSITAE

**Achillea millefolium* L.	yarrow

Ambrosia artemisiifolia L.	ragweed
Anaphalis margaritacea (L.) Benth. & Hook	pearly everlasting
Antennaria neglecta Greene	everlasting
Arctium minus Schk.	burdock
Artemisia vulgaris L.	mugwort
**Aster* spp.	aster
**Aster cordifolius* L.	heart-leaved aster
Aster ericoides L.	dense-flowered aster
Aster macrophyllus L.	large-leaved aster
**Aster novae-angliae* L.	New England aster
Aster simplex Willd.	panicled aster
Carduus nutans L.	nodding thistle
Chrysanthemum leucanthemum L.	ox-eyed daisy
**Cirsium arvense* (L.) Scop.	Canada thistle
Cirsium vulgare (Savi) Tenore	bull thistle
Conyza canadensis (L.) Cronq.	horseweed
Conyza canadensis var. *canadensis* (L.) Cronq.)	horseweed
Erechtites hieracifolia (L.) Raf.	fireweed
Erigeron annuus (L.) Pers.	daisy fleabane
Erigeron philadelphicus L.	common fleabane
Erigeron strigosus var. *strigosus* Muhl.	daisy fleabane
Eupatorium maculatum L.	joe-pye-weed
Eupatorium rugosum Houtt.	white snakeroot
Galinsoga ciliata (Raf.) Blake.	galinsoga
Helianthus divaricatus L.	woodland sunflower
Helianthus giganteus L.	sunflower
Hieracium pratense Tausch.	yellow hawkweed
Hieracium scabrum Michx.	hairy hawkweed
Inula helenium L.	elecampane
**Lactuca biennis* (Moench) Fern.	wild lettuce
Lactuca serriola L.	prickly lettuce
**Prenanthes altissima* L.	white lettuce
**Solidago* spp.	goldenrod
Solidago arguta Ait.	sharp-leaved goldenrod
Solidago bicolor L.	silverrod
Solidago caesia L.	blue-stemmed goldenrod
**Solidago canadensis* L.	Canada goldenrod
Solidago juncea Ait.	early goldenrod
Solidago rugosa var. *sphagnophila* Graves	rough-stemmed goldenrod
Sonchus asper (L.) Hill.	spiny-leaved sow thistle
Tragopogon pratensis L.	goat's beard
Taraxacum officinale Weber.	dandelion

NON-VASCULAR PLANTS

Mosses

SPHAGNACEAE

Sphagnum russowii Warnst.

DICRANACEAE

Dicranum scoparium Hedw.

LEUCOBRYACEAE

Leucobryum glaucum (Hedw.) Ångstr. ex Fr.

MINACEAE

Mnium ciliare (C. müll.) Schimp. [*Plagiomnium ciliare* (C. müll.) Kop.]
Mnium cuspidatum Hedw. [*Plagiomnium cuspidatum* (Hedw.) Kop.]

AULACOMNIACEAE

Aulacomnium palustre (Hedw.) Schwaegr.

AMBLYSTEGIACEAE

Leptodictyum riparium (Hedw.) Warnst.

BRACHYTHECIACEAE

Brachythecium spp.
Brachythecium rutabulum (Hedw.) B.S.G.

ENTODONTACEAE

Pleurozium schreberi (Brid.) Mitt.

HYPNACEAE

Callicladium haldanianum (Grev.) Crum
Hypnum imponens Hedw.

POLYTRICHACEAE

Polytrichum commune Hedw.
Polytrichum commune var. *perigoniale* (Michx.) Hampe
Polytrichum juniperinum Hedw.

Lichen

CLADONIACEAE

Parmelia caperata (L.) Ach.


