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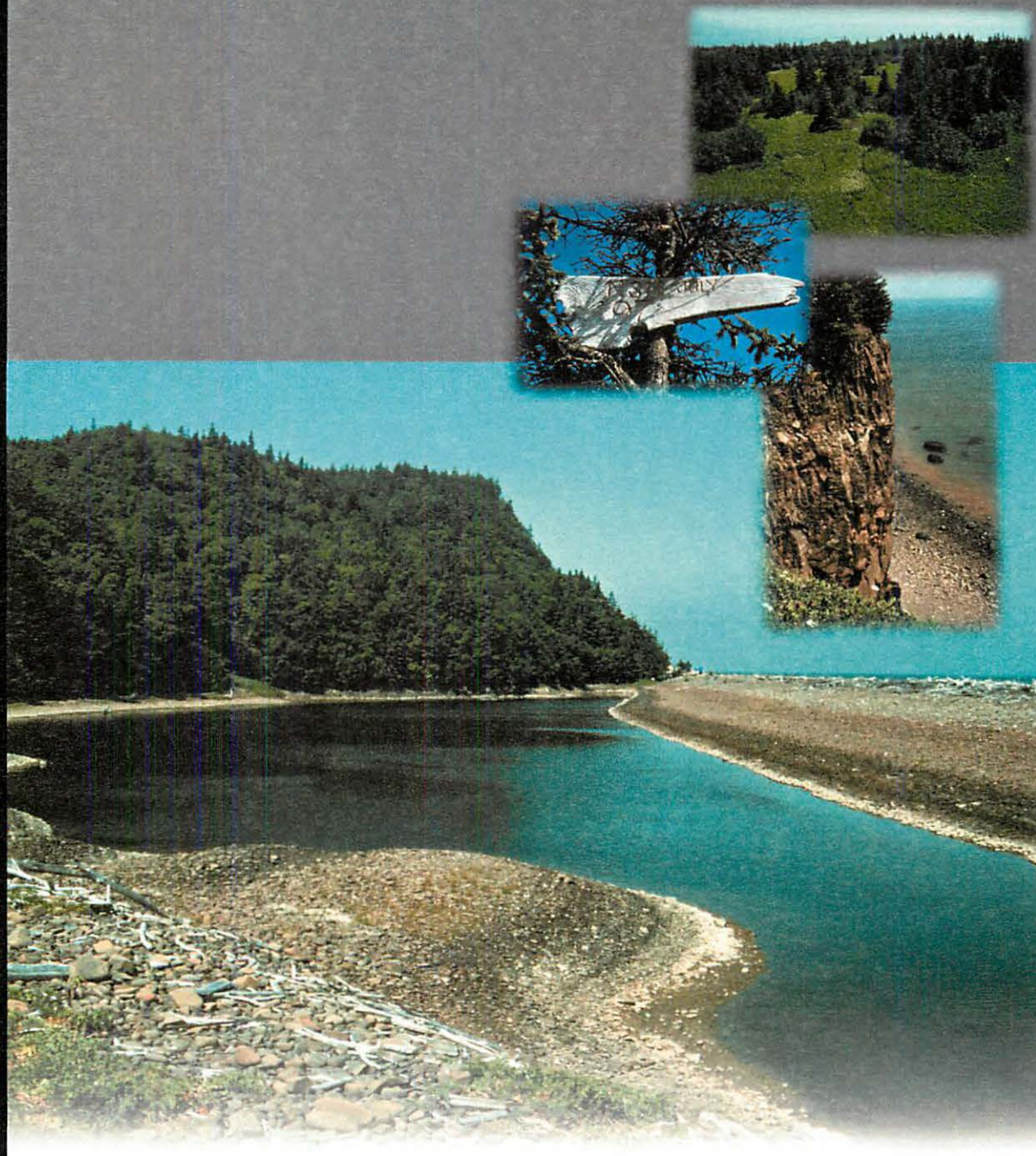
CURATORIAL REPORT 90

The Nova Scotia Museum Isle Haute Expedition July, 1997



NOVA SCOTIA
Tourism and Culture

A FAMILY *of* 25 MUSEUMS

The Nova Scotia Museum Isle Haute Expedition July, 1997

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C U R A T O R I A L R E P O R T S

The Curatorial Reports of the Nova Scotia Museum make technical information on museum collections, programs, procedures and research accessible to interested readers.

This report contains the preliminary results of an on-going research program of the Museum. It may be cited in publications, but its manuscript status should be clearly noted.

D E D I C A T I O N

This report is dedicated to the memory of an enthusiastic naturalist, Mr. Don Keith of Dartmouth. As with many who took part in this field expedition, one of Don's dreams was to visit Isle Haute. Don introduced the Museum's advance crew to Isle Haute in October of 1996, just months prior to his death. His formal training was in geology but his boundless interest and deep expertise encompassed all aspects of natural history. Being a teacher and science curriculum advisor for the Dartmouth school system, and being a proactive naturalist, he greatly influenced and cheerfully guided thousands of students, and members of the public, in the pursuit of the natural sciences.

Fig. 1: Mr Don Keith with his wife Joan and the advance crew.

The advance crew, October 1996, proudly stands in front of the N. S. Department of Natural Resources helicopter prior to departing for the island. From left to right: David Keenlyside (Canadian Museum of Civilization), Howard Donohoe (N. S. Department of Natural Resources), Calum Ewing (N. S. Museum of Natural History), Don Keith, Joan Keith, Andrew Hebda (N. S. Museum of Natural History), Bob Grantham (N. S. Museum of Natural History), and Glen Thompson (Civil Air Search and Rescue).

Table of Contents

Introduction 1

The Mysterious Meeting Place 3

A First Look: The Archaeology of Isle Haute 7

Geological Reconnaissance of Isle Haute 11

The Vascular Plants of Isle Haute 14

Preliminary Report on 1997 Collections of Isle Haute Lichens 16

Preliminary Results of Invertebrate Sampling 17

The Herpetofauna of Isle Haute 21

The Birds of Isle Haute 22

Mammals of Isle Haute 25

Citation List 28

Appendix 1 31
Technical Information—Isle Haute Lighthouses

Appendix 2 32
Geological Collections and Photos

Appendix 3 34
Systematic List of Isle Haute Flora

Appendix 4 38
Alphabetic Vascular Plant List, 1997

Appendix 5a 41
Lichens Recorded for Isle Haute

Appendix 5b 43
John Erskine's Isle Haute Lichen List

Appendix 6 44
Preliminary list of invertebrate taxa recorded from Isle Haute, Cumberland Co.

Appendix 7 46
Ground Beetles (Carabidae) collected on Isle Haute

Appendix 8 47
Isle Haute Birds

Appendix 9 50
List of other sources

Appendix 10 51
List of Figures, Illustrations and Tables

Introduction

Purpose of the expedition

Although Isle Haute has been the subject of moderate investigations in the past, it continues to offer the opportunity to discover new information and to verify older finds. It is an island rich in legend, history, and Mi'kmaq tradition. It is composed of towering geological features and is the home of a curious assemblage of animals and plants. Because of these, the island is of interest to persons working in a variety of disciplines, many of which are represented among the staff of the Nova Scotia Museum. Because the museum was undertaking the study of the island, an invitation was extended to others, who may have been experiencing difficulty in getting to the island, to participate in the expedition. The museum is well positioned to undertake such an endeavour by virtue of its mix of scientific and technical expertise.

This report presents the preliminary results of field work conducted on Isle Haute between July 14 and July 18, 1997, and includes references to previous studies.

Composition of the expedition

The group visiting the island varied in composition during the week. The expedition was led by Bob Grantham, Curator of Geology at the Museum of Natural History. The work on the island was conducted by crews of museum staff, research associates and volunteers from the Collections and Interpretations Sections of the N. S. Museum of Natural History (Stephen Archibald, Debra Burleson, Norma Bishop, David Butler, Martha Devanney, Darren Drake, Calum Ewing, Karen Gilhen, Jason Taylor, Andrew Hebda, Kim Jarrett, Keith Jensen, Alex Wilson, John Gilhen, Karen Casselman, Ian Booth, Ted Casselman, Andrew Gale, Fred Joyce); the Collections Section of the Maritime Museum of the Atlantic (Dan Conlin); the Collections and Interpretation Sections of the Museum Services Division (David Christianson, Sheila Stevenson); and representatives from Corporate Services Division (Carleton MacLean, Bob Ogilvie). These teams were assisted by staff from the Fundy Geological Museum (Ken Adams); Parks Canada (Michael Wilder, Roger Lewis); Canadian Museum of Civilization (David Keenlyside, Helen Krismanson); Acadia University (Fred Scott, Andy Davis); Goldn' Crystals Minerals (Doug Boddy, Heather Boddy); and Ian Booth; as well as nine representatives of the news media. In all, over 50 people came and went from the island during the five days. A core crew of five stayed the full time.

Logistics and safety

Permission to visit the island was granted from the Canadian Coast Guard Service, Saint John, New Brunswick. Travel to the island was by local boat charter out of Harbourville. The vessel *Manda&Jeffrey* skippered by Hugh Finley was contracted for the full expedition period and provided excellent daily crossings to the island.

Getting to the island with field equipment, supplies, camping gear and staff, and providing the opportunity for daily changes to crew composition was a challenge which was met admirably by the crew of the *Manda&Jeffrey*. Wilderness camping was the

Fig. 2: *Base Camp on the Island*

accommodation on the island. The unserviced base camp was set up on the only flat grassy area at the top end of the beach on the shores of the lagoon on the northeast end of the island. *Just for Me Outdoor Adventures for Women*, operated by Sue Ross, was contracted to provide a food service for the expedition. Her experienced cook, Erin O'Brien, had the most demanding challenge of the entire expedition. With no refrigeration, and fresh water in short supply, she worked cullinary miracles that we fondly remember to this day. The provision of a food service proved to be a wise choice, as all available staff time could then be devoted to the goals of the expedition. The ingenuity of the museum's Interpretation staff in setting up the base camp kitchen was appreciated. Innovation was the driving force as the "kitchen" was erected using available materials on the island.

The possibility of injury or death on the island was very real. Help in any form was hours away. Safe work practices were always the top priority and were diligently observed by all participants. Adhering to the guidelines set out in *The Safe Work Methods Handbook* of the Department of Natural Resources, ensured a well-planned and safely executed expedition. Communications with the mainland was primarily by a satellite phone provided by R&S Electronics and Glen Tel. A cell phone and two, handheld portable amateur radio transceivers were available. Communication redundancy proved to be a wise idea.

Public Relations

One day, mid-week was spent hosting representatives from the news media. Largely organized by Museum of Natural History's Interpretation Section staff member Brenda Boutilier, it resulted in wide coverage and extensive public interest in the expedition. Reporters and photographers included: Steven Fraygood and Caroline Grant (CBC—Halifax), Diane Doiron and Rick Conrad (Chronicle Herald— Halifax), Stephen Bornais (Daily News— Dartmouth), Anne Otton (Mirror Examiner— Middleton), Sara Keddy (The Register — Berwick), David Redwood and Tony Seed (Shunpiking —Halifax).

Fig. 3: Isle Haute as sketched by JFW Des Barres in the 1770s

Fig. 4: The Isle Haute lighthouse and visitors, circa 1900.

Fig. 5: The author in one of the treasure pits.

The Mysterious Meeting Place

Dan Conlin, Curator of Marine History, Maritime Museum of the Atlantic

Isle Haute lies on the Bay of Fundy horizon looking very much like an overturned canoe or the capsized hull of a sailing ship. One of the few large prominent islands in the upper Bay of Fundy, Isle Haute is an arresting landmark visible along hundreds of miles of Bay of Fundy coastline in both New Brunswick and Nova Scotia. Depending on the weather or time of day, the appearance of the island can change radically. Many bay residents swear that it moves around.

In this paper we will look at the human history of Isle Haute, since the arrival of Europeans. I will leave the island's very intriguing pre-European history to the archeologists. Aside from my curiosity about the island as a marine historian, I have a personal interest in Isle Haute. I grew up spending summers along the Bay of Fundy at Turner Brook, near Harbourville. I spent many hours gazing at Isle Haute, imagining its beaches and yearning to go there. It seemed almost like another planet—so visible, yet so remote. Finally, when I was 14, I made it to the island on a Boy Scout trip. I was captivated by the island's remote beauty and have returned over a dozen times since, including as part of the 1997 Nova Scotia Museum expedition.

Since the expedition I have found that Isle Haute holds a powerful attraction to a large number of people who have never visited it, but have watched and wondered about its distant and remote mysteries. Yet a study of the island's past shows that it was once far from isolated. In the days when almost everything moved by water, Isle Haute was at a crossroads where the bay of Fundy splits, and was often visited, sometimes by large numbers of people.

The first recorded impression of Isle Haute was by the man who gave it its present name—Samuel de Champlain. His description of the island in May of 1604 makes interesting reading:

> *We crossed part of the Bay of some 5 or 6 leagues in breadth to a place which we named the Cape of Two Bays and we passed an island, which is a league from it and which is about that distance in circumference, and is some 40 or 50 fathoms in elevation. It is entirely surrounded by great rocks, excepting in one place where there is a slope at the foot of which is a pond of salt water, which lies at the base of a gravel point having the form of a spur. The top of the island is flat, covered with trees and has a very good spring ...* (Champlain, 1613).

Worth noting is that Champlain, or some of his crew, appear to have landed on Isle Haute to record its spring. Many of the features he noted can still be seen today. Champlain was most impressed by the height of the island and its awesome vertical cliffs which still impress visitors. He named it Ile Haute or High Island. Of course the island was known to different people by different names. The missionary Silas Rand recorded the Mi'kmaq name as Maskusetkik, which he translated as place of wild potatoes. After the arrival of Europeans, there are very few references to native peoples on the island, but one exception was noted by anthropologists Ruth and Wilson Wallis:

> *In June 1724 thirty Maliseet came by canoe to "the mysterious and lonely island at the headwaters of the Bay of Fundy, 'Isle Haut'. There they met with fifty Micmac arrayed in war paint. A feast of dog flesh was eaten to give them courage in battle and the war dance was held." They then set out on one of the many attacks on the Port Royal Fort."* (Wallis, 1955)

What became of the native use of the island is a question for archeologists and other historians, but this 1724 reference is interesting as it hints at a possible significance of the island as a rendezvous or meeting place between the two first nations groups of the Bay of Fundy.

The island's name was further changed as New England fishing crews Anglicized Isle Haute to Isle Holt or even Holt Island. (Today it remains officially known as Isle Haute but is locally pronounced, depending on what part of the Bay of Fundy you come from, as *Eye-la Haut* or *Eye-la Hot*.) By its many

names, Isle Haute was recorded on the earliest charts of the Bay of Fundy which soon noted both its spring, the surrounding tide rips and a good anchorage in most winds on the north east side. The noted hydrographer Des Barres not only charted, but made extensive sketches of Isle Haute to assist mariners in recognizing the landmark. He filled his sketches with sailing vessels—from fishing sloops to sizable ships—partially for scale but also to recognize the significant amounts of fishing and trade that occurred around the island from the late 18th century onward. Clearly the island served as shelter and a watering place and may have been used for firewood or ballasting.

The island eventually proved quite productive with regular exports of sheep, cattle and hay leaving the island in boats and barges.

Shipwrecks, of course, are associated with shipping. While Isle Haute never came near the fearsome reputation of ship-killing Nova Scotian islands like Sable, Seal or Saint Paul, it became more of a concern in the late 19th century as shipping and lumber exports from the inner Bay of Fundy expanded. A lighthouse was proposed for the island in 1855 and strongly recommended by the Royal Navy in 1857 because of Quaco Ledge, a hazard to the west of the island. However Nova Scotia's lighthouse commissioners seemed to have found additional mainland lighthouse along the Bay of Fundy to be a more affordable solution. In 1875 the need for an Isle Haute lighthouse was again raised, this time as a question in the House of Commons. By then the federal Department of Marine was at work surveying for a lighthouse. The report on the establishment of the light gives an interesting snapshot how the arrival of the lighthouse in 1878 altered the island:

> *"The keeper has constructed a road from the beach to the lighthouse about one mile in length on a grade that will permit stores etc. to be hauled to the station ... The island is covered in birch and fir - the timber being of little or no value except for firewood. The light is visible all around the horizon. There is about one and a half acres of cleared land round the lighthouse on which the keepers has planted crops—and a considerable quantity of land at the west end can be made available for the same purpose."* (Gov. Of Canada, 1879).

The new lighthouse was an impressive 53-foot, four-storey wooden tower with a dwelling attached (See Appendix 1 for details. An identical twin to this lighthouse still stands at Wood Island, P.E.I.) The first keeper, Nelson Card, and his family began the first of many changes to the island. Fields near the lighthouse were cleared and cultivated. Other areas were regularly burned over for pasture. The island eventually proved quite productive with regular exports of sheep, cattle and hay leaving the island in boats and barges. Less successful was a turn-of-the-century attempt by a New Brunswick company to set up a fox farm. A keeper's son introduced frogs and toads prior to 1946.

Card also built a small wharf and sheds by the spring at the northeast anchorage. He even built a 33-foot schooner on Isle Haute called *Only Son.* After World War Two, a more substantial wharf was built, with a large boat ramp and winch to pull boats out of the water. Remnants of the wharf were clearly visible until the early 1980s but today only a few pilings can be seen at low tide.

The Isle Haute keepers faced serious isolation in the wintertime when ice, tides and storms often cut off the mainland for weeks at a time. In World War Two, friendly RCAF pilots often dropped newspapers and small parcels for the keeper. In a pre-radio age, the keepers evolved a system of fires to communicate with friends and family in Advocate, the nearest mainland community. One fire meant all was well. Two fires meant someone was sick, while three meant a doctor was needed. Four fires meant a death. The last was used most notably during one winter storm during the tenor of keeper Percy Morris. He had had gone into Advocate for supplies leaving his wife Bertha and a hired man to tend the light. Storms delayed his return and in his absence, the hired man suffered a heart attack and died. His wife lit the death fires, but severe weather kept help away for some time over which time. Meanwhile, she had to share the lighthouse with a corpse while her nervous husband frantically struggled to hire a boat large enough to reach the island, not knowing who had died.

Winter's isolation was more than compensated for by the large numbers of visitors in summertime. At a time

when the Bay of Fundy was ringed by busy fishing and shipping ports, the island provided an ideal gathering place for Sunday picnics and special outings, know as "Bay Parties". At the turn of the century up to three hundred people would arrive on the island on a single day, with July 12 gatherings organized by the Orange Lodge fraternal order. A special gathering also took place in 1881 when two boatloads of guests arrived for the marriage of the keeper's daughter, Ida Card. (see Fraser, 1989; Mahar, 1981).

Human occupation of the island came to an end in 1956. The light was scheduled to be automated when a lantern fire destroyed the tower, the dwelling and all its contents. Today only the fieldstone foundation remains, filled with the rusty wreckage of the fire. A skeleton tower replaced the old wooden tower. It is now solar powered and serviced by helicopters from Saint John, N.B. who use a nearby wooden helicopter pad. The future of minor light stations such as Isle Haute are now under review by the Canadian Coast Guard and it may be wise to give some thought to the day when the island becomes surplus to navigational purposes.

Isle Haute has long generated Bay of Fundy folklore. In Spencers Island, tales are told of the bottomless pond on the east end where, at certain times of the day when the light is exactly right, a schooner can be seem trapped in the depths below. (Unfortunately, sounding of the pond indicates depths of little more than three to four metres at its deepest.)

The greatest number of legends concern the island's treasure myth. Pirate treasure stories are common to Nova Scotia and were well studied by the folklorist Helen Creighton. She found that the same basic pattern of treasure legend is told, with local variations all over Nova Scotia. It is held that pirates killed and buried one of their numbers so his spirit would guard the treasure. Its ghost can be seen at night marking the treasure, but treasure hunters have to thwart his often terrifying powers by a variety of rituals such as maintaining absolute silence and using silver shovels. There is no evidence that real pirates ever buried treasure and no one has ever discovered any genuine pirate treasure in Nova Scotia, but the legends persist. These treasure legends produce interesting and colourful folklore, but they have often led to destruction and waste by treasure hunters, and notably so on Isle Haute.

There is no evidence that real pirates ever buried treasure and no one has ever discovered any genuine pirate treasure in Nova Scotia, but the legends persist.

A particularly Gothic version of the Isle Haute treasure myth holds that the island moves once every seven years, and should you be on the island at midnight when it moves, a flaming headless ghost rises from the treasure site. Three treasure hunters are said to have confronted this ghost in the 19th century but it killed two of them and left the third insane.

A marginally more plausible legend describes a Moncton man named Sam McCready who searched for William Kidd's treasure on Isle Haute, claiming to have found a stone listing gold and jewels buried at a certain depth. The stone was supposedly kept by his family in a bank vault, but like so many of the alleged evidence of pirate treasure, conveniently disappeared.

Further legends from St. Martin tell of a fisherman who went to Isle Haute and returned with something heavy and never worked another day in his life, or of local people who helped groups of Americans arrive with empty chests and leave with heavy ones. While these are all common folklore patterns, Isle Haute was undoubtedly visited by real treasure hunters. Their obsessed antics have created a folklore all on their own. Lightkeepers and their families recall treasure hunters using dousing rods and other classic treasure rituals. Ella Fraser, daughter of keeper Percy Morris, recorded one occasion when her father deliberately buried an old kettle where they noticed treasure hunters marking a spot and then secretly watched the commotion and excitement when the "treasure" was unearthed.

Perhaps the most consumed digger was a British Columbia man named Dougald Carmichael. In 1925 and 1929 he made numerous futile attempts to locate treasure at several points on the island, apparently even attempting to drain the pond.

In the 1940s, Isle Haute's reputation reached the ears of an American writer of pirate and ghost stories named Edward Rowe Snow. A few years after hearing about Isle Haute, Snow "discovered" a map from shadowy

origins that coincidentally resembled Isle Haute and was supposedly drawn by Ned Lowe, a well-documented pirate from the 1720s. Snow arrived on the island in 1952 and with the aid of an early model of metal detector, claims to have unearthed a handful of gold and silver coins near a skeleton. He published photos of his find in *Life* magazine, although it is open to question whether what he claimed to have found was treasure, shipwreck gold or merely a plant. Snow was candid in admitting that the real money in treasure hunting came not from finding anything but rather from writing about it and selling books.(see McLellan, 1955; Trueman, 1970; Snow, 1952).

Unfortunately Snow's efforts and those of other treasure hunters have led to the pointless and frenzied digging on Isle Haute, which hold tragic consequences for the island's history. The spot most favoured by Snow and other treasure hunters at one end of the pond also happens to be one of the more important archeological sites on the island—of very old habitation by native peoples.Treasure hunters have left much of this site looking like a World-War-One battlefield with numerous craters in the cobble beach, some over 1.5 m deep. Since my first visit to the island in 1978, I have several times noticed fresh holes and digging at different locations, although less so in recent years, indicating that some destructive and obsessed individuals are still at work.

Fortunately most people who visit Isle Haute today aren't treasure hunters and treat the island with respect. As evident from the carved signboards near the spring, a surprising number of people manage to organize their own expeditions, hiring fishing boats to take them to remote Isle Haute. One weekend when I travelled to the island from Harbourville, other visitors arrived the same night from Advocate on a zodiac and from St. Martin on a cabin cruiser, continuing the island's very old tradition of attracting people from all sides of the bay.

Fig. 6: Archaeological excavation at Isle Haute.

Fig. 7: Stone artifacts recovered from Isle Haute.

A First Look:

David J. Christianson, Curator of Archaeology,
History Section, Nova Scotia Museum

Dr. David Keenlyside, Atlantic Region Archaeologist, Archaeological Survey of Canada, Canadian Museum of Civilization

In cutting open a beaver-dam at Cape Chignecto, a small portion of the earth floated away; Glooscap changed it into a moose and set his dogs on it. The moose took to the bay and made off; whereupon Glooscap turned him back into land, made him an island—the Isle of Holt—and fixed him there. From Mi'kmaq Glooscap story recorded by Silas Rand.

Previous Work on Isle Haute

Archaeological remains from Isle Haute were first reported by J.S. Erskine in 1956, as part of an expedition to the Island by the Nova Scotia Museum of Science. He reports that Fullerton, the lighthouse keeper at the time, had found 'arrowheads' at the eastern end of the Island. The use of the island by the Mi'kmaq is also supported by at least one of the named locations on the island—Indian Flats.

The first systematic survey, although brief, was undertaken by George Hiseler in 1992, working for Jacques Whitford Environmental Limited of Halifax. His findings substantiated those of Erskine and Fullerton, but more significantly, drew attention to widespread surface disturbance by treasure seekers. Over the years, there have been sporadic reports to the Nova Scotia Museum of illegal removal of artifacts from the Island for personal collections. All designated archaeological sites in the Province of Nova Scotia are protected under legislation from such destructive activities.

In November of 1996, a small team of scientists from the Nova Scotia Museum accompanied staff from the Nova Scotia Department of Natural Resources on a brief helicopter supported reconnaissance of Isle Haute to assess the potential for future research. Enthusiastic observations on the natural and human history convinced Museum staff to plan a multi-disciplinary study for the summer of 1997.

The Summer 1997 Investigation

The authors were invited to join the Nova Scotia Museum of Natural History in the expedition as part of the museum's Island Ecosystem Project. It presented us with the opportunity to reassess the nature and extent of what little was known of the archaeology and to determine its potential. Objectives included both research and heritage resource protection interests. Our specific goals were to:

1) establish the location and extent of historic and pre-contact archaeological sites and obtain samples for scientific analyses,

2) determine the impact of human and natural agencies on these resources,

3) establish the period(s) of occupation on the island and to develop hypotheses for reasons why people inhabited Isle Haute, and

4) identify bedrock and surface sources of lithic raw material, such as chert, rhyolite and chalcedony, suitable for stone tool knapping and also, sources of native copper.

Fieldwork Strategy

Given the short 4—5 day period of the project, priorities were established to recover the maximum amount of field data. Our research focussed on two areas. The first was the barrier beach and lagoon system at the northeastern end of the Island which was identified previously as having archaeological remains. The beach was walked carefully and locations of lithic

scatter and any other cultural material or features were noted. Lithic scatter refers to the pieces of stone debris produced when making stone tools. Representative samples were collected and recorded to surface location. Test units (2 x 1 meters) were placed at two of the highest concentrations of lithic scatter, carefully excavated with trowels and any features, stratigraphy or artifacts were recorded. Secondly, a broad, flat, elevated terrace overlooking the west end of the lagoon was investigated. According to local oral tradition, this elevated terrace, was known as Indian Flats. A line of eight small test pits were excavated along the central portion of the terrace and samples recorded.

Principal Findings

1) Surrounding the lagoon, along the inside of the barrier beach, the lithic scatter was extensive, however, it was concentrated in at least six discrete areas. The beach is principally composed of large cobbles with very little soil having formed. There appears to be a direct correlation between the lithic concentrations and areas cleared of large cobbles. These cleared areas are also characterized by having some soil deposits with a small amount of plant growth. It would appear that these organically richer areas resulted from human activity and, possibly, are the sites of former tent or wigwam structures. Also noted on the beach, were roughly circular, shallow depressions c.2.5-3 meters in diameter. These were quite subtle and usually were seen only with low level cross-lighting either early or late in the day. Insufficient time was available to test these areas, but we suspect that they, too, may have been associated with wigwam structures. Lichen growth on these features suggested some degree of antiquity with few indications of recent disturbance.

The steepness of both sides of the barrier beach is considerable, providing protection from the wind and affording an excellent seasonal camping location. Noteworthy, in terms of inhabitability of Isle Haute, is the presence of two freshwater springs that have outlets along the south and west sides of the lagoon. In historic times, one of the main attractions of the Island to passing ships was the ready availability of freshwater.

It would appear that these organically richer areas resulted from human activity and, possibly, are the sites of former tent or wigwam structures.

2) Test pits along the elevated terrace produced a small amount of worked lithic material, at least confirming pre-contact occupation. Available time, however, did not permit any further testing. The area lies adjacent to one of the freshwater sources, and given its elevated vantage point, overlooking the lagoon and eastern end of the Island, it would have provided an ideal camping spot.

3) Although our findings are somewhat preliminary, it does not seem that Isle Haute served as a significant source for lithic raw materials used to produce stone tools and, hence, this was not a primary reason for people to come to the island. Most of the considerable amount of worked stone recovered is identifiable from mainland deposits of chert, chalcedony and rhyolite. Given the predominant volcanic character of this part of the Bay of Fundy, it was somewhat surprising that good chert or rhyolite sources were not found. The only available naturally occurring fine-grained materials were found in the occasional beach cobble.

4) Geological team members of the project were successful in locating a source for native copper on the island just west of the lagoon and barrier beach area. Significantly, a small quantity of rolled nodules of copper (probably in their natural state) were excavated in one of the test units. The copper was directly associated with buried cultural, fire-charcoal features and lithic scatter. This evidence suggests that copper was being sourced for tool making or non-utilitarian uses.

5) Two areas of lithic scatter were systematically excavated and each produced extensive samples of flakes and other byproducts of stone tool manufacture. One of the units had two layers of gravel beach containing stone flakes. A humic soil layer separated these layers. The intermediary stratum did not contain any artifacts suggesting two distinct periods of occupation. The occurrence of discrete artifact scatters along the beach may reflect a series of repeated occupations, but could also be interpreted as multiple dwellings within a single encampment.

6) Given the preliminary nature of this research, it is difficult to establish precisely when, and for how long,

Isle Haute was occupied by aboriginal peoples. One important clue was the finding of a distinctive corner-notched projectile point. Typologically, this style is associated with late prehistoric occupations from southern New Brunswick and eastern Maine dating from the period A D 1200–1400. Perhaps the closest related site comes from the Shediac area reported by K. Leonard (1996), where similar style arrow points dating from c. AD 1300 were found directly associated with native copper. A ground haematite artifact was also recovered that is typically associated with late pre-contact sites in Nova Scotia and Prince Edward Island. Research in the early 1980s at nearby Cape D'Or uncovered several earlier pre-contact occupations dating back c. 1200 and 2000 years ago, both associated with native copper (Keenlyside, 1983).

Unfortunately, human activities have also had a negative impact on the archaeological sites. The greatest damage was caused by the search for a rumoured, but almost certainly non-existent, treasure.

7) Who were these people? We know that Mi'kmaq oral traditions identify Isle Haute as a special place in the context of Glooscap stories and, historically, Mi'kmaq are recorded visiting Isle Haute. As well, the once abundant wildlife in Atlantic Canada in pre-contact times would logically would have made Isle Haute, an ideal habitat for sea life such as seals, walrus, fish and waterfowl. This fact, combined with the availability of freshwater, was likely Isle Haute's main attraction, probably primarily during the spring, summer and fall seasons. The island affords excellent visibility of the Bay and adjacent shorelines, yet has protected areas behind the high barrier beaches and elevated terraces.

8) One of the fieldwork objectives was to identify and evaluate the impact natural and human agencies have had on the archaeological resources. First, coastal erosion is an ongoing process in the Bay of Fundy and more generally across the Maritimes. Although precise information on erosional impact has not been established for Isle Haute, several comments can be made. Evidence of earlier occupation during the late Palaeo-Indian through to the Archaic period (9500–3500 years ago) probably has been removed by rising sea levels. It is estimated that sea levels were at least 30 metres lower 7500 years ago than today. In several areas, modern over-wash of cobbles was noted intruding on archaeological surface deposits. This process is continuing. Once disturbed, some archaeological material will be re-deposited at locations farther along the barrier beach due to longitudinal drift of the foreshore beach cobbles.

Unfortunately, human activities have also had a negative impact on the archaeological sites. The greatest damage was caused by the search for a rumoured, but almost certainly non-existent, treasure. Two large 5 metre crater-like depressions and numerous smaller depressions caused by random digging can still be seen at the south end of the barrier beach. Some of these disturbances were within the areas of lithic scatter, and have essentially destroyed the potentially valuable archaeological remains. Another factor having an adverse effect on these sites has been the removal of artifacts by individuals for personal collections. The Special Places Protection Act does offer protection to all archaeological sites in Nova Scotia. It is illegal to remove artifacts from archaeological sites or to damage these sites through metal detector searches or other forms of digging. Although the Island is isolated and not easily accessible, it is also difficult to monitor activities on these archaeological sites. In many instances, collectors do not realize the full impact of their actions, or that these sites are best left intact because they constitute a valuable heritage resource and should be preserved.

Summary

Our preliminary archaeological survey of Isle Haute indicates its use by aboriginal people 600–800 years ago, with earlier occupations being highly likely. Sourcing of raw materials for stone tools does not appear to have been a primary reason for occupation. It is most likely that Isle Haute was a seasonal food resource area for a virtual cornucopia of marine life to harvest. Few archaeological sites have been recorded on offshore islands, making Isle Haute especially significant. The full extent of the use of Isle Haute remains to be discovered from future investigations. And still, questions remain about the extent of use of the Bay of Fundy between 8000–400 years ago. Might some evidence of this earlier occupation remain on Isle Haute?

Crew and Thanks

The Isle Haute archaeological fieldwork was jointly conducted with the Canadian Museum of Civilization, Hull, QC. We would like to thank the following individuals who worked with us during our week on Isle Haute. They include Helen Keenlyside, David Kristmanson, Dan Conlin, Karen Gilhen, Michael Wilder and Robert Frame.

Fig. 8: Bob Grantham sports the latest in geological fashion. Safety was a key factor in working on the island. Hard hats, safety glasses, visibility-vest, and steel-toed boots were essential gear

Fig 9: Fractured columns of basalt are visible along the north shore.

Fig. 10: Native copper occurs on the northeast end of the shoreline outcrop. It occurs as sporadic blebs on the columnar joint surfaces.

Geological Reconnaissance of Isle Haute

Robert G. Grantham, and Martha E. Devanney
Nova Scotia Museum of Natural History

Introduction

The motivation to conduct a geological reconnaissance of the island came from the need to verify a special, old collection record; to study the nature and distribution of basalt on the island; and to obtain information on the type and distribution of chalcedony and chert. Five days were spent on the island conducting the work.