St. Lawrence Islands National Park
and environs
MAP I
Le Parc National des Iles du St-Laurent
et les environs
Miles 0 1 2 Miles
Metres 1000 0 1000 2000 Metres
Topography
Contour lines in metres above sea level
Approximate elevation above St. Lawrence River
Less than 1m
1 to 15m
15 to 30m
30 to 45m
45 to 60m
Over 60m
National Park
MACDONALD-CARTIER FREEWAY
401
2
25
32
81
GANANOQUE
HOWE ISLAND
Beaurivage I.
Lindsay I.
McDonald I.
Aubrey I.
Mermaid I.
BOSTWICK ISLAND
Hay Island
Thousand
Islands
ST LAWRENCE RIVER
Thwartway Island
Seven Pines I.
Camelot I.
Endymion I.
Gordon I.
STAVE ISLAND
75 m ±
Halstead's Bay
Landon's Bay
Mulcaster I.
Ivy I.
ASH ISLAND
Constance
Georgina I.
CLUB ISLAND
Rockport
TAR ISLAND
GRENADIER
Squaw Island
Adelaide I.
ST LAWRENCE RIVER
Mallorytown Landing
BRIDGE ISLAND
Historical Site
CANADA
U.S.A.
76°10'
410000m.E.
76°00'
420000m E.
44°20'
4910000m.N.
430000m E
75°50'
440000m

St. Lawrence Islands National Park
and environs
MAP 2
Le Parc National des Iles du St-Laurent
et les environs
Miles 0 1 2 Milles
Metres 1000 0 1000 2000 Metres
Bedrock geology
(After Wynne-Edwards)
Red granite
White quartzite
Migmatite
Syenite and related rocks
White pegmatite
Sandstone
Diabase and andesite dykes
National Park
MACDONALD-CARTIER FREEWAY
GANANOQUE
HOWE ISLAND
McDonald I.
Lindsay I.
Aubrey I.
Mermaid I.
BOSTWICK ISLAND
Hay Island
Thousand
ST LAWRENCE RIVER
Islands
Leek Island
Seven Pines
Camelot I.
Endymion I.
CANADA
U.S.A.
Halsteads Bay
Gordon I.
STAVE ISLAND
Mulcaster I.
Ivy Lea
ASH ISLAND
Georgina I.
Constance
HILL ISLAND
CLUB ISLAND
Rockport
TAR ISLAND
Squaw Island
GRENADIER ISLAND
Adelaide I.
ST LAWRENCE RIVER
Mallorytown Landing
Chimney Island
Historical Site
Jones Ck.
76°10'
44°25'
4920000m.N.
76°00'
44°30'
75°50'
4910000m.N.
44°20'
410000m.E.
420000m.E.
430000m.E.
440000m.E.
4920000m.N.
44°25'


St. Lawrence Islands National Park
and environs
MAP 5
Le Parc National des Iles du St-Laurent
et les environs
Miles 0 1 2 Miles
Metres 1000 0 1000 2000 Metres
Vegetation and land use 1976
Forested
Softwood
Mixedwood
Hardwood
Non-Forested
Bare rock
Upland shrubs and herbs
Marsh
Cultivated
Urban, recreational, cleared
National Park
MACDONALD-CARTIER FREEWAY
GANANOQUE
HOWE ISLAND
Thousand
Islands
ST LAWRENCE RIVER
ST LAWRENCE RIVER
STAVE ISLAND
Halsteads Bay
BOSTWICK ISLAND
Hay Island
Leek Island
Seven Pines
Camelot I
Endymion I.
Gordon I
McDonald I
Lindsay I
Aubrey I
Mermaid I
Mulcaster I
ASH ISLAND
Georgina I
Constance
Ivy
Rockport
CLUB ISLAND
TAR ISLAND
Squaw Island
Adelaide I.
Mallorytown Landing
Chimney Island
Historical Site
Jones Ck
CANADA
U.S.A.
4920000 m.N.
4910000 m.N.
410000 m E
420000 m.E.
430000 m E
440000 m.E.
Prepared by Forest Management Institute

Source: Canadian Nautical Charts 1418, 1419, 1420.


St. Lawrence Islands National Park and environs
MAP 7
Le Parc National des Iles du St-Laurent et les environs
Major watersheds
National Park
MACDONALD-CARTIER FREEWAY
GANANOQUE
Thousand Islands
ST LAWRENCE RIVER
HOWE ISLAND
BOSTWICK ISLAND
Hay Island
McDonald I
Lindsay I
Aubrey I
Mermaid I
Seven Pines I.
Leek Island
Camelot I.
Endymion I.
Gordon I
STAVE ISLAND
Halsteads Bay
Landons Bay
Knights Creek
Beaver Meadow Ck.
Mulcaster I
ASH ISLAND
Ivy Lea
Georgina I
Constance
HILL ISLAND
CANADA
U.S.A.
LaRue Creek
Rockport
CLUB ISLAND
TAR ISLAND
GRENADIER ISLAND
Squaw Island
Adelaide I.
Jones Creek
Mallorytown Landing
Chimney Island Historical Site
Prepared by Forest Management Institute

Final Plot Number	Original Plot Number	Map Land Type	Map Forest Type	Plot Canopy Cover	Number of Species	Association	Sub-Association
1	14	1R	5O-sH1	0	4	1. VICIA – RHUS TYPHINA – TYPHA	Vicia – Poa pratensis
2	26	1R	R	0	7	1.	Vicia – Poa pratensis
3	44	4-3mcW-F	U_1	0	8	1.	Vicia – Poa pratensis
4	42	4-3mcW-F	U_1-U_2	0	9	1.	Vicia – Poa pratensis
5	43	4-3mcW-F	U_1	0	9	1.	Vicia – Poa pratensis
6	45	4-3mcW-F	U_1-U_2	0	12	1.	Vicia – Poa pratensis
7	46	3-5mcW(O)	U_1-U_2	0	8	1.	Vicia – Poa pratensis
8	86	1-3mcT/R-R	7OH-BdChA4	0	14	1.	Vicia – Poa pratensis
9	79	5-6O/W	M_1	0	18	1.	Vicia – Poa pratensis
10	105	3-4mfL	U_2	0	13	1.	Vicia – Poa pratensis
11	60	2vcF/R	U_2	5	9	1.	Vicia – Poa pratensis
12	61	2vcF/R	U_2	1	15	1.	Vicia – Poa pratensis
13	70	2cF/R	U_1	0	8	1.	Vicia – Poa pratensis
14	4	1R	5rOArM1/1gBChsH1	0	26	1.	Vicia – Poa pratensis
15	100	1R	R	0	12	1.	Rhus typhina – Calamagrostis
16	11	1-2cT/R-R	7rOM-sHA3	3	9	1.	Rhus typhina – Calamagrostis
17	34	1R	5wPrOrP3	2	11	1.	Rhus typhina – Calamagrostis
18	10	1-2cT/R-R	3rO-Po1	1	18	1.	Rhus typhina – Calamagrostis
19	68	1-3R-cF/R	3rCeO1	0	14	1.	Rhus typhina – Calamagrostis
20	13	1R	R	0	7	1.	Rhus typhina – Calamagrostis
21	16	1R	3rO-wP1	1	9	1.	Rhus typhina – Calamagrostis
22	24	1R	5rOsH-ArM12	2	12	1.	Rhus typhina – Calamagrostis
23	25	1R	R-U_2	0	10	1.	Rhus typhina – Calamagrostis
24	99	1R	5O-sHBd1	0	10	1.	Rhus typhina – Calamagrostis
25	32	1R	5rO-wP2/3rCeP1	0	15	1.	Rhus typhina – Calamagrostis