Geological Setting of Isle Haute

The island is composed entirely of basalt. It is part of the Triassic-Jurassic Fundy Basin and is called the North Mountain Basalt (**Fig. 11**). The North Mountain Basalt is a series of rapidly extruded lava flows and is widely accepted by most workers as being of early Jurassic age (Wade *et al.*, 1996) with a U-Pb zircon age of 202 ±1Ma. (Hodych and Dunning, 1992). It is found in Nova Scotia and on Grand Manan Island of New Brunswick. The impressive 100 m. Combined thickness flows forming Isle Haute's shear cliffs is only the surface expression of the total thickness of the basalt in the area of the island which is approximately 500 m (Fig. 21 — Wade *et al.*, 1996 reproduced here with permission as **Fig. 12**).

Massive outpouring of early Jurassic lavas took place around the globe at the beginning of the breakup of Pangea (Puffer, 1992). Rifting was well advanced at this time and the area was in a pre-continental drift position. World sea levels were much lower (Puffer, 1992). An extensive rift valley existed in early, eastern North America and gave rise to the rocks known as the Newark Supergroup (**Fig. 13**) The Supergroup in the Fundy Basin is represented by the Wolville Formation (Tw), Blomidon Formation (Tb), North Mountain Basalt (Jnm), McCoy Brook Formation (Jm) and its equivalent the Scots Bay Formation (Js).

The sedimentary formations (Wolfville, Blomidon, McCoy Brook and Scots Bay) are an impressive near 10km thickness of middle Triassic to middle Jurassic fluvial, lacustrine, playa and eolian **red beds**. Conglomerate, sandstone, siltstone, siliceous siltstone, cherty limestone and shale make up these units which are found below and above the basalt. The lithologies indicate an environment of deep rifting similar to the rift valleys of East Africa of today. The boundary of the Triassic and Jurassic formations records a mass extinction event (Olsen, P.E., N.H. Shubin and M. Anders, 1987). The cause of the mass extinction event remains a mystery. It is possible that it is related to the impact of a large bolide. Evidence of this event has been sought within Nova Scotia (Mossman and Grantham, 1998)

The greatest volume of the Jurassic age formations is beneath the central Bay of Fundy. Approximately 1000 m. of North Mountain Basalt and 2500 m of early to mid-Jurassic sedimentary units were deposited (Wade *et al.*, 1996). It is suggested that approximately 1 to 2 km of middle to late Jurassic sediments may have been deposited but has since been removed by erosion (Wade *et al.*, 1996).

An overview description of the Fundy Basin Jurassic formations is contained in the paper by David J. Mossman and Robert G. Grantham, *The Continental Jurassic of the Maritime Provinces Canada*, (Morales, ed., 1996).

The North Mountain Basalt is a basic volcanic rock. It is a high-titanium, quartz-normative tholeiitic basalt. It is suggested that the source is subcontinental lithospheric (Greenough *et al.*, 1989; Dostal and Greenough, 1992; Puffer, 1992). The feeder system is a point of discussion. Wade et al. have suggested that there are two possible sources for the narrow fissure eruption system: the Grand Manan Fault system or the basin axis, on the northern side of Cobequid Bay, running between Cape Split and Cape Sharp/Partridge Island and extending to near Grand Manan.

The basalts were extruded during a relatively short

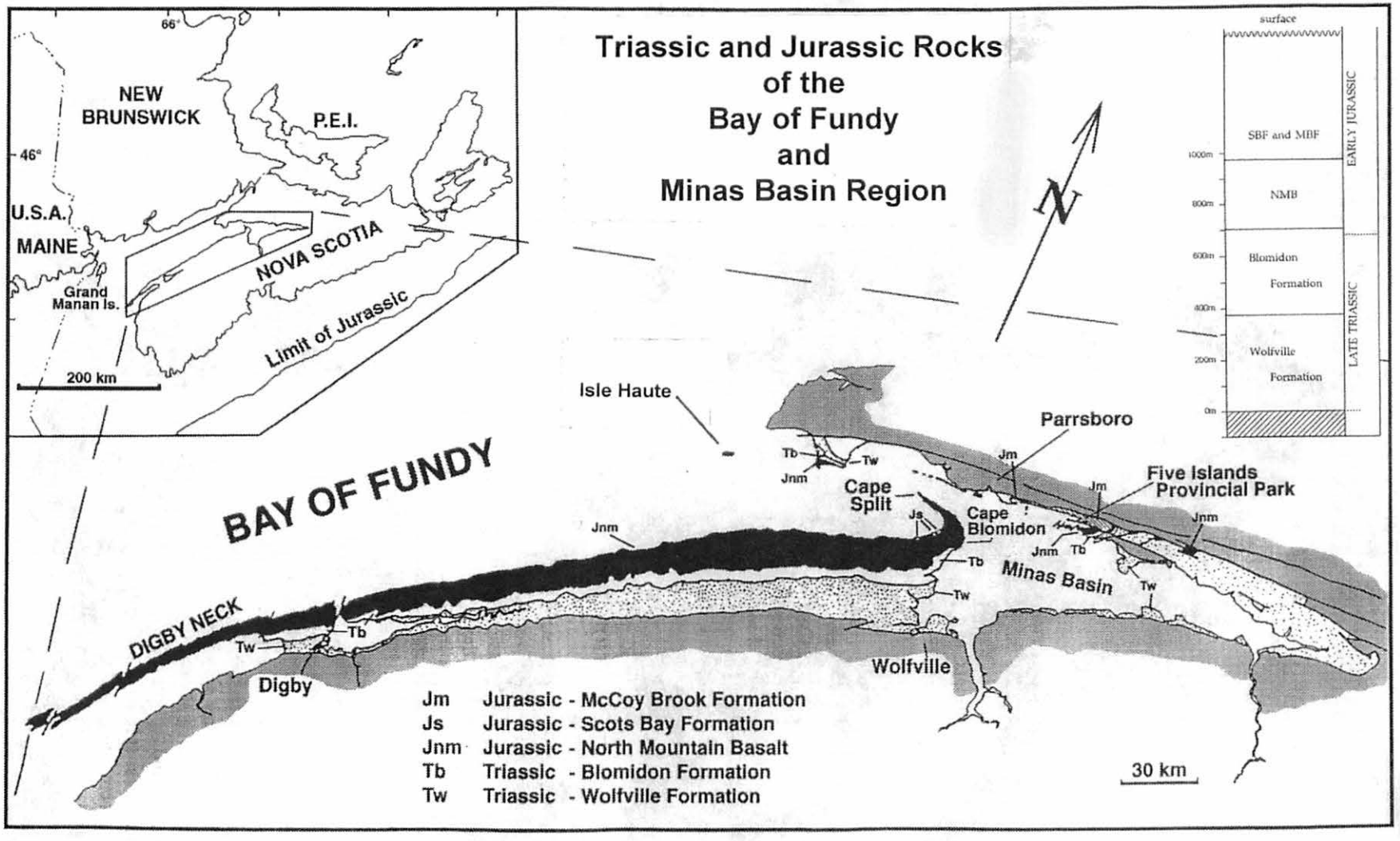

Fig. 11: Map showing the distribution of Triassic and Jurassic formations in the Bay of Fundy.

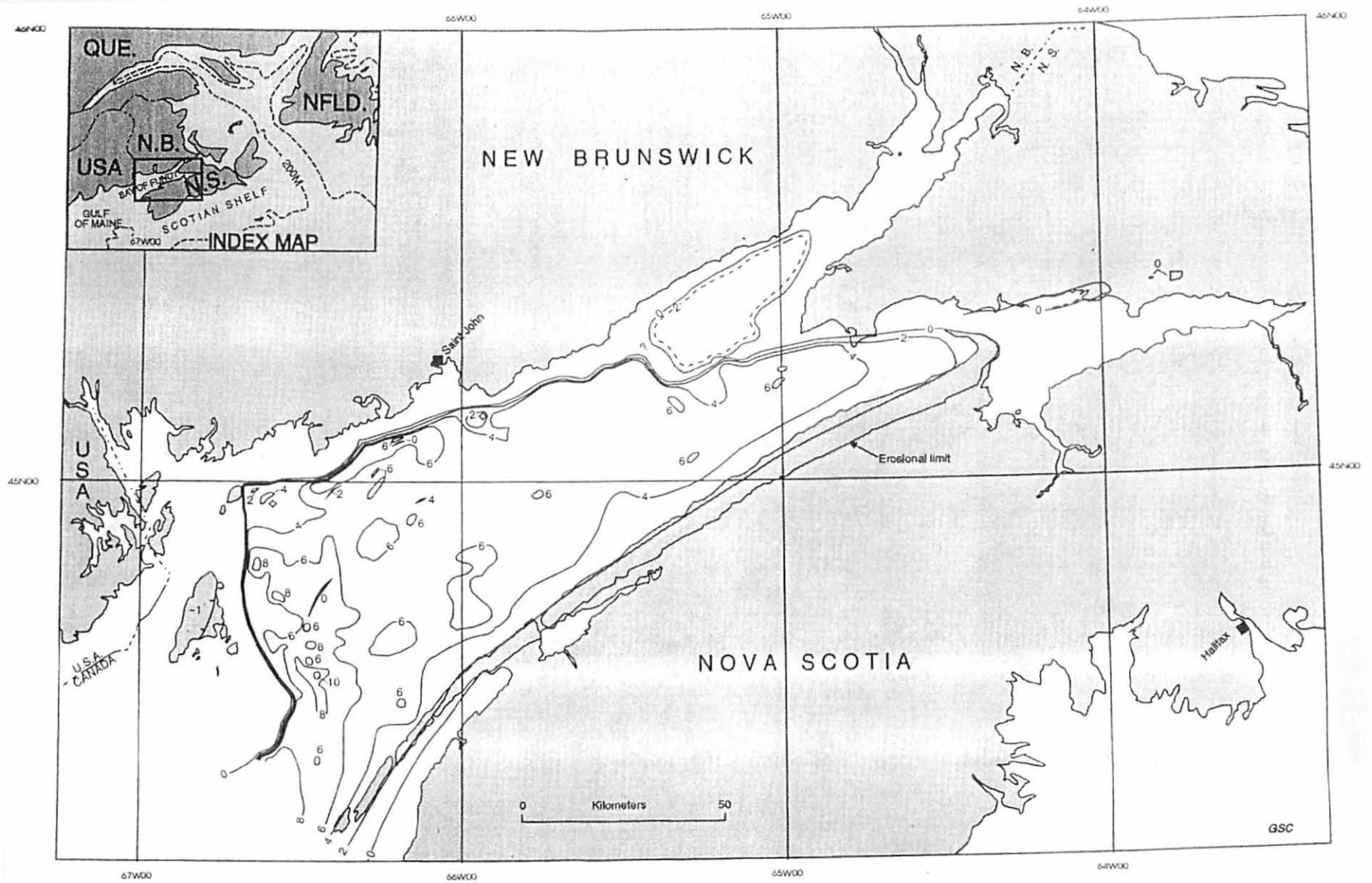

Fig. 12: Isopach map showing thicknesses of North Mountain Basalt in the Fundy Rift Basin.

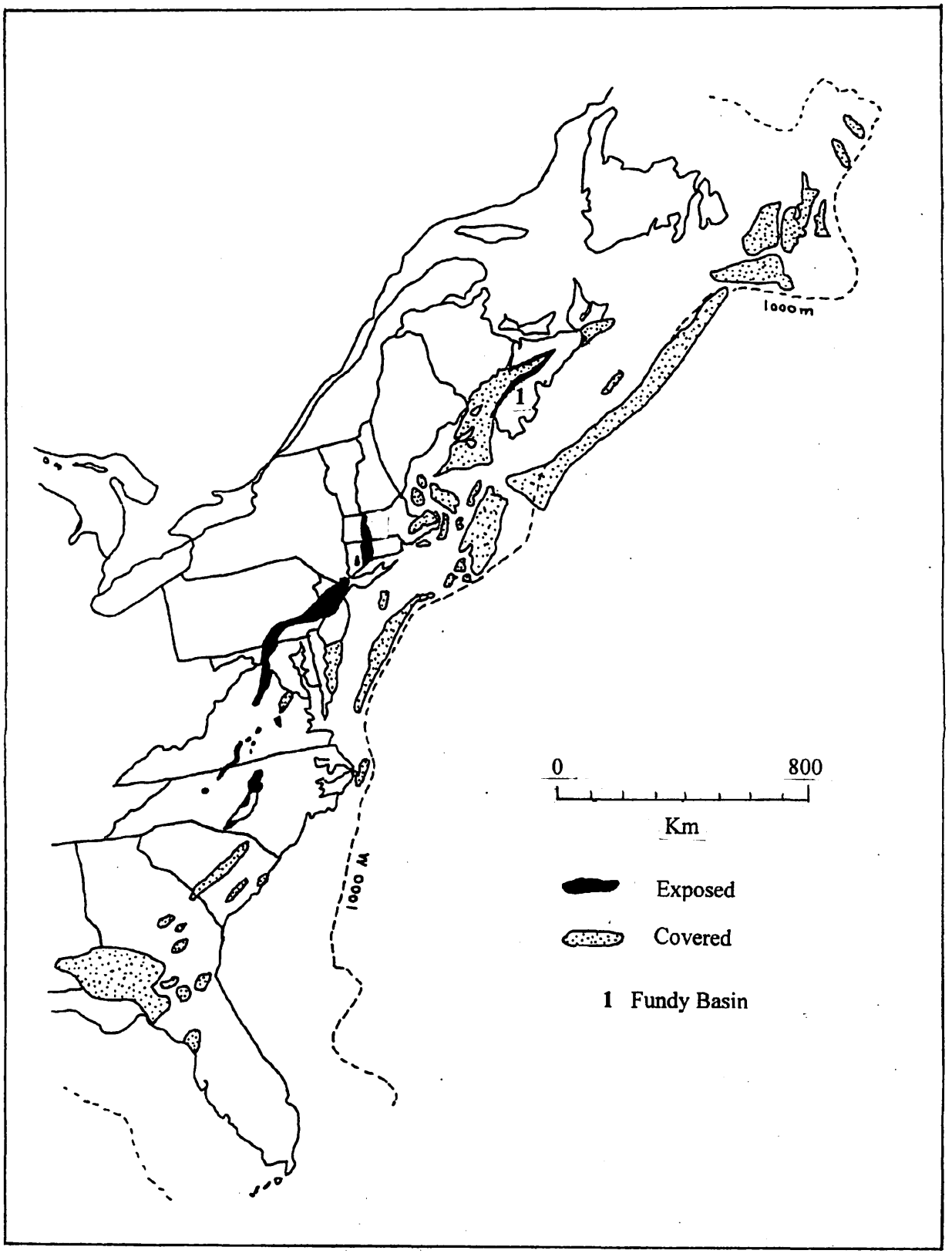

Fig. 13: Distribution of the Newark Supergroup in eastern North America.

period, ca. 550,000 yrs (Olsen *et al.*, 1989). In support of this is the fact that there are a few thin (less than a metre), and of small linear extent (less than 50 metres) interflow beds of reddish-brown sandstones (Colwell, 1980; Colwell and Cameron, 1985). Examples of the interflow beds can be found in the shoreline exposures between Black Rock and Harbourville. They are not found on Isle Haute.

The North Mountain Basalt has been divided into three separate units (Papezik *et al.*, 1987; Jones and Mossman, 1988). A 190m thick, ponded flow in the Digby area is the lower unit; a middle unit is composed of several, thin flows totalling 50m which are distinguished by their amygdaloidal nature; and a third, upper unit of coarse-grained basalt totalling 160 m maximum. Isle Haute is composed of this upper unit. The lower unit, covering an area of about 10,000 square kilometres makes it one of the greatest outpourings of lava on the face of the planet. It has been compared to the Hawaiian style of lateral dyke injection-fissure eruptions (Papezik *et al.*, 1987).

Isle Haute

The flows on Isle Haute demonstrate well the nature of the North Mountain Basalt, having continuity along strike and showing good flow contacts. Basalt columns are visible only on the north side of the island. One area of interest on the south side of the island displayed a suspected spinifex texture (photo 97.22.02). It has since been proven not to be a spinifex texture.

Unique Challenges

The entire geological survey of Isle Haute took place on the basalt exposures that make up the island's shoreline. There are a number of challenges and hazards to working in this setting:

- Field work must be planned around the Bay of Fundy tides -tidal variance of over 15 metres (50 ft).
- Beach composed of rounded, unstable, cobbles of varying sizes, some covered with seaweed. Steel-toed boots required for uneven terrain.
- Steep incline of approximately 15 degrees on the cobble beach.
- Basalt cliffs of up to 100 metres (300 ft). Rock falls frequent. Hard hats required.
- All field equipment (rock hammer, chisels, safety glasses, sample bags, etc) and necessities (food & water) must be carried. Specimen collection added a great deal of weight to backpacks on return to base camp.