26	78	3-2mcT/R	U_2	5	9	1.	Rhus typhina – Calamagrostis
27	89	1R	5/3rO-wP2/2	0	4	1.	Rhus typhina – Calamagrostis
28	18'	1-2R-mcT/R	5wPHe-W2/3rCe1	1	6	1.	Rhus typhina – Calamagrostis
29	93	1R	5rOwP1	1	7	1.	Rhus typhina – Calamagrostis
30	19	1-2RmcT/R	5wPHe-W2/3rCe1	0	4	1.	Rhus typhina – Calamagrostis
31	90	1R	U_2-R	0	4	1.	Rhus typhina – Calamagrostis
32	101	1R	5HepP-Ce2	5	5	1.	Typha – Sagittar
33	2	6-5O-W	M_1	0	9	1.	Typha – Sagittar
34	52	3-5mcW(O)	7O1/3gB-AB3	1	15	1.	Typha – Sagittar
35	63	4-6vcW-O	M_1	0	10	1.	Typha – Sagittar
36	15	2-3vcW	M_1	0	12	1.	Typha – Sagittar
37	87	6O-W	M_1	0	8	1.	Typha – Sagittar
38	88	4-6O/W	M_1	0	1	1.	Typha – Sagittar
39	98	1R	R	0	5	1.	Typha – Sagittar
40	17	2-3mfL/R	5O-BdsH4	1	4	2. IMPATIENS	Impatiens – Urtica
41	56	3-5cF-W(O)	5APoB2/3gB2	2	17	2.	Impatiens – Urtica
42	72	3-5cW-F	5PogB2	3	10	2.	Impatiens – Urtica
43	55	3-4cF-W	3gB3	4	14	2.	Impatiens – Urtica
44	91	1R	5/3rO-wP2/2	0	5	2.	Impatiens – Urtica
45	39	2-3cT/R(R)	5Po4	5	11	2.	Impatiens – Urtica
46	41	2-3cT/R(R)	U_2	0	8	2.	Impatiens – Urtica
47	3	1R-vcW	5PoW	0	14	2.	Impatiens – Urtica
48	66	4-5vcW(O)	3/1gB-Po1/1	1	18	2.	Impatiens – Urtica
49	64	3cF-F/R	7O3	3	5	2.	Impatiens – Urtica
50	76	4mcT	U_2	4	9	2.	Impatiens – Urtica
51	38	2-3cT/R(R)	7rO4	2	9	2.	Impatiens – Parthenocissus
52	69	1-3R-cF/R	5gB-OChsH2/3gB-ChrCe2	4	11	2.	Impatiens – Parthenocissus
53	71	3-5cW-F	5gB3	1	13	2.	Impatiens – Parthenocissus
54	47	3-5mcW(O)	5/3PoA1/2	3	21	2.	Impatiens – Parthenocissus
55	67	3mcW	5O-ChAgB2/3gBCh2	4	19	2.	Impatiens – Parthenocissus
56	48	4-3mcW-F	7wPO-MA2/3gBrMOA2	2	20	2.	Impatiens – Parthenocissus
57	50	3-2cF-W	5rO-rMPo3/3gBsH1	4	24	2.	Impatiens – Parthenocissus
58	1	1R-vc W	5PoW2	5	9	2.	Impatiens – Parthenocissus
59	12	1-2cT/R-R	7rOM-sHA3	1	15	2.	Impatiens – Parthenocissus
60	49	4-3mcW-F	5rO-rMPo3/3gBsH1	3	10	2.	Impatiens – Parthenocissus
61	97	3-5vcW(O)	M_1-U_1	1	8	2.	Impatiens – Parthenocissus
62	5	3-5mcW(O)	5E-A1/5rCe-B2	4	14	2.	Ribes – Circaea
63	6	3-5mcW(O)	5OB-A2/3gB1	3	15	2.	Ribes – Circaea
64	29	3-1mcT/R(R)	7wOrO4	0	10	2.	Ribes – Circaea
65	65	3cF-F/R	7O3	0	10	2.	Ribes – Circaea
66	106	3-1mcT/R-R	7O4	3	12	2.	Ribes – Circaea
67	107	3-4mcT-T/R	7MO-rPwP4	3	12	2.	Ribes – Circaea