Field Work with Comments

Day 1—July 13, 1998

Specimens 97.16.01 to 97.18.05; Photos 97.16.01 to 97.16.03

Once Base Camp was settled, went east around Tip Rip to the Giant Boulders and the Stack on the island's south side. Specimens examined and collected from the cobble beach are largely "float", some basalt and associated minerals which originate from the island and surrounding area, and other more exotic rocks and minerals carried from other locations by currents, tides and glaciers. There are several shear zones where movement has crushed rock in the area making it easier to erode.

Day 2—July 14, 1998

Specimens 97.20.01 to 97.24.01(a); Photos 97.20.01 to 97.22.03

Go to Seal Cove on the south side near the island's west end. Distinct horizontal layers indicate up to five separate basalt flows. Most of the basalt is coarse grained, but some areas are vesicular with gas bubbles "frozen" in rock. There is a little amygdaloidal basalt, which results when secondary mineralization later fills the gas vesicles with minerals. Glassy unit indicates area of rapid cooling. Collect specimens of minerals from the zeolite family, which have a framework of aluminosilicates combined with sodium (Na) and calcium (Ca). Zeolites, such as stilbite (provincial mineral), heulandite, thompsonite and natrolite are commonly found in cavities and veins in basalt. Find clear variety of the mineral, apophyllite at Cohen's Crevasse -confirms suspected locality of similar specimen in museum Geology Collection. Apophyllite is often a mineral that is found in association with zeolite minerals. This is the only known locality for clear apophyllite in Nova Scotia.

Day 3—July 15, 1998

Specimens 97.24.01(b) to 97.28.03; Photos 97.28.01 to 97.28.03

Return to Seal Cove to collect additional specimens of zeolite minerals (including analcime) and apophyllite. Several varieties of the mineral quartz collected, including amethyst, porcelain agate and jasper.

Day 4—July 15, 1998

Specimens 97.30.01 to 97.36.01; Photos 97.30.01 to 97.36.01

Went to Boar's Head on the north shore near the western tip of the island. Basalts in many areas on this

side of the island show well-defined columnar-jointing. This hexagonal pattern develops as a result of shrinkage cracks that form during cooling. Some of the basalt columns further fractured. Some blebs of native copper were found *in situ* (where they were formed) in fractured basalt columns approximately 250 to 300 metres west of Base Camp. This copper formed as the result of secondary mineralization. There are several talus slopes of loose, unconsolidated material that has fallen from cliff faces to form rock slides.

Day 5—July 16, 1998

No field work—no field assistant. Organized geological specimens collected. Packed up Base Camp.

Acknowledgements

Several people played a role in the geological component of the expedition. Chief geologist, Robert Grantham on secondment to the Department of Natural Resources at the time of the expedition and now returned to the Museum of Natural History, was assisted by Martha Devanney of the Museum of Natural History. In addition, Ken Adams of the Fundy Geological Museum, and geology technician, Darren Drake, assisted for one day of the expedition. The expedition also benefited from the cooperation of two groups holding the mineral rights on the island - Doug & Heather Boddy; and Ian Booth.

Results of Work

The collections made, and photographs taken are listed in **Appendix 2**. The work was solely confined to the shoreline with only one 30-minute hike from the camp site up the trail to the first clearing at the top. This gave the brief opportunity to observe a thin, red, fine-grained clay till (?) underlying the organic soil on the top of the island. This late observation requires further on-site study to enable a statement be made with regard to the glacial history of the island.

Of note was the absolute rarity of micro-crystalline quartz varieties. The specimen record of clear apophyllite in the collection has been verified as coming from Isle Haute. It is possibly the Chipman specimen. However this cannot be confirmed. The best zones and only in situ chalcedonies were found near Boar's Head (see collections list).

Fig. 14: 1995 aerial photo of the island.

Fig. 15: Alternate-leaved Dogwood, *Cornus alternifolia*

Fig. 16: The ravine running down to the salt pond.

Fig. 17: Indian Cucumber-root, *Medeola virginiana*

Fig. 18: Toothwort, *Dentaria diphylla*

Fig. 19: Unique arctic-alpine flora can be found on cliff faces.

The Vascular Plants of Isle Haute

Alex Wilson, Manager of Collection Management, Nova Scotia Museum of Natural History

For an area as small as Isle Haute, the number of vascular plants species is surprisingly large. We have records of almost three hundred taxa. Sable Island nd Bon Portage Island are both larger but have shorter species lists. It should be noted that the diversity of island biota depends on several factors, including range of habitats, human disturbance and degree of isolation from the mainland.

Our list has been assembled from earlier collections at the Nova Scotia Museum herbarium which includes numerous specimens collected by W. B. Schofield and J. S. Erskine in 1953; collections and records made by J. Jotcham and F. Fergus in 1981 for the Roland Herbarium at the Nova Scotia Agricultural College; and specimens and records from the EC Smith Herbarium at Acadia University made by Ruth (Hersey) Newell (1980) and Etta Hudgins (1977). The EC Smith Herbarium also contains many records from Schofield, Erskine and Jotcham. Records from Mike Crowell's 1993 survey and Ray Fielding's records from 1996 have also been added. Our additions to the list from this Nova Scotia Museum Expedition (those marked with ***) are modest, although new specimens (marked with an *) have been added to the museum herbarium.

Our botanical investigations on this trip were restricted to the eastern half of the island. It is quite possible that some additional specimens, most likely grasses, may be found in the Dalhousie Herbarium from collections made by Dr. M.J. Harvey (c. 1970). I am grateful to Ruth Newell, Marian Zinck and Nancy Muzzatti for compiling this list.

The most conspicuous plant community occupies the "top" of the island. Much of this area has been disturbed in the past by agricultural endeavours (cultivated fields and rough pasture land), by burning and, possibly, by logging. Many of the previously open areas (see Fig. 20) are now growing up in White (Pasture) Spruce (*Picea glauca*) and Alder (*Alnus viridis*) (see Fig. 16). But there are still conspicuous fields around the old lighthouse site where the modern navigation tower now stands.

These open areas contain a mixture of grasses and forbs (thistles, raspberry, horsetail, buttercups, hairbells, chickweed, timothy, asters, goldenrod, vetch, clover, etc), some native, many introduced (example of white and pink yarrow growing together). The area to the east of the old lighthouse is primarily White Spruce but the air photo taken in October 1996 shows some deciduous trees, possibly White Birch. The grass slope at the very west end of the island may support additional plant species.

The ravine and associated slope running down to the pond and barrier beach on the east end of the island is of particular botanical interest. It is a mosaic of mixed and deciduous stands of varying ages. The area is accessible via the old wagon road which leads from the beach (formerly the site of a wharf and a shed) up to the foundation of the old light house and the more recent navigation tower. The track runs parallel with the ravine for some distance and there are a few trails off to the sides. The trees are not noteworthy for their size with the exception of a few birches growing on a small plateau on the south side of the ravine. Ray Fielding reported other large trees on the south side of the island further to the west. They may have survived cutting and fire by virtue of their inaccessibility. Other plants in this older stand included Small Enchanter's-Nightshade (*Circaea alpina*) and Oak Fern (*Gymnocarpium dryopteris*).

Near the bottom of the slope, just above the brackish pond, is another plateau on the north side of the ravine (Indian Flats). This area of small deciduous trees was thought, by the archeologists, to have once been used by First Nations People possibly as a camp or work site. A preliminary survey revealed some stone tool flakes. A brief botanical survey yielded Indian Cucumber Root (*Medeola virginiana*) the root of which is thought to have been eaten by the Mi'kmaq.

A careful search was conducted along the bottom of the ravine for toothwort. An earlier collection was annotated as *Cardamine* x *maxima* which is the only record of this taxon from Nova Scotia. A small patch of toothwort was located just above the stream which runs most of the length of the ravine. Despite the robust

Fig. 20: 1951 air photo of Isle Haute. Note extensive burned areas to the east of the cultivted zone near the lighthouse.

nature of these plants, the specimen was identified as the more common *Cardamine diphylla*. Other plants in this area included White and Yellow Birch (25–30 cm DBH), Mountain and Moose Maple, American Beech, and Balsam Fir. Impatiens is abundant along the stream in some spots and the slopes harbour numerous ferns including Rocky Polypody (*Polypodium virginia*), Lady Fern (*Athyrium filix-femina*), Spinulose Wood Fern (*Dryopteris spinulosa*). The leaves of a *Prenanthes* species grow to a remarkable size. Rattlesanke-root (*P. alba*) has been reported by one researcher. As no specimen is on file, this remains to be confirmed. If present, it would be the first locality for this more southern species, in Nova Scotia. The Alternate-leaved Dogwood (*Cornus alternifolia*) which grows along the slope has a remarkably fine appearance. The leaves, which are generally undamaged, have a bluish cast.

Another habitat which is relatively inaccessible but deserves attention are the cliff faces. Although sparsely vegetated, some of the arctic-alpine species which have been well-documented at Cape d'Or, Cape Split, and at other points along the Bay of Fundy, grow here. These include *Primula laurentiana*, *Sedum rosea*, *Huperzia selago*, and *Woodsia ilvensis*.

The outer barrier beach and shorelines around the base of the cliffs are sparsely vegetated although the Geology teams did note masses of macroscopic seaweeds on some outcrops. The shores of the pond which include the inner barrier beach, do support typical halophytes like Orach (*Atriplex patula*) Beach Pea (*Lathurus maritimus*), Seashore Plantain (*Plantago maritima*), Black-grass (*Juncus gerardii*), White Spruce (*Picea glauca*) and Scotch Lovage (*Ligusticum scothicum*).

However it was the lichen flora of this inner barrier beach which attracted the greatest attention. Research Associate Karen Casselman has recorded this diverse cryptogamic community, and a summary appears in this report as Appendix 5.

Fig. 21: Lichens on basalt.(T.Casselman photo)

Preliminary Report on 1997 Collections of Isle Haute Lichens

Karen Diadick Casselman, Research Associate, Nova Scotia Museum of Natural History

The lichens of Isle Haute reflect the human disturbance that has characterized the island's history. Foot traffic on the trails and human disturbance on the beach, in addition to natural occurrences such as storms and severe weather, all have affected the lichen flora of Isle Haute. Beach cobble is heavily lichenized, to such an extent that a complete inventory would take several weeks to compile. In contrast, smaller trees such as *Alnus* and *Betula* are relatively lichen-free on Isle Haute, which would not necessarily be the case in similar habitats on the mainland.

A number of macrolichens common on the mainland are apparently absent on the island, particularly showy genera such as *Platismatia.* While this may be due to a lack of suitable substrate (i.e. large trees such as *Acer* and *Picea*), other less easily identified macrolichens have proliferated. *Parmelia saxatilis*, a greenish-grey lichen that normally occurs on rock, and the very similar *P. sulcata* which is common on ornamental trees, are both to be found in their usual location on Isle Haute as well as on additional substrates. That these and the bright orange *Xanthoria parietina* were particularly conspicuous near former latrine sites is consistent with lichen abundance in nitrogen-enriched environments.

Among the most recognizable saxicolous lichens on the main Isle Haute beach is the so-called map lichen, *Rhizocarpon geographicum.* To describe this species as 'common' on the island would not do justice to a profligacy that rivals sub-alpine zones in Cape Breton Highland Park where this same bright green and black lichen is also extremely common. Among the more amusing finds amid the cobble were two bones completely lichenized with a thick crust of *Xanthoria polycarpa.* Clearly these 'orange artifacts' derived from mammals; thus *X. polycarpa* specimen# 1 is tagged 'pig leg bone'; and specimen # 2, 'pork chop'.

Lastly, it is interesting to compare our sampling with John Erskine's Isle Haute collections from forty years ago. Why was his list so short? Erskine made a number of trips to the island, but it possible that his lichen sampling was but one of many botanical chores. Among the Erskine collections we did not find, is the very common Nova Scotia lichen *Cladonia rangiferina.* I saw no indication of suitable habitat for this upland species which on the mainland occurs generally where one finds *Kalmia, Rhodora canadensis* and *Vaccinnium* spp., or alternatively, in bogs.

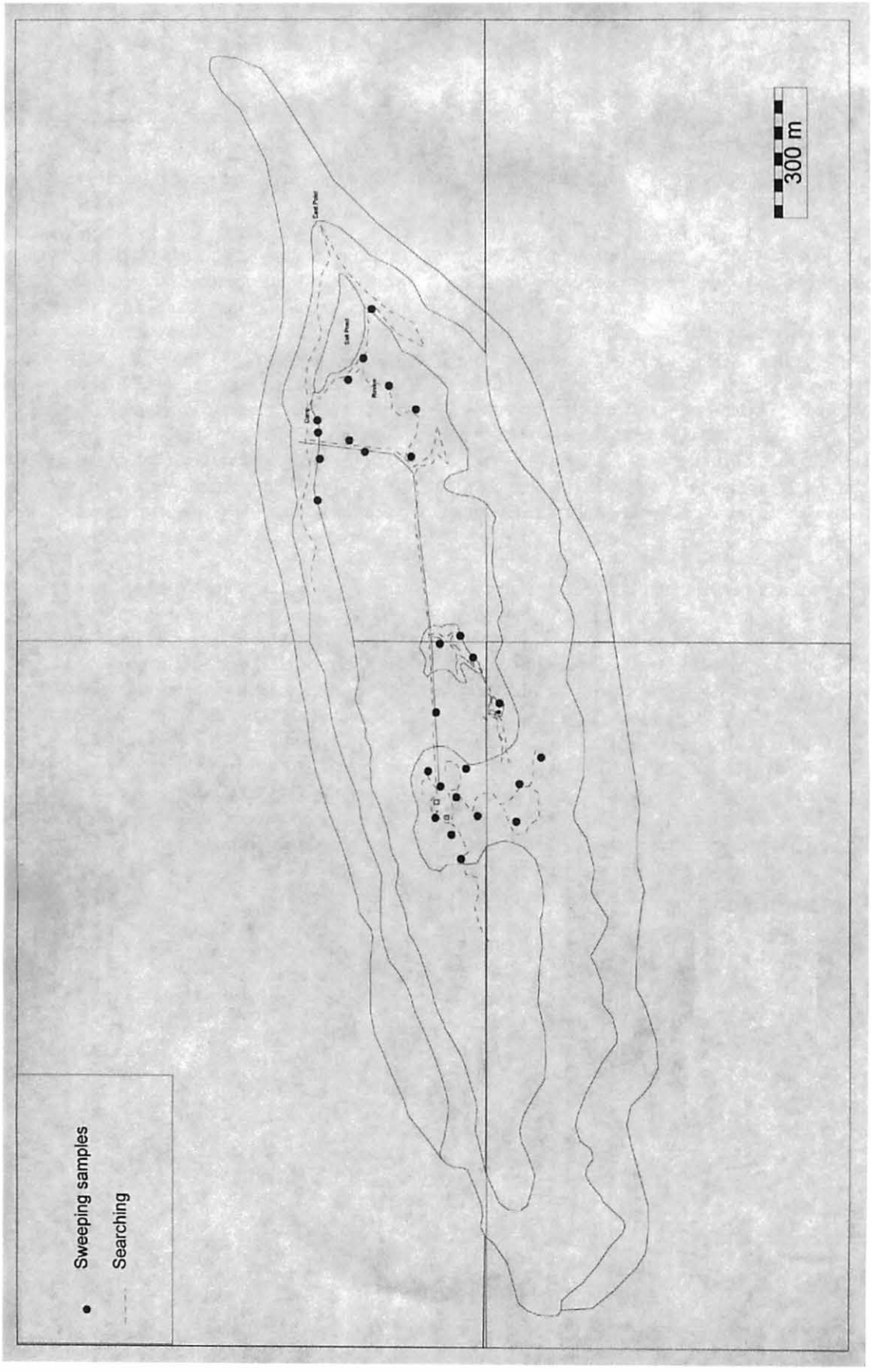

Fig. 22: Plan of Isle Haute showing areas covered during searching (dashed lines), and locations of beating and sweeping samples (solid circles).

Preliminary Results of Invertebrate Sampling

Calum N. Ewing, Assistant Curator, Nova Scotia Museum of Natural History

Introduction

The invertebrate fauna of Nova Scotia has not been extensively studied, with the exception of selected taxa (for example Brunelle, 1997; Ferguson, 1955; LeBlanc & McClung, 1979; Wright, 1979). Similarly, the fauna of Nova Scotia's offshore islands has not been comprehensively sampled although Wright (1985) presented a faunal list for Sable Island that included invertebrates, and reported several significant records for Nova Scotia.

The earliest records of invertebrate collections on Isle Haute appear to be those of Dr. Charles Townsend in 1921. He collected specimens of *Gnaphosa muscorum* (L. Koch) on Isle Haute (Platnick & Shadab, 1975) while studying the birds of the island and the surrounding mainland areas (Townsend, 1922). In 1953, D.C. Ferguson visited the island and recorded 46 species of Order Lepidoptera (Nova Scotia Museum, unpublished data). Specimens of several of these taxa and a few other orders of insects (Plecoptera, Hemiptera, Coleoptera, Diptera and Trichoptera) were preserved in the collection of the Nova Scotia Museum.

Methods

The invertebrate fauna of Isle Haute, Cumberland County, was sampled on October 21, 1996 and July 14-18, 1997. Samples were collected from all habitats represented on the island in a qualitative manner to assess the diversity of invertebrate taxa present. No quantitative sampling was conducted to assess biomass. A previous study of the invertebrates of the island focussed on Lepidoptera, the focus of the collection effort during this study was placed on the non-insect invertebrates and insect orders other than lepidoptera. Samples were collected by searching, beating, sweeping, pitfall traps and separation from leaf litter.

Searching

Searching was conducted in all habitats by examining areas likely to contain invertebrate specimens (Fig. 22). Microhabitats sampled included: under rocks and boards, under the bark of rotting logs, and on the surfaces of tree trunks and herbaceous plants. Once located, specimens were collected by hand or aspirator into glass vials, and preserved in 70% isopropyl alcohol by volume).

Aquatic specimens were collected by hand or with a fine mesh nylon dip net into glass jars and preserved in 10% formalin (by volume).

Beating and sweeping

Specimens were collected from trees and shrubs (Fig.22) by beating branches over a 1.0 m x 0.6 m white cloth. Small dislodged specimens were then collected by aspirator while larger specimens were collected directly into glass vials.

Specimens were swept from shrubs and herbaceous plants using a 0.5-m-diameter sweep net. Samples were transferred to killing jars with ethyl acetate as a killing agent. Once dead, specimens were transferred to glass vials. Specimens were preserved in 70% isopropyl alcohol (by volume) in the field.

Separation

Leaf litter samples were taken at two locations (Fig. 23) representing older hardwood dominated forest and young mixed woods. Litter samples were collected from 0.25-m^2-areas taking all litter down to soil level and returned to the laboratory in labelled plastic bags. As soon as possible samples were processed with a berlese funnel consisting of an aluminum funnel with a 1.25 cm mesh screen. The funnel was placed over a collecting jar with 70% ethyl alcohol (by volume). A 25W incandescent light bulb mounted in a metal reflector was placed over the sample. The samples were tended daily and dry litter was removed and checked for dead or trapped arthropods. In this manner, each sample required three or four days to process.

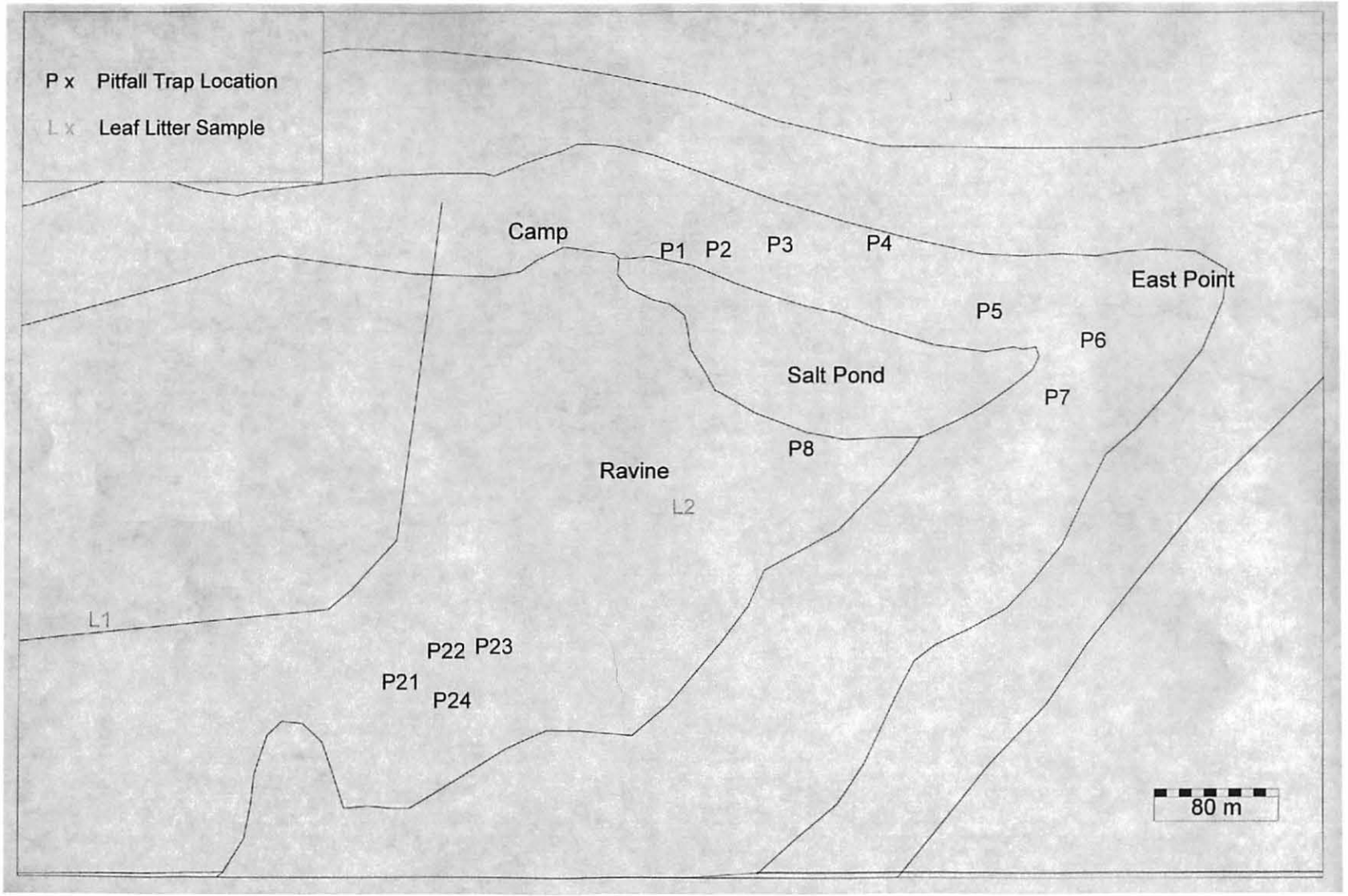

Fig. 23: Plan of east end of Isle Haute showing locations of leaf litter samples L1 (young mixed woods along trail), L2 (older hardwood dominated woods in ravine) and locations pitfall traps (Px). Pitfall traps P1–P8 were set on cobble and gravel beach; P21–P24 were set in spruce -alder woods. Traps P22 and P24 were baited with rancid beef liver.

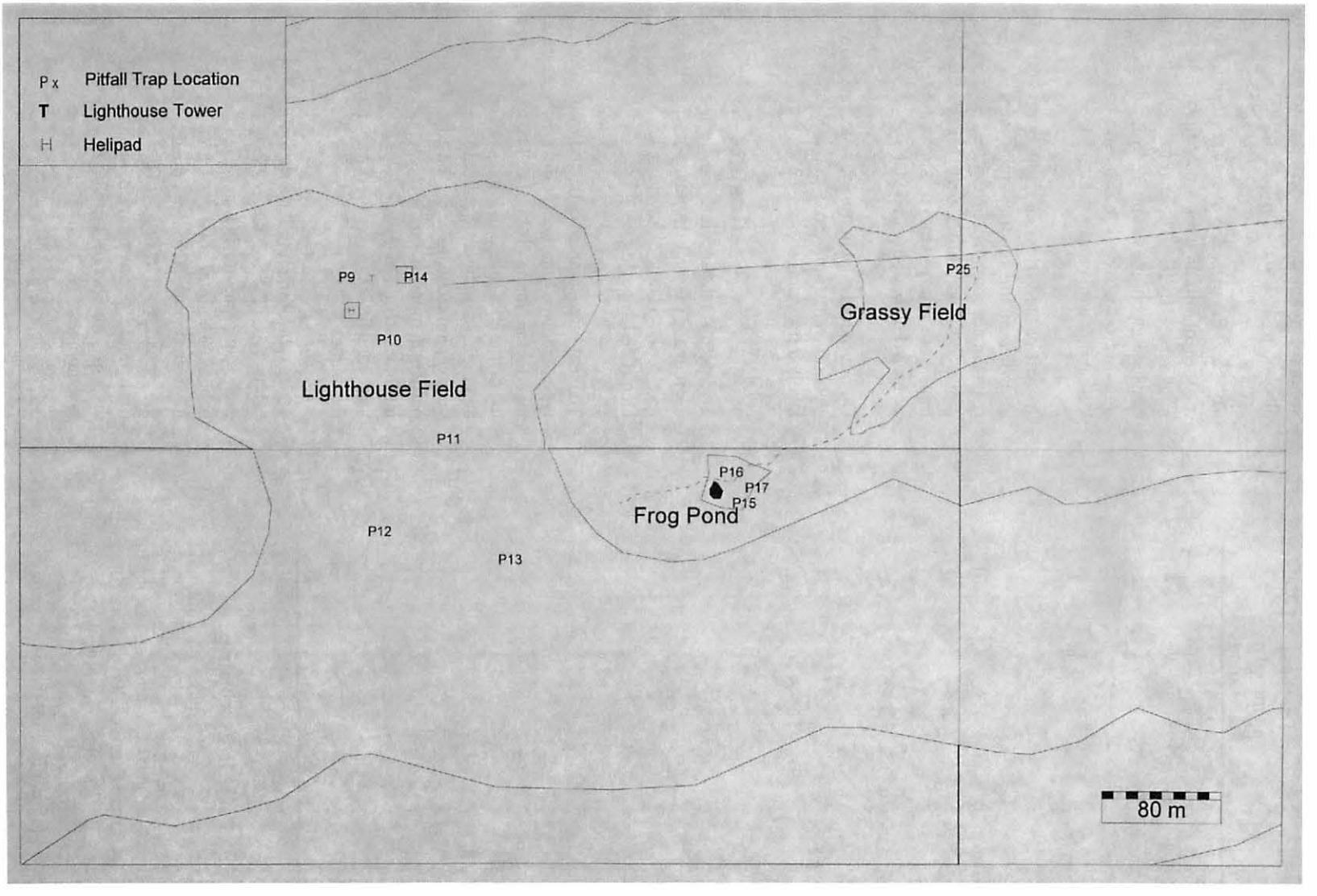

Fig. 24: Plan of centre portion of Isle Haute showing location of pitfall traps (Px). Pitfall trap P14 was placed at the base of the foundation of the old lighthouse. Traps P15–P16 were placed in waterlogged soil surrounding the small pond.

Table 1. Preliminary results of leaf litter samples

Taxa	L1-young mixed hardwoods	L2-older
Mollusca		
Gastropoda	3	2
Araneae		
Hahniidae	2	
Lycosidae		1
Linyphiidae	8	13
Pseudoscorpiones		
Neobisidae		10
Acari		
Oribatida	31	83
Mesostigmatida	26	45
Collembola		
Entomobryidae	21	31
Poduridae	88	150
Sminthuridae	5	9
Homoptera		
Aphididae		1
Coleoptera		
Carabidae	1	
Ptiliidae	1	
Staphylinidae	1	1
Diptera		
Sciaridae		1
Lepidoptera		
larvae	1	
Hymenoptera		
Braconidae		2
Diplopoda		
Caseyidae		1

Pitfall Trapping

Pitfall traps were set in all habitats encountered (Figs. 23, 24). Traps consisted of 500 ml white plastic beverage cups sunk into the ground so that the lip was flush with the ground surface. Traps were filled with 150-200 ml of 50% ethylene glycol (by volume) antifreeze in water as a killing agent and preservative. The traps were left in place for three to five days when the contents were recovered into glass jars and returned to the laboratory. Samples were rinsed in 35% (by volume)ethyl alcohol, sorted and stored in 70% ethyl alcohol in glass vials until identified.

To assess the presence of carrion-feeding arthropods, a series of pitfall traps was baited with 30-50g of rancid beef liver. These traps did not contain the ethylene glycol preservative. Specimens from baited traps were recovered into plastic bags and killed in killing jars with ethyl acetate.

As part of the vertebrate trapping program, described elsewhere in this report, similar traps were set. These traps did not contain preservative and were baited with moist dog food. Any invertebrates collected in these traps were removed into plastic bags then preserved in isopropyl alcohol in glass vials.

On return to the laboratory all specimens in isopropyl alcohol were transferred to 70% ethyl alcohol and labelled for storage.

Results

To date, all of the specimens collected have been sorted to order and the majority have been identified to family level only. Only a few taxa have been completely identified to species.

The leaf litter samples collected from different habitat types showed markedly different assemblages of invertebrate fauna (Table 1). The older hardwoods in the ravine above the Salt Pond showed greater diversity and higher numbers of animals than the sample from younger mixed woods on the top of the island. Of particular note is the occurrence of the Caseyid millipede *Underwoodia iuloides* (Harger) in the hardwood litter sample, the only Diplopod collected on the island.

The results of the pitfall trap samples were grouped by habitat type (Table 2) where the specimens collected in each trap were amalgamated with those in the same habitat. The total number of trap days was calculated for each habitat. The abandoned field habitat showed the greatest diversity. The cobble beach and freshwater pond margin habitats showed similar diversity (numbers of families) but somewhat different assemblages.

Table 2. Preliminary results of pitfall trap samples from Isle Haute, 1997

Taxa		Cobble Beach 24 TD	Abandoned Field 18 TD	Wet Pond Margin 9 TD	Young Mixed Woods 8 TD*	Older Hardwoods 251 TD*
Gastropoda:	Helicidae		X			
Gordioida:	Gordea				X	
Araneae:	Theridiidae		X			
	Linyphiidae (Erigoninae)	X	X			
	Amaurobiidae					X
	Hahniidae		X			X
	Lycosidae	X	X	X		
Opiliones:	Phalangidae	X	X			X
Acari:	Mesostigmatida	X	X	X		
Collembola:	Entomobryidae		X			
	Sminthuridae	X	X	X		
	Poduridae	X	X	X		
Homoptera:	Cicadellidae		X			
Coleotera:	Carabidae		X		X	X
	Staphylinidae		X			
	Scarabeidae		X			
	Cerambicidae	X				
Diptera:	Culicidae			X		
	Sciaridae	X	X			
	Tephritidae		X	X		
	undetermined		X	X		
Lepidoptera:	undetermined larvae		X			
Hymenoptera:	Braconidae?		X			
	Formicidae		X			

* Dry traps only--no preservative used; TD = trap days

The list of invertebrates recorded from Isle Haute (Appendix 6) to date represents at least eighty-five families of which 46 families are insects. Some orders (eg. Acari) have not yet been identified to family and will undoubtedly increase this number. Five of these families include taxa not previously represented in the Nova Scotia Museum of Natural History collection. Of particular note are the occurrences of a number of taxa of European origin including the Machilid bristletail *Petrobius brevistylis* Carpenter, the terrestrial isopods *Oniscus asellus* L., *Porcellio scaber* Latreille and *P. spinicornis* Say and the Lithobiid centipede *Lithobius forficatus* (L.).

The assemblage of Ground Beetles (Carabidae) present on the island (Appendix 7) shows a distinct change in 1997 from the species collected in 1953. The only species collected in 1953, *Harpalus affinis* (Schrank) was not collected in 1997. It is unknown, however, how extensive the collecting effort was in 1953 with respect to non-lepidopterous taxa.

Discussion

Since the identification of the invertebrate material collected on Isle Haute is incomplete, it is difficult to conduct any analysis of the data available. The higher diversity and numbers of animals in the litter samples from the hardwood-dominated ravine most likely reflects the more disturbed nature of the younger forest habitat on the top of the island. This part of the island was burned regularly to clear pastures for livestock until the mid 1950s (Erskine, 1956). The ravine above the Salt Pond shows greater domination by hardwoods and generally larger trees indicating a longer period of relatively undisturbed development. The occurrence of the diplopod *Underwoodia iuliodes* (Harger) in this ravine habitat represents the third locality for this species in Nova Scotia. It has been found in other hardwood forest areas, including the McFarlane Woods Nature Reserve and is one of only two species of diplopods native to North America (Shelley, 1988).

Assemblages of carabid beetles are often used as a tools to assess habitat types and changes after disturbance (eg. Holliday & Hagley, 1978; Loreau, 1992; Quinn *et al.*, 1991). It appears that the carabid fauna of Isle haute has undergone some change following the abandonment of agricultural activities in the 1950s. Many of the species of carabids collected in 1997 are typical of wooded habitats (Downey & Arnett, 1996) and occur in these habitats as well as the abandoned fields on Isle Haute. Although it is unknown how extensive the efforts to collect carabids were in 1953, it is significant that the single species collected then, *Harpalus affinis* (Schrank), was not collected in 1997. Pearsall & Walde (1995) did not find *H. affinis* in abandoned orchards in the Annapolis Valley, Nova Scotia, although it did occur in active, organically managed orchards. This supports the apparent disappearance of this species from the island following the discontinuance of agricultural activities. Other species occurring on Isle Haute, including *H. rufipes* DeGeer and *Pterostichus coracinus* Newman, were commonly found in abandoned orchards.