68	74	3-2mcT/R	7wP-OBd3	1	15	2.	Ribes – Circaea
69	77	3-4mcT(W)	U_2	5	6	2.	Ribes – Circaea
70	75	3-2mcT/R	9O-M4	1	12	2.	Ribes – Circaea
71	20	3mcT/R	7BehM-wP4	3	8	2.	Ribes – Circaea
72	109	3-1mcT/R-R	7wP2/5OA-MwB1	3	9	2.	Ribes – Circaea
73	23	1R	5/1O-sHA1/1	3	9	2.	Ribes – Circaea
74	92	2-4mfL/R	7He1/5rO-MPowP3	5	10	2.	Ribes – Circaea
75	85	1-3mcT/R-R	3wPpP-MrO3	4	17	2.	Ribes – Circaea
76	94	1-3cT/R-R	7OMPo-sHBd4	4	15	2.	Ribes – Circaea
77	103	3-4mcT-T/R	7O-A4	4	12	2.	Ribes – Circaea
78	104	3-4mcT-T/R	7O-M1/5APo-sHwP2	5	14	2.	Ribes – Circaea
79	8	1-2cT/R-R	7rOM-sHA3	1	9	3. ARALIA	Aralia – Carpinus
80	9	1-2cT/R-R	3rO2	3	11	3.	Aralia – Carpinus
81	62	1R	3O-wPpPrP1/1ChrCe1	1	7	3.	Aralia – Carpinus
82	40	2-3cT/R-R	7rO4	4	8	3.	Aralia – Carpinus
83	102	1-3vcT/R	5rOwP-MB3	3	7	3.	Aralia – Carpinus
84	22	1-2R-mcT/R	5wPHe-W2/3rCe1	4	11	3.	Aralia – Carpinus
85	96	2-4cT/R	7OMPo-sHBd4	5	9	3.	Aralia – Carpinus
86	21	1-2R-mcT/R	5OM-AsHBd4	4	12	3.	Aralia – Carpinus
87	73	2cT	7OM-sHBd3	2	10	3.	Aralia – Carpinus
88	31	1R	5O-wP3	3	11	3.	Aralia – Carpinus
89	33	3cT/R	5wP-OHe3	3	11	3.	Aralia – Carpinus
90	36	1-3R-mcT/R	5HewPwOrOrM4	5	7	3.	Quercus alba – Ostrya
91	57	2vcF/R	7rOwO4	3	10	3.	Quercus alba – Ostrya
92	58	2vcF/R	7rOwO4	3	15	3.	Quercus alba – Ostrya
93	54	3cW	9wO4	4	17	3.	Quercus alba – Ostrya
94	80	1-3mcT/R-R	3/1pP-wPgB2/2	3	17	3.	Quercus alba – Ostrya
95	108	3-4mcT-T/R	7HewP-O1/5MsHPo2	4	17	3.	Quercus alba – Ostrya
96	7	3-5mcW(F)	7PoOA-M2/3BPoA-O2	4	16	3.	Quercus alba – Ostrya
97	53	3-5mcW(O)	7O1/3gB-AB3	3	13	3.	Quercus alba – Ostrya
98	51	3-5mcW(O)	7O1/3gB-AB3	5	18	3.	Quercus alba – Ostrya
99	59	2vcF/R	7rOwO4	4	14	3.	Quercus alba – Ostrya
100	81	1-3mcT/R-R	7OM-wP4	4	19	3.	Quercus alba – Ostrya
101	84	1-3mcT/R-R	3wPpP-MrO3	4	16	3.	Quercus alba – Ostrya
102	82	1-3mcT/R-R	5HewP-OM4	5	16	3.	Quercus alba – Ostrya
103	83	1-3mcT/R-R	7O-wP3	3	22	3.	Quercus alba – Ostrya
104	37	1-3R-mcT/R	7rOwOrM-wP4	3	11	3.	Quercus alba – Ostrya
105	27	3-1mcT/R(R)	7HewP-rO4	5	9	3.	Tsuga
106	35	1-3R-mcT/R	5O-wPrMA4	5	11	3.	Tsuga
107	28	3-1mcT/R(R)	7HewP-rO4	5	11	3.	Tsuga
108	30	3-1mcT/R(R)	7wOrO4	4	7	3.	Tsuga
109	95	2-4cT/R	7OMPo-sHBd4	5	8	3.	Tsuga