The high proportion of introduced European taxa in the invertebrate fauna of Nova Scotia has been noted previously (Wright, 1985). The Machilid bristletail *Petrobius brevistylis* Carpenter was first reported from Nova Scotia by Bousfield (1958), as *P. maritimus* L. It has subsequently been reported from several locations on the shores of the lower Bay of Fundy and the Atlantic coast of Nova Scotia (Bousfield, 1962, Wygodzinski & Schmidt, 1980). Isle Haute is the ninth locality reported for this species and the only reported location in the upper Bay of Fundy. Wygodzinski and Schmidt (1980) suggest that this species which occurs exclusively in the splash zone of rocky shores was likely carried to North America as eggs attached to rocks used as ballast in sailing vessels. This would also likely explain its occurrence on Isle haute as this island hasbeena stopping place for vessels for several centuries.

The Lithobiid centipede *Lithobius forficatus* (L.) is another European arthropod that is typically found only near human settlements or open disturbed habitats (Eason, 1964). It has been introduced into Newfoundland, Nova Scotia and much of eastern North American where it has become completely naturalized, often displacing other large native centipedes (Palmén, 1954). On Isle Haute it was the only chilopod found and occurred only in the high disturbed area around the camp site above the beach. Similarly, the terrestrial isopods collected were most abundant in the area of the campsite and all three species collected are European introductions (Lindroth, 1967).

The mode of colonization of islands by arthropods is the topic of much investigation. Flying insects and other aerially dispersing invertebrates, such as spiders, can easily make the crossing from the mainland to Isle Haute. The distribution patterns of these invertebrates on islands does not normally differ significantly from the distributions expected based on mainland populations (Enckell, *et al.*, 1987). Bousfield (1962) sited transport on marine flotsam as an important vector for the dispersal of non-flying arthropods and suggested that this could partially explain the high incidence of species such as *Oniscus asellus* L. in the intertidal areas of shorelines. Transport to islands through human activities has also been shown to be an important vector, particularly with respect to non-aerially dispersing taxa which often persist on islands only in habitats disturbed by human activity (Enckell, *et al.*, 1987). The significant proportion of anthropochorous invertebrate species present on Isle Haute supports the importance of human transport as a dispersal vector, especially for non-aerially dispersing taxa.

Acknowledgements

The author is indebted to the following for their assistance with the collection of samples in the field: Andrew Hebda, John Gilhen, Fred Scott, Jason Taylor, Andrew Gale, David Butler, Martha Devanney and Robert Grantham. Dr. David McCorquodale, Leslie Pezzack, Andrew Hebda, Paul-Michael Brunelle, Fred Scott and Barry Wright have assisted with identifications of material.

Fig. 25: High densities of frogs exist in the pond.

Fig. 26: Since there were no ponds on the island, one was excavated on the east side of the plateau, so the frogs could lay their eggs.

The Herpetofauna of Isle Haute

John Gilhen, Research Associate, Nova Scotia Museum of Natural History

The amphibians and reptiles of Isle Haute were sampled during the expedition using dip nets, and by surveying at night with flashlights. Three species of amphibians were found using these methods, but no reptiles were recorded.

The Eastern Redback Salamander, *Plethodon cinereus*, is native to the island. This species is abundant throughout the woodlands and in the grassy clearing at the light station. The redback morph was the only one observed. Of over 50 individuals observed, all had dark reddish-brown stripe down the back, showing little or no variation. This is most unusual for Nova Scotia, as most amphibians and reptiles in the province show remarkable variation in colour. Also the tail of every individual was in a state of regeneration, which indicates heavy predation, probably by Deer Mice.

Erskine (1956) stated the "toad and bullfrog" were introduced to the island by the son of a former lighthouse keeper. Since there were no ponds on the island, one was excavated on the east side of the plateau, so the frogs could lay their eggs. The Eastern American Toad, *Bufo americanus americanus*, was observed. Small black tadpoles were crowded in the shallows of the dug pond and several juveniles were observed at the light station. Adult Green Frog, *Rana clamitans melanota*, were crowded around the edge and in the pond. Unusually high densities of amphibians were recorded, but this is likely because the populations are concentrated around the only breeding pond on the island. Only adults were observed and no tadpoles were seen in the pond. The marked gaps in age classes suggest that the pond either dries up some years, or there is cannibalism taking place. Since the habitat is not sufficient to support a population of Bullfrog, *Rana catesbeiana*, their reported introduction is a mistake in identification. The Green Frog was probably the species in question, and not the Bullfrog.

Fig. 27: Salt pond as seen from the east end with cobble barrier beach on right. Note coloured banding on cobble slope indicating changes in water levels.

Fig. 28: Open fields, viewing south from the light tower.

Fig. 29: Trail passing through alder flat. Photo taken in November 1996.

The Birds of Isle Haute

Andrew Hebda, Curator of Zoology, Nova Scotia Museum of Natural History

The first collections on record are eggs collected by Watson J. Bishop of Kentville in May 1888 and July 1890, with an additional egg, a Common Eider, collected by an unknown collector in June of 1889. These initial visits follow, by only a few years, the construction of the first lighthouse on the island (Conlin, Chapter 1, this manuscript). The next observations were recorded by Charles W. Townsend MD, who spent 5 days on the island in July of 1921, as part of his summer study of birds of the western portion of Cumberland County (Townsend, 1922). Charlie Patriquin, of Wolfville, visited the island and surveyed the avifauna in the mid-1920s (Merritt Gibson, personal communication), although his species list is not currently available.

The first official Nova Scotia Museum presence on the island was in the first weekend in June of 1953, when a team visited Isle Haute. Observations were made on a number of taxa, and several bird specimens were taken. These specimens are in the collection of the Nova Scotia Museum of Natural History. The island was also surveyed twice (August 1987 and August 1990) during data collection for the Maritime Breeding Bird Atlas (Erskine, 1992). Visits by Art Crowell in August, 1993 and in June of 1994 and by Raymond Fielding (1996) resulted in a greatly-expanded listing of birds.

A reconnaissance team from the Museum of Natural History visited the site in November of 1996, making note of avifauna, with another interdisciplinary Nova Scotia Museum team spending five days on Isle Haute in July of 1997.Supplementary data from the Nova Scotia Department of Natural Resources verified the presence of Peregrine falcons nesting on the island in 1997 (M. Elderkin, personal communication).

These species records (common and scientific names) are summarized in Appendix 8. They comprise 60 species, representing 25 Families of birds in 10 Orders. Earlier observations represent, primarily, species with significant use of water and shorelines for feeding and nesting. Reports of Passeriform birds were not made until 1993.

Methods

The avifauna of Isle Haute, was monitored on October 21, 1996, and July 14–17, 1997. Monitoring consisted of direct observation as well as identification by bird call. Island habitats were surveyed for evidence of nesting and any evidence of predation on the avifauna. Morning chorus was only monitored from 0430 to 730 hrs. on the 15th of July.

Results

The surveys of 1996 and 1997 confirmed the presence of 29 species, (Table 1).

In addition to these observations, bones were retrieved from several sites associated with the salt pond (Figure 27). These were primarily gull and cormorant skulls and wing bones. One bird pellet, containing 64 individual *Nereis* sp. mandibles was recovered from the East end of the cobble beach. Based on the size of the pellet, it was probably from a medium-sized corvid - large crow, small raven (F. Scott, personal communication). As well, several small yellow birch trees (*Betula alleghaniensis*) (DBH < 15 cm) showed evidence of recent woodpecker (Yellow-bellied Sapsucker) activity in the ravine between the Storm Camp and Indian Flats.

Discussion

Bird community development after human abandonment (post-farming, forest harvesting or burning) reflects specific changes in habitat, recruitment and emigration as well as food availability (Welty, 1963; Ricklefs, 1990). As biotic communities on abandoned islands progress toward a state similar to that which existed before settlement, the nature of the habitats changes e.g. open fields reverting, ultimately, to mixed forests. The avifauna of Isle Haute demonstrates some of these successional patterns as well as patterns related to features characteristics of the respective Theme Region 810—Basalt Peninsula (Davis and Browne, 1997).

Table 1: ***Bird species of Isle Haute*** **(July 1997).**

Species	**Location on Island** (refer to base map)
Common Loon	Brackish pond and near anchorage
Double-crested Cormorant	Snag on cobble beach by salt pond
Common Eider (nesting)	Cobble beach at east end of salt pond
Turkey Vulture	Above long-grass field at about 150 metres
Spotted Sandpiper	Mud flat at west end of salt pond
American Woodcock	West margin of field near light tower
Herring Gull	Brackish pond and cobble beach
Greater Black-backed Gull	Cobble beach at east end of brackish pond
Black Guillemot	Off cobble beach near anchorage
Least Flycatcher	Trail crest near storm camp
Tree Swallow	Lower trail near Indian Flats - mixed wood
Blue Jay	Upper trail (alder thicket)
Common Raven	Trail crest near storm camp
Black-capped Chickadee	Long grass field
Red-breasted nuthatch	Low scrub west of frog pond
Golden-crowned Kinglet	Coniferous scrub east of light tower field
Swainson's Thrush	Throughout upper portions of trail
American Robin	Conifers south-west of light-tower field
Cedar Waxwing	Mixed scrub south of light tower field
Red-eyed Vireo	Ravine in maple birch association
Yellow-rumped Warbler	White spruce at south border of light-tower field
Black-throated Green Warbler	In alder thicket on upper trail
American Redstart	Mixed edg in scrubland s. of light-tower field
Common Yellowthroat	Alder thicket on upper trail
White-throated Sparrow	In trees and shrubs in light-tower field
Common Grackle	Alder thicket on upper trail
Brown-headed Cowbird	Scrub in light-tower field
Red Crossbill	Lower portion of trail near Indian Flats
Pine Siskin	Near storm camp in transition between upper ravine and alder thicket (flat)

Analysis of the aerial photographs taken in 1951 (Figure 20) indicates about 50% of available surface area on the top of the island as well as in the ravine show evidence of recent disturbance (cultivation (10%), recent fire (30%), older burn (10%)). Due to this land use, available habitats were generally open and grassy in nature, with scattered and marginal occurrence of mixed wood throughout the island. The only wooded stands of substance were found in areas where burning and cropping were not undertaken, such as the ravine, marginal areas along the periphery and the poorly-drained section south of the cultivated fields (light-tower field). The abandonment of the island in 1956 (Conlin, this Manuscript) has resulted in a

gradual re-establishment of larger areas of tree and shrub-dominated plant associations. Analysis of the 1995 aerial photographs showed that only about 10% of the area could now be considered open habitat, and 10% was somewhat open—discontinuous canopy. Open habitats now exist only on peripheral portions of the island (cliff areas and beaches) and in proximity to the light tower (Figure 28)—areas, previously, under direct cultivation.

The portion of the access trail on the top of the island is dominated by a stand of Alder (*Alnus sp.*), with a high (3-6 metre) canopy (Fig. 29). Due to a very open understorey in combination with a dense canopy in this section, this plant community functions more as a treed habitat rather than a forest edge habitat.

The avifauna of the island reflects these habitats. Early Old Field species such as the Savannah Sparrow were present. Field Edge and Mid-succession species such as Eastern Kingbird, Common Yellowthroat, Field Sparrow and Song Sparrow were noted. Species associated with Forest Interior Edges, such as Downy Woodpecker and Northern Flicker, Black-capped Chickadee, Red-eyed Vireo, Common Yellowthroat, American Goldfinch and Red-breasted Nuthatch were also observed. In addition, Forest Interior species such as Black-throated Green Warbler and American Redstart were noted, although no Black and White Warblers were observed or heard.

Red-eyed Vireos were recorded at four locations on the island. However, it was noted by Fred Scott that their calls differed from those of the mainland populations in that they were truncated, missing complex portions of repertoire characteristic of the species. Whether this is attributable to founder effects, or an example of microgeographic dialects (Briskie, 1999) is unknown.

We note that Peregrine Falcons have been confirmed as nesting on the island, after an absence of several years.

Acknowledgements

The author wishes to acknowledge the significant contribution of the following individuals in their assistance in their observations and collection of field samples: Andrew Davis, Fred Scott, Calum Ewing and John Gilhen. David Butler and Stephen Archibald noted and collected osteological and pellet material, and Barry Wright examined the retrieved bird pellet for contents. Mark Elderkin provided insight into Peregrine Falcon nesting on the island.

Mammals of Isle Haute

Fred W. Scott, Curator of the Wildlife Museum, Biology Dept., Acadia University

Marine mammals

Grey seals (*Halichoerus grypus*) and Harbour Seals (*Phoca vitulina*) are common around the island, especially at the western end where there are exposed rocks favoured by Grey Seals as haulouts. Greys seem to dominate in numbers, at least during the 1997 visit.

Bats

Though nobody had ever recorded bats on the island, there was no reason to believe they were not there and the expedition confirmed the presence of the Little Brown Bat (*Myotis lucifugus*) in small numbers, by one mist net capture and several visual and bat detector observations. A mist net was set at the foot of the gully where the canopy began to open up and captured one male bat. One was also set up at the frog pond for one night, but could not be placed high enough to intercept the two or three animals that were observed and monitored with a bat detector as they hunted. Very few feeding buzzes were heard, indicating a low rate of prey capture. There are no structures on the island suitable for maternity colonies and it is unlikely that any bats now breed there.

Terrestrial mammals

The only resident terrestrial mammal known to occur on Isle Haute is the Deer Mouse (*Peromyscus maniculatus*). The Isle Haute population is estimated to have been isolated for as long as 7500 years and has been studied in detail by Mark Pulsifer (1981). He found it to be significantly different from the adjoining mainland population in two important respects: Isle Haute animals are significantly larger and more aggressive (judged by frequency of tail-wounding) than mainland ones. There are behavioural differences as well; in captivity they spent significantly more time above ground than mainland Deer Mice and in a period of two years could not be induced to breed, whereas mainland Deer Mice bred readily under the same captive conditions.

At the time of our 1997 visit Deer Mice appeared to be abundant; on his first night John Gilhen set six Havahart traps at the edge of the woods behind the base camp and caught three animals.

During the expedition we saw evidence that two other terrestrial mammal species are at least accidental visitors or temporary residents on the island. The nearly complete skeleton of a White-tailed Deer (*Odocoileus virginianus*) was found on the shore near the lagoon at the eastern end of the island, and relatively fresh scat of American Mink (*Mustela vison*) was observed on rocks on the inner shore of the lagoon. There were also accumulations of crow and gull remains (bones and feathers) that had been pulled into some crevices between rocks by an animal. This behaviour is known in mustelids and unknown in any of the birds present on the island. Bob Grantham described an animal seen alive on the shore that appears to have been a mink.

Mink are good swimmers and very common along all of Nova Scotia's rocky shores. They are known to venture some distance from land on ice and can obviously reach Isle Haute from the mainland when conditions are suitable. With the presence of many nesting seabirds, there is as much or more food for them on Isle Haute than on the mainland. Whether any have ever established a breeding population is unknown.

Mammal trapping, 14–17 July 1997

F. Scott, with assistance of A. Hebda, J. Taylor, J. Gilhen and A. Gale

The objective was to trap forested talus slopes on the island to determine if a relict population of *Sorex dispar* exists there. We did not want the traps pre-empted by the deer mice (*Peromyscus maniculatus*) that are common on the island, so pitfall traps were used. The preferred size, 750-ml ice cream containers, were no longer available so large plastic "beer cups" were used as instead, set dry with about 2 cc of canned dogfood and a small wad of fibrefill bedding material. Deer mice could readily get in and out of these without affecting the trap's ability to capture small shrews. The traps were placed wherever a suitable hole could be dug and as close as possible to the stream and/or to crevices between or under boulders or logs. All traps were flagged with coloured tape directly overhead and were checked at least twice and usually three times a day.

Trapping sites

1. The Gully

This is a steep-sided ravine (slopes of 35–45°) facing approximately east with a small flowing stream (the only one on the island?) that runs into the lagoon. Traps were set along the lower 100 m, mostly close to the stream but in a few cases as much as 10 m from it where sites were suitable. The streambed is almost entirely medium to large boulders (up to 0.5 m diameter) and the ravine banks are old stable talus, increasingly covered upslope withsoil/humus/leaf-litter. Forest is predominantly deciduous, generally 10-15 m high. The overstory is mostly Yellow Birch, with some Balsam Fir and White Spruce. Canopy closure is estimated at 50% (bottom) to 85% (top). Understory is sparse, mostly Yellow Birch with some Striped Maple. There are many treefalls and rotting logs and stumps, some quite large. Ground cover is lush, obscuring 80–90% of the substrate near the stream and progressively less upslope. Within 3 m of the stream it is almost entirely *Prenanthes* sp. with extremely large leaves (30–45 cm long) and *Impatiens* sp. (jewelweed); beyond 3 m, *Dryopteris spinulosus* (Spinulose Wood Fern) becomes the most abundant species, followed by *Aralia nudicaulis*, *Oxalis acetosella* and very tall (up to 1.3 m), robust *Streptopus* sp. Mosses are largely restricted to rocks in the streambed and, on the slope, to rotting wood. Seventy-eight pitfalls were set at this site.