Differential species of sub-association: *Vicia – Poa pratensis*
Vicia cracca
Poa pratensis

Characteristic species of sub-association *Vicia – Poa pratensis*
Phleum pratense
Agropyron repens
Cirsium arvense
Asclepias syriaca
Aster novae-angliae

Differential species of sub-association: *Rhus typhina – Calamagrostis*
None were found

Characteristic species of sub-association *Rhus typhina – Calamagrostis*
Rhus typhina
Calamagrostis canadensis
Juniperus communis
Danthonia spicata

Differential species of sub-association: *Typha – Saggittaria*
Sagittaria latifolia
Typha latifolia

Characteristic species of sub-association: *Typha – Sagittaria*
Phalaris arundinacea
Alisma plantago-aquatica

Differential species of sub-association: *Impatiens – Urtica*
None were found

Characteristic species of sub-association: *Impatiens – Urtica*
Urtica dioica

Differential species of sub-association: *Impatiens – Parthenocissus*
Equisetum hyemale

Characteristic species of sub-association: *Impatiens – Parthenocissus*
Fraxinus nigra

Differential species of sub-association: *Ribes – Circaea*
Actaea alba

Characteristic species of sub-association *Ribes – Circaea*
Ribes spp.
Vitis riparia
Galium triflorum
Sambucus canadensis

Differential species of sub-association *Aralia – Carpinus*
Carpinus caroliniana

Characteristic species of sub-association: *Aralia – Carpinus*
Fagus grandifolia

Differential species of sub-association *Quercus alba – Ostrya*
Quercus alba

Characteristic species of sub-association: *Quercus alba – Ostrya*
Ostrya virginiana
Viburnum acerifolium
Gaultheria procumbens

Differential species of sub-association *Tsuga*
None were found

Characteristic species of sub-association: *Tsuga*
Tsuga canadensis

Shared differential and characteristic species of association *Vicia – Rhus typhina – Typha*
Rosa spp
Fragaria virginiana
Hypericum perforatum
Juncus tenuis
Agrostis tennuis
Luthrum salicaria
Rumex crispus
Polygonum convolvulus

Shared differential and characteristic species of association. *Impatiens*
Impatiens biflora
Onoclea sensibilis
Sambucus rubens
Aster spp.
Circaea quadrisulcata
Rubus odoratus
Rhus radicans
Parthenocissus quinquefolia
Arisaema triphyllum

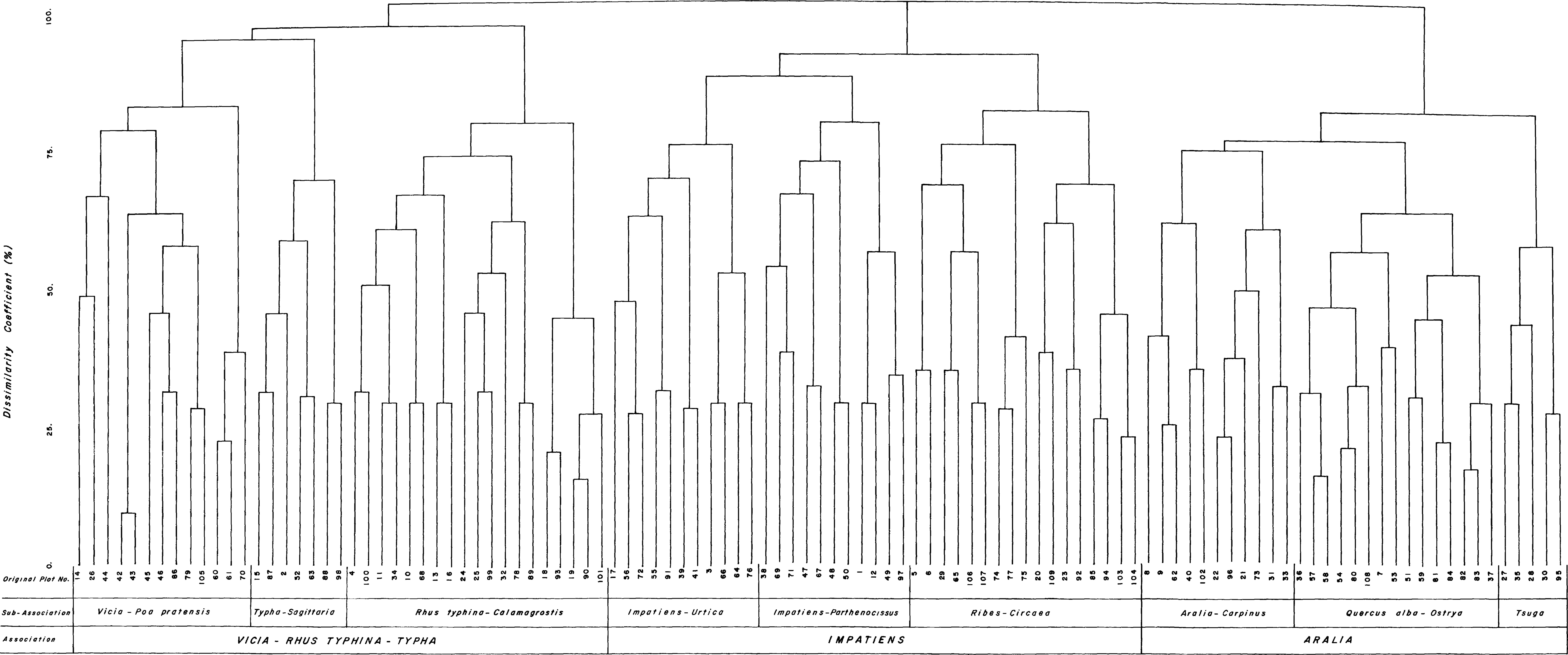
Shared differential and characteristic species of association *Aralia*
Pteridium aquilinum
Aralia racemosa
Maianthemum canadense