2. Streambed below trail

A shallow gully with slopes of about 15°, situated at the south side of the trail to the top, about 50 m up from the campsite. The gully contains an ephemeral rivulet that was not running at the time of our visit, though the bottom of it was damp to mucky in places. Forest overstory is Yellow Birch and Striped Maple, with a canopy closure of about 60%. There was no significant understory. Ground cover was 100% *Prenanthes* and *Impatiens* in the lowest wettest areas, quickly diminishing to about 30% coverage of *Aralia nudicaulis*, *Dryopteris spinulosus* and grasses at 2 m or more from the gully bottom. Rocks were scattered and small, usually <30 cm diameter. There was a clump of cinnamon fern at the downhill end of the gully where the slope dropped and steepened abruptly. Forty pitfalls were set at this site.

Results

No mammals were captured in any pitfalls, but several at the bottom of the gully were visited on at least two of the three nights, and some of the dogfood was eaten. Droppings left behind were definitely not the uniform pellets left by *Peromyscus*; they were black, runny and irregular in length and diameter, typical of shrew droppings (in shrews the urinary and intestinal tracts empty into a cloaca), and from their size were left by an small unidentified species of *Sorex*, rather than the mouse-sized short-tailed shrew (*Blarina brevicauda*) which if present could not have been missed in the trapping done by Pulsifer. We now know that the "beer cup" size is too small to catch shrews and will not be used if another trapping visit is made.

Large numbers of ground beetles (Family: Carabidae) of at least five species were taken in the pitfalls, and also small harvestmen (*Phalangida*), spiders, slugs and at least one earthworm. No Redbacked Salamanders (*Plethodon cinereus*) were caught, though they are common elsewhere on the island.

Table 1:Trap-night summary

Night of	Gully	Streambed below trail	
July 14-15	78	0	
July 15-16	78	40	
July 16-17	78	40	
Trap-nights	234	80	Total = 314
-20% improperly set			= 251

Isle Haute mammals and island biogeography

Since MacArthur and Wilson (1967) first proposed their theory of island biogeography there have been many refinements and elaborations, but their basic theory has been confirmed in hundreds of published studies. Regardless of habitat or climate, there is a relationship between the size of an island and the diversity of species it harbours, and between the island's species diversity and its distance from mainland sources of colonizers. A species equilibrium will be reached when there is a balance between extinction and colonization. The smaller the population the greater the likelihood of extinction, especially by accident, and the further an island is from the mainland, the smaller its chance of being reached by colonizers. In very general terms, a reduction of an island ƒs size by a factor of 10 will halve the number of species (if an island of 100 hectares holds 10 species, then one of 10 hectares will only have 5). However, this distance-area relationship does not predict which species of those eligible will establish themselves, or survive an isolating change such as the sea-level rise that made Isle Haute an island. To a large extent the persistence of a particular resident species, or the success of a particular colonizer, depends on what

habitats are present, and what other species are already occupying them. These principles apply to ecological islands just as much as to physical ones.

In the case of Isle Haute, when it was part of the mainland it presumably had all common members of the terrestrial small mammal community of that region that its habitats could support, including Short-tailed, Common and Smoky Shrews, Red-backed Voles, Deer Mice, Woodland Jumping Mice, Red Squirrels and Eastern Chipmunks. These species vary in their habitat requirements. The most common of all small mammals in Nova Scotia is the Common Shrew (*Sorex cinereus*), found in all but urban habitats. The Short-tailed Shrew (*Blarina brevicauda*) is almost as adaptable. On the mainland, Red-backed Voles (*Clethrionomys gapperi*) are by far the most abundant forest rodent, and Deer Mice are the second most abundant. But Deer Mice are also able to use a variety of disturbed, successional and edge habitats that Red-backed Voles never use. Common shrews are equally plastic in their habitat preferences. We know that until the late 1950s the top of Isle Haute was almost completely deforested at one time or another, for lumber, firewood,
pasture and crops, and was a mosaic of mostly successional habitats. It would have been logical to predict that both Deer Mice and Common Shrews, the two most plastic species, would have survived on Isle Haute, but in fact only one of them did.

The Gully is the only forested area of any size on the island that was certainly never cleared and probably never disturbed significantly, and the only hardwood stand. Because it is steep-sided and has some stable talus (a slope composed of loose rocks or boulders), it was possible that it also harboured a relict population of the Long-tailed Shrew (*Sorex dispar*). This species was first discovered in the southern Wentworth Valley in 1984 (Scott, 1987) and at a second location at the north end of the valley in 1986 (Scott and van Zyll de Jong, 1989), both at sites with extensive hardwood-forested talus. In 1996 Lance Woolaver discovered a third population about 35 km to the west, on a tributary of the Portapique River (Woolaver, Elderkin and Scott, 1998). I believe this shrew is probably present in all the steep valleys that drain the south side of the Cobequid Mountains. It is presumably restricted to hardwood talus habitats because at one time it could not compete successfully outside of them, and the most probable reason is that there were two other species of small shrew competitors (Common and Smoky Shrews). Since neither are present on Isle Haute, it seemed to raise the chances of finding Long-tailed Shrews there. The trapping we carried out definitely proves that there is a resident species of *Sorex* in the Gully. If the Common Shrew (*Sorex cinereus*) was present, the entire island is suitable habitat for it and it should be found everywhere, like the Deer Mouse. However, a relict population of Long-tailed Shrews might remain restricted to the Gully site simply because of long-standing adaptation to that habitat.

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Appendix 1

Technical Information—Isle Haute Lighthouses

County: Cumberland
Location: On highest point of this island in Bay of Fundy at entrance to Minas Channel
Latitude: 45 15 08
Longitude: 065 00 30

Year Lit: 1878

	Colour	Character	Elevation	Range
1878	White	Flashing (40 sec.)	365	20
1914	"	Group Flashing (25 sec.)	"	"
1956	"	Flashing (5 sec.)	362	14
1979	"	Flashing (4 sec.)	352	
1980	"	"	356	

Apparatus:

1878	Catoptric Reflector	Oil
	Catoptric Refector Long Focus	"
1914	"	Oil Vapour
1956	Dioptric - 6th Order	Acytelene Gas
1979	"	Electric Battery
1981	"	Solar Battery
1914 - 1956	Hand Foghorn	

Structure:

1878	53 ' white square tower (20' x 20'), attached dwelling (26' x 31') almost hidden by trees, barn, oil store (16' x 12')
1956	40 ' skeleton tower painted red
1980	skeleton tower - aluminium

Keepers:

1878 - 1888	Nelson Card
1889 - 1904	G. Judson Reid
1904 - 1941	Percy E. Morris
1941 - 1946	Donald Morris
1946 - 1956	John Fullerton
1956 -	Made unwatched

Appendix 2
Geological Collections and Photos

Specimens Collected

97.16.01	copper oxides? from east end.
97.16.02	stilbite? heulandite? siliceous sinter?
97.18.01	east beach bar float - quartz and tan thin veinlets of ?
97.18.02	heulandite amygdule, same locality as .01
97.18.03	amethyst and amygdule of ? east beach, end of pond - lagoon east end at high storm beach
97.18.04	tan mineral ?? from east beach near point meeting N East beach - east tip
97.18.05	malachite ? from shear zone 1 to 2 metres wide and 50 to 60 metres from last one
97.20.01	geode from loose on beach - large block - 1/4 garage size block
97.20.02	fragments from another not collectable geode for id work
97.20.03	loose - fresh chalcedony - from cliff side of largest "boulder" at "The Boulders"
97.20.04	several flow units - interflow - aa ? - glassy & vesicular coarse xtalline quartz - different - had not seen these before
97.22.01	two pieces basalt from higher in cliff to indicate nature of upper low units - very vesicular
97.22.02	crystal texture of glassy unit - not well developed spinifex
97.22.03	apophyllite ! ! ! ! from Cohen's Crevasse
97.22.04	stilbite same locality
97.24.01	thompsonite - float on beach approx 100 m east of camp site
97.24.01	jasper float on beach
97.24.02	agates, first major rock slide/ravine - can see up to the top - all from loose in slide - see map for detail
97.24.02	same number - all from same area - different minerals
97.26.01	analcime - same locality as 97.24.02
97.26.02	stilbite - same locality as 97.24.02
97.26.03	porcelain agate - same locality as 97.24.02
97.26.04	vesicular basalt - same locality as 97.24.02
97.26.05	inverse botryoidal agate and quartz
97.26.06	basalt breccia healed with porcelain agate and one small light patch of amethyst
97.26.07	heulandite - same locality as 97.24.02
97.26.08	stilbite ? - same locality as 97.24.02
97.26.09	stilbite ?? on larger block - same locality as above
97.26.10	basalt - spinifex texture? - similar to same as south side - see photo 97.22.02
97.28.01	stilbite - 1/2 way along first open cove
97.28.02	natrolite? - same locality as .01 above
97.28.03	heulandite with surface staining same locality as specimen 97.28.01 above
97.30.01	blebs of copper in situ ! ! ! - good find. Martha found these located approximately 250 tp 300 m west of campsite in fractures, no preferred orientation - fractured columns all blebby copper - very productive spot!
97.32.01	chert? chalcedony? from first gully east of Boar's Head - all from talus
97.32.02	stilbite
97.32.03	laumontite → will change to leonhardite
97.32.04	sugary agate
97.32.05	amethyst
97.34.01	unknown black mineral and metallic yellow mineral
97.34.02	apophyllite? from 75 to 100 m east of last locality
97.34.03	apophyllite - float - 500 m east of Boar's Head
97.34.04	magnetite(?) float 600 m east of Boar's Head.
97.34.05	magnetite (?) goethite? - obsidian? about 700 m east of Boar's Head in talus
97.36.01	red basalt from 1/2 way up large slide (talus slope) 900 m east of Boars Head

Photographs taken

97.16.01	shots of camp
97.16.02	shear zone east end
97.16.03	point at east end — from north side
97.20.01	several scenic shots
97.20.02	shots of specimen 97.20.04 location
97.22.01	several shots of Cap d'Or/Cape Split in distance also shots of Martha using radio
97.22.02	spinifex texture in glassy flow unit — still continuing
97.22.03	shot of spec.97.22.02 above
97.28.01	locality of spec. 97.28.01 above
97.28.02	panoramma of first open cove
97.28.03	breccia zone near vertical - 2.5 to 3 m wide - all fragments highly slickensided — age of shear ?
97.30.01	several shots of copper in situ — stereo pairs
97.30.02	shots of Martha & Darren collecting copper
97.32.01	shot from outcrop to camp
97.32.03	scenic shots heading to Boars Head
97.32.04	faulted contorted columns
97.32.05	shots from top of Boars Head — last one is of the tree krumholtz effect and dead
97.34.01	looking up cliff
97.36.01	twisted columns with Martha as scale in lower right of photo

Appendix 3
Systematic List of Isle Haute Flora

Bryophytes
Desmatodon longifolius
Encalypta sp.
Tortula mucronifolia

Pteridophytes

Lycopodiaceae
Lycopodium annotinum
Lycopodium clavatum
Diphasiastrum digitatum
Huperzia lucidula
H. selago

Equisetaceae
Equisetum arvense
Equisetum sylvaticum
Equisetum sylvaticum, var. *pauciramosum*, forma *multiramosum*

Ophioglossaceae
Botrychium lanceolatum, var. *angustisegmentum*
Botrychium multifidum
Botrychium sp.

Osmundaceae
Osmunda cinnamomea
*O. claytonia**

Dennstaedtiaceae
Pteridium aquilinum, var. *latiusculum*
Dennstaedtia punctilobula

Thelypteridaceae
Phegopteris connectilis
Thelypteris noveboracensis

Dryopteridaceae
*Athyrium filix-femina**
A. filix-femina, var. *michauxii*
Deparia acrostichoides
D. expansa
D. intermedia
D. marginalis
D. spinulosa
*Gymnocarpium dryopteris****
Onoclea sensibilis
Polypodium virginianum
*Polystichum acrostichoides**
P. braunii, var. *purshii*
Woodsia ilvensis
Matteuccia struthiopteris

Gymnosperms

Taxaxeae
Taxus canadensis

Pinaceae
Abies balsamea
Juniperus communis, var. *depressa*
Picea glauca
P. mariana
P. rubens

Angiosperms
1. Dicotyledons

Ranunculaceae
*Actaea alba**
A. rubra
Coptis trifolia
Ranunculus abortivus
Ranunculus abortivus, var. *acrolasius*
R. acris
*R. repens**
Thalictrum pubescens

Urticaceae
Urtica dioica
U. dioica, var. *procera*

Fagaceae
*Fagus grandifolia**

Betulaceae
*Alnus viridis**
Betula alleghaniensis
B. cordifolia
B. cordifolia x *B. papyrifera* (hybrid)
B. papyrifera
B. papyrifera x *B. populifolia* (hybrid)
Chenopodiaceae
*Atriplex patula**
A. hastata

Portulacaceae
Claytonia caroliniana

Caryophyllaceae
Arenaria lateriflora
Cerastium vulgatum
C. vulgatum, var. *hirsutum*
Stellaria calycantha
S. graminea
S. media
Stellaria sp.

Polygonaceae
Polygonum aviculare
P. persicaria
P. sagittatum
Rumex acetosella
R. crispus
R. orbiculatus
Rumex sp.

Salicaceae
Populus tremuloides
Salix bebbiana
S. discolor
Salix sp.

Brassicaceae
Arabis drummondii
Capsella bursa-pastoris
Cardamine parviflora, var. *arenicola*
C. pensylvanica
C. diphylla (var. *maxima?*)
Cardamine sp.*
Draba arabisans
D. glabella
D. verna

Ericaceae
Vaccinium angustifolium
V. vitis-idaea, var. *minus*

Pyrolaceae
Moneses uniflora
Pyrola asarifolia
P. elliptica
Pyrola sp.

Monotropaceae
*Monotropa uniflora**

Primulaceae
Lysimachia rummularia
Primula laurentiana
Trientalis borealis

Grossulariaceae
Ribes glandulosum
*R. hirtellum**
R. hirtellum var. *calcicola*
*R. lacustre**

Crassulaceae
*Sedum rosea**

Saxifragaceae
Astilbe sp.
Mitella nuda

Rosaceae
Amelanchier bartramiana, cf. *A. canadensis*
A. cf. *laevis*
Amelanchier sp.
Dalibarda repens
Filipendula ulmaria
*Fragaria virginiana**
Potentilla simplex
P. simplex, var. *calvescens*
Potentilla sp.
Prunus pensylvanica
*P. virginiana****
Pyrus malus
Rosa virginiana
Rubus allegheniensis
R. canadensis
R. hispidus
R. idaeus
R. pubescens
Sorbaria sorbifolia
Sorbus americana
S. americana x *decora* (hybrid)
S. decora

Fabaceae
Lathyrus maritimus
L. maritimus, var. *pellitus*
Trifolium hybridum
T. pratense
T. repens
Vicia cracca

Onagraceae
*Circaea alpina**
Epilobium ciliatum
E. angustifolium
E. glandulosum
E. leptophyllum
E. palustre
Epilobium sp.
Oenothera biennis
O. perennis, forma *rectipilis*
Oenothera sp.

Cornaceae

Cornus alternifolia
C. canadensis
Cornus sp.

Aceraceae
Acer pensylvanicum
*A. spicatum**

Oxalidaceae
Oxalis acetosella
O. stricta
Oxalis sp.

Geraniaceae
Geranium robertianum

Balsaminaceae
Impatiens capensis
I. pallida

Araliaceae
*Aralia nudicaulis**

Apiaceae
Aegopodium podagraria
Carum carvi
Coelopleurum lucididum
Daucus carota
Heracleum lanatum
*Hydrocotyle americanum**

Apiaceae, *con't*
Ligusticum scothicum
*Osmorhiza claytonia**

Convolvulaceae
Calystegia sepium

Lamiaceae
Galeopsis tetrahit
Lycopus americanus
L. uniflorus
Mentha arvensis
Prunella vulgaris

Plantaginaceae
Plantago juncoides
P. juncoides, var. *laurentiana*
P. juncoide,s var. *decipiens*
P. major
P. maritima
P. rugelii

Scrophulariaceae
Euphrasia officinalis
E. randii
Euphrasia sp.
Rhinanthus crista-galli
*Veronica officinalis**
V. serpyllifolia, var. *borealis*

Campanulaceae
Campanula aparinoides
*C. rotundifolia**

Rubiaceae
Galium triflorum
Mitchella repens

Caprifoliaceae
Diervilla lonicera
Lonicera canadensis
Sambucus canadensis
*S. racemosa**

Asteraceae
A. millefolium
A. millefolium, var. *borealis*
Anaphalis margaritacea
Antennaria canadensis
Aster acuminatus
A. cordifolius
A. foliaceus
A. lateriflorus
A. macrophyllus
A. novi-belgii
A. tradescanti
A. umbellatus
Aster sp.
Chrysanthemum leucanthemum
Cirsium arvense
Eupatorium perfoliatum
Euthamia graminifolia
E. graminifolia, var. *nuttallii*
Gnaphalium sylvaticum
Hieracium caespitosum
H. floribundum
H. pilosella
H. piloselloides
H. scabrum
Hieracium sp.
Leontodon autumnalis
Matricaria maritima
Prenanthes alba
P. altissima
Senecio vulgaris
Solidago bicolor
S. canadensis
S. flexicaulis
S. macrophylla
S. nemoralis
S. puberula

S. rugosa
S. sempervirens
Sonchus arvensis
S. asper
Taraxacum officinale
Tussilago farfara

1. Monocotyledons

Juncaceae
Juncus articulatus
J. brevicaudatus
J. bufonius
J. effusus
*J. gerardi**
J. tenuis
Luzula multiflora

Cyperaceae
*Carex arctata****
C. aurea
C. brunnescens ssp. *sphaerostachya*
C. communis
C. crawfordii
C. demissa
C. flava
C. gracillima
C. hormathodes
C. intumescens
C. leptalea
C. leptonervia
C. ormostachya
C. pallescens
C. projecta
C. silicea
C. stipata
Scirpus atrocinctus
Eleocharis tenuis

Poaceae
A. trachycaulum, var. *majus*
Agrostis capillaris
A. gigantea
A. perennans
A. hyemalis
Ammophila breviligulata
Anthoxanthum odoratum
Bromus ciliatus
B. inermis
Calamagrostis canadensis
Cinna latifolia
Danthonia spicata
Deschampsia flexuosa
Elymus repens
E. virginicus
Festuca filiformis
F. rubra
Glyceria melicaria
G. striata, var. *stricta*
Hierochloë odorata
Phleum pratense
Poa compressa
P. glauca
P. palustris
P. pratensis

Liliaceae
Clintonia borealis
Erythronium americanum
Maianthemum canadense
*Medeola virginiana**
Polygonatum pubescens
*Smilacina amplexifolius****
S. racemosa
S. stellata, var. *crassa*
Smilacina sp.
Streptopus amplexifolius
S. amplexifolius, var. americanus
S. roseus, var. *perspectus**
*Trillium erectum**
T. erectum, var. *albiflorum*

Iridaceae
Sisyrinchium montanum
Sisyrinchium sp.