Companion species occurring only in associations *Vicia – Rhus typhina – Typha* and *Impatiens*
Solanum dulcamara
Lycopus americanus
Pyrus malus
Oxalis stricta
Convolvulus arvensis
Geum canadense
Lactuca biennis
Stachys hispida
Scutellaria galericulata
Alnus rugosa

Companion species occurring only in associations *Impatiens* and *Aralia*
Dryopteris austriaca
Viola spp.
Pyrola elliptica
Podophyllum peltatum
Amelanchier arborea
Streptopus roseus
Smilax herbacea
Betula papyrifera
Amphicarpa bracteata
Trillium spp.
Prenanthes altissima
Acer saccharum

Companion species occurring only in associations: *Vicia – Rhus typhina – Typha* and *Aralia*
Convolvulus sepium
Achillea millefolium
Poa compressa
Pinus strobus
Deschampsia flexuosa
Vaccinium angustifolium
Thuja occidentalis

Companion species occurring in all associations
Solidago canadensis
Spiraea latifolia
Solidago spp.
Rubus spp.
Cornus racemosa
Galium circaezans
Ranunculus acris
Acer rubrum
Carex spp.
Galium asprellum
Quercus borealis
Populus tremuloides
Lysimachia ciliata
Betula populifolia
Ilex verticillata
Carya ovata
Prunus serotina
Polygonatum pubescens
Prunus virginiana
Tilia americana
Aster cordifolius
Viburnum lentago
Viburnum rafinesquianum
Fraxinus americana
Dryopteris marginalis
Celastrus scandens
Geranium robertianum



Dissimilarity Coefficient (%)
100.
75.
50.
25.
0.
Original Plot No.
14 26 44 42 43 45 46 86 79 105 60 61 70 15 87 2 52 63 88 98 4 100 11 34 10 68 13 16 24 25 99 32 78 89 18 93 19 90 101 17 56 72 55 91 39 41 3 66 64 76 38 69 71 47 67 48 50 1 12 49 97 5 6 29 65 106 107 74 77 75 20 109 23 92 85 94 103 104 8 9 62 40 102 22 96 21 73 31 33 36 57 58 54 80 108 7 53 51 59 81 84 82 83 37 27 35 28 30 95
Sub-Association
Vicia - Poa pratensis
Typha-Sagittaria
Rhus typhina- Calamagrostis
Impatiens-Urtica
Impatiens-Parthenocissus
Ribes-Circaea
Aralia- Carpinus
Quercus alba - Ostrya
Tsuga
Association
VICIA - RHUS TYPHINA - TYPHA
IMPATIENS
ARALIA