Orchidaceae
Corallorhiza maculata
Goodyera repens, var. *ophioides*
Platanthera hyperborea
P. lacera
P. psycodes
Liparis loeselii
Malaxis monophylla
Spiranthes cernua

Appendix 4
Alphabetic Vascular Plant List, 1997

Abies balsamea
Acer pensylvanicum
*Acer spicatum**
Achillea millefolium
A. millefolium, var. *borealis*
*Actaea alba**
A. rubra
Aegopodium podagraria
Agropyron trachycaulum, var. *majus*
Agrostis capillaris
A. gigantea
A. hyemalis
A. palustris
A. perennans
*Alnus viridis**
Amelanchier bartramiana cf. *A. canadensis*
Amelanchier cf. *laevis*
Amelanchier sp.
Ammophila breviligulata
Anaphalis margaritacea
Antennaria canadensis
Anthoxanthum odoratum
Arabis drummondii
*Aralia nudicaulis**
Arenaria lateriflora
Aster acuminatus
A. cordifolius
A. foliaceus
A. lateriflorus
A. macrophyllus
A. novi-belgii
A. tradescanti
A. umbellatus
Aster sp.
Astilbe sp.
*Athyrium filix-femina**
A. filix-femina, var. *michauxii*
Atriplex hastata
*A. patula**
Betula alleghaniensis
B. cordifolia
B. cordifolia x *B. papyrifera (hybrid)*
B. papyrifera
B. papyrifera x *B. populifolia (hybrid)*
Botrychium lanceolatum, var. *angustisegmentum*
B. multifidum
Botrychium sp.
Bromus ciliatus
B. inermis
Calamagrostis canadensis
Calystegia sepium
Campanula aparinoides
*C. rotundifolia**
Capsella bursa-pastoris
Cardamine diphylla (var. *maxima?)*
C. parviflora, var. *arenicola*
C. pensylvanica
*Carex arctata****
C. aurea
C. brunnescens var. *sphaerostachya*
C. communis
C. crawfordii
C. demissa
C. flava
C. gracillima
C. hormathodes
C. intumescens
C. leptalea
C. leptonervia
C. ormostachya
C. pallescens
C. projecta
C. scoparia
C. silicea
C. stipata
Carum carvi
Cerastium vulgatum
C. vulgatum, var. *hirsutum*
Chrysanthemum leucanthemum
Cinna latifolia
*Circaea alpina**
Cirsium arvense
Claytonia caroliniana
Clintonia borealis
Coelopleurum lucididum
Coptis trifolia
Corallorhiza maculata
Cornus alternifolia
C. canadensis
*Cornus sp. **
Dalibarda repens
Danthonia spicata
Daucus carota
Dennstaedtia punctilobula
Deparia acrostichoides
Deschampsia flexuosa
Diervilla lonicera
Diphasiastrum digitatum

Draba arabisans
D. glabella
D. verna
D. intermedia
D. marginalis
D. spinulosa
Eleocharis tenuis
Elymus repens
E. virginicus
Epilobium angustifolium
E. ciliatum
E. glandulosum
E. leptophyllum
E. palustre
Epilobium sp.
Equisetum arvense
E. sylvaticum
E. sylvaticum var. *pauciramosum* forma *multiramosum*
Erythronium americanum
Eupatorium perfoliatum
Euphrasia officinalis
E. randii
Euphrasia sp.
Euthamia graminifolia
E. graminifolia, var. *nuttallii*
*Fagus grandifolia**
Festuca filiformis
Festuca rubra
Filipendula ulmaria
*Fragaria virginiana**
Galeopsis tetrahit
Galium triflorum
Geranium robertianum
Glyceria melicaria
Glyceria striata, var. *stricta*
Gnaphalium sylvaticum
Goodyera repens, var. *ophioides*
*Gymnocarpium dryopteris****
Heracleum lanatum
Hieracium caespitosum
H. floribundum
H. pilosella
H. piloselloides
H. scabrum
*Hieracium sp.**
Hierochloë odorata
*Hydrocotyle americanum**
Huperzia lucidula
H. selago
Impatiens capensis
I. pallida
Juncus articulatus
J. brevicaudatus
J. bufonius
J. effusus
*J. gerardi**
J. tenuis
Juniperus communis, var. *depressa*
Lathyrus maritimus
L. maritimus, var. *pellitus*
Leontodon autumnalis
Ligusticum scothicum
Liparis loeselii
Lonicera canadensis
Luzula multiflora
Lycopodium annotinum
Lycopodium clavatum
Lycopus americanus
L. uniflorus
Lysimachia nummularia
Maianthemum canadense
Malaxis monophylla
Matricaria maritima
*Medeola virginiana**
Mentha arvensis
Mitchella repens
Mitella nuda
Moneses uniflora
*Monotropa uniflora**
Oenothera biennis
Oenothera perennis, forma *rectipilis*
Oenothera sp.
Onoclea sensibilis
*Osmorhiza claytonia**
Osmunda cinnamomea
*O. claytonia**
Oxalis acetosella
O. stricta
Oxalis sp.
Phegopteris connectilis
Phleum pratense
Picea glauca
P. mariana
P. rubens
Plantago juncoides
P. juncoides, var. *laurentiana*
P. juncoides, var. *decipiens*
P. major
P. maritima
P. rugelii
Platanthera hyperborea
P. lacera
P. psycodes
Poa compressa
P. glauca
P. palustris
P. pratensis
Polygonatum pubescens
Polygonum aviculare
P. persicaria
P. sagittatum

Polypodium virginianum
*Polystichum acrostichoides**
P. braunii, var. *purshii*
Populus tremuloides
Potentilla simplex
P. simplex, var. *calvescens*
Prenanthes alba
*P. altissima**
Primula laurentiana
Prunella vulgaris
Prunus pensylvanica
*P. virginiana****
Pteridium aquilinum, var. *latiusculum*
Pyrola asarifolia
P. elliptica
*Pyrola sp.**
Pyrus malus
Ranunculus abortivus
R. abortivus var. *acrolasius*
R. acris
*R. repens**
Rhinanthus crista-galli
Ribes glandulosum
*R. hirtellum**
R. hirtellum, var. *calcicola*
*R. lacustre**
Rosa virginiana
Rubus allegheniensis
R. canadensis
R. hispidus
R. idaeus
R. pubescens
Rumex acetosella
R. crispus
R. orbiculatus
Rumex sp.
Salix bebbiana
S. discolor
Salix sp.
Sambucus canadensis
*S. racemosa**
Scirpus atrocinctus
*Sedum rosea**
Senecio vulgaris
Sisyrinchium montanum
Sisyrinchium sp.
*Smilacina amplexifolius****
S. racemosa
S. stellata, var. *crassa*
Smilacina sp.
Solidago bicolor
S. canadensis
S. flexicaulis
S. macrophylla
S. nemoralis
S. puberula
S. rugosa
S. sempervirens
Sonchus arvensis
S. asper
Sorbaria sorbifolia
Sorbus americana
S. americana x *decora* (hybrid)
S. decora
Spiranthes cernua
Stellaria calycantha
S. graminea
S. media
Stellaria sp.
Streptopus amplexifolius, var. *americanus*
*Streptopus roseus**
S. roseus var. *perspectus*
Taraxacum officinale
Taxus canadensis
Thalictrium pubescens
Thelypteris noveboracensis
Trientalis borealis
Trifolium hybridum
T. pratense
T. repens
*Trillium erectum**
T. erectum, var. *albiflorum*
Tussilago farfara
Urtica dioica
U. dioica, var. *procera*
Vaccinium angustifolium
V. vitis-idaea, var. *minus*
*Veronica officinalis**
V. serpyllifolia, var. *borealis*
Vicia cracca
Viola blanda
V. cucullata
V. macloskeyi
V. selkirkii
Viola sororia
Viola sp.
Woodsia ilvensis

Appendix 5a
Lichens Recorded for Isle Haute

Alphabetical list of species visually identified and/or collected = 56

Beach: basalt cobble , sublittoral zone, above high water line (saxicolous)

Aspicilia caesiocinerea
Aspicilia cinerea
Candelariella vitellina
Hypogymnia physodes (also corticolous, on Isle Haute trees)
cf. *Lecanora poliophaea*
Lecanora polytropa
Lecanora rupicola
Pertusaria sp.
Rhizocarpon geminatum
Rhizocarpon geographicum
Rhizocarpon polycarpon
Parmelia sulcata (also corticolous, on trees)
Sarcogyne regularis
Verrucaria cf. *mucosa*
Xanthoria elegans
Xanthoria parietina

Beach: basalt cobble, supralittoral zone, adjacent to high water mark of lagoon

Acaraspora fuscata
Acaraspora sp. (brown; non-areolate, diffusely squamulose with pruinose black disc)
Buellia sp. (*verruculosa?*)
Buellia sp. (*subdisciformis*?)
Candelariella cf. *xanthostigma*
Candelariella sp. (minute sqaumules, discs less than .25 mm)
Lecanora poliophaea (papillate; prominent red-brown discs; K-, C-)
Verrucaria sp. (scurfy black thallus)
Rhizocarpon polycarpon

Beach (driftwood)

Caloplaca holocarpa
Cladonia cristatella
Cladonia coniocraea
Cladonia fimbriata
Lecanora sp. (several unidentified species)

Lichens on trees on trail to lighthouse (corticolous)

Evernia mesomorpha
Fistulariella roesleri
Hypogymnia physodes
Hypogymnia krogii
Hypogymnia vittata
Lobaria pulmonaria
Melanelia subaurifera (also saxicolous)
Parmelia bolliana
Parmelia galbina
Parmelia squarrosa
Parmelia sulcata
Peltigera aphthosa
Physcia aipolia
Platismatia glauca
Punctelia appalachensis
Punctelia subrudecta
Ramalina americana
Ramalina dilacerata
Ramalina fimbriata

Other species and locations
Cladonia furcata (on moss beside trail; only 1 clump measuring 3-5 cm in diameter)
Peltigera aphthosa (large but fragmented thallus on path to latrine, north end of beach)
Cladonia squamosa (amid detritus at NSMNH encampment)
Melanelia subaurifera (on basalt cobble with *P. saxatilis* near latrine)
Parmelia saxatilis (in latrine area on cobble)
Xanthoria polycarpa (abundant on bird and mammal bones on beach;

TOTAL 1997 SPECIES = 56
Total Erskine species = 16

Erskine species confirmed and/or re-identified in 1997 = 14
Species presumably identified by JSE that have no known synonym (unidentifiable) = 2

NSMNH material (identified by Karen Diadick Casselman) collected by Alex Wilson, Sheila Stevenson and Karen Diadick Casselman July 16, 1997

Appendix 5b
John Erskine's Isle Haute Lichen List

With notations by Karen Diadick Casselman July 1997

There are a total of 16 Isle Haute specimens at NSMNH herbarium that were collected by John Erskine. These are:

Alectoria jubata (= *Usnea* sp.)
Buellia coracina (not a known synonym; = my *Buellia* sp.?)
Cladonia cristatella (confirmed 1997)
Cladonia pyxidata (= my *C. fimbriata*)
Cladonia rangiferina
Cladonia squamosa (confirmed 1997)
Cladonia subcariosa (not a known synonym)
Cladonia uncialis (= my *C. furcata*)
Evernia furfuracea (= my *E. mesomorpha*)
Lecanora rupicola (confirmed 1997)
Parmelia physodes = (*Hypogymnia physodes*)
Parmelia rudecta (= my *Punctelia subrudecta*)
Parmelia saxatilis (confirmed)
Parmelia sublaevigata (not a known synonym)
Stereocaulon paschale
Sticta pulmonaria (= *Lobaria pulmonaria*)

Total of Erskine species confirmed in 1997 = 14
Total Erskine species unconfirmed in 1997 = 2 (*Cladonia rangiferina, Stereocaulon paschale*)

Appendix 6
Preliminary list of invertebrate taxa recorded from Isle Haute, Cumberland Co.

Cnidaria
- Semaeostomeae
  - Ulmaridae

Nematomorpha
- Gordioida
  - Gordea

Mollusca
- Mesogastropoda
  - Littorinidae
  - Hydrobiidae
- Stylommatophora
  - Helicidae
- Myoida
  - Myidae

Arthropoda:
Arachnida
- Araneae
  - Theridiidae
  - Araneidae
  - Agelenidae
  - Linyphiidae (Linyphiinae)
  - Linyphiidae (Erigoninae)
  - Amaurobiidae
  - Hahniidae
  - Lycosidae
  - Clubionidae
  - Liocrannidae
  - Gnaphosidae†
  - Thomisidae
  - Salticidae
- Pseudoscopriones
  - Neobisidae
- Opiliones
  - Sclerosomatidae
  - Phalangiidae
- Acariformes
  - Mesostigmata
  - Oribatida

Insecta
- Microcoryphia
  - Machilidae
- Collembola
  - Sminthuridae
  - Entomobryidae
  - Poduridae
- Odonata
  - Aeshuidae
  - Libellulidae
- Orthoptera
  - Acrididae
  - Rhaphidophorinae
  - Gryllacrididae
- Plecoptera
  - Nemouridae
- Hemiptera
  - Notonectidae
  - Gerridae
  - Miridae
  - Nabidae *
  - Pentatomidae
- Homoptera
  - Cercopidae
  - Cicadellidae
- Coleoptera
  - Carabidae
  - Dytiscidae
  - Ptiliidae
  - Staphylinidae
  - Lampyridae
  - Elateridae
  - Scarabeidae
  - Cantharidae *
  - Cephaloidae *
  - Cerambycidae *
  - Chrysomelidae *
  - Curculionidae
- Trichoptera
  - Limnephilidae

Diptera
- Tipulidae
- Culicidae
- Sciaridae
- Rhagionidae
- Phoridae
- Syrphidae
- Tephritidae
- Muscidae
- Tachinidae

Lepidoptera
- Coleophoridae ‡
- Oecophoridae ‡
- Choreutidae ‡
- Tortricidae ‡
- Papionidae ‡
- Pieridae ‡
- Lycaenidae
- Nymphalidae
- Danaidae
- Geometridae ‡
- Noctuidae ‡

Hymenoptera
- Cimbicidae
- Tenthredinidae
- Ichneumonidae
- Formicidae
- Vespidae
- Megachilidae
- Apidae

Crustacea

Isopoda
- Oniscidae
- Porcellionidae

Amphipoda
- Gammaridae

Decapoda
- Portunidae

Chilopoda

Lithobiida
- Lithobiidae

Diplopoda

Chordeumatida
- Caseyidae

† collected in 1921 and 1997
‡ collected / reported only in 1953
*** include taxa new to NSMNH collection**

Appendix 7
Ground Beetles (Carabidae) collected on Isle Haute

Species	1953	1997	Typical Habitat[1]
Sphaeroderus lecontei Dejean		X	moist forest litter, moss
Pterostichus adstrictus (Eschscholtz)		X	coniferous areas
P. coracinus Newman		X	under debris in woods
P. luctuosus Dejean		X	
P. melanarius (Illiger)		X	
P. pensylvanicus LeConte		X	forest litter
Harpalus rufipes DeGeer		X	open fields; waste areas
H. affinis (Schrank)	X		open, dry, weedy areas
Calathus ingratus Dejean		X	hardwood forest litter
Synuchus impuncatus (Say)		X	open fields; light dry forests

[1] after Downie & Arnett (1996)

Appendix 8
Isle Haute Birds

a. Bishop bird skins collected 1889-1890
b. Townsend observations 1921
c. Lloyd Duncanson collections 1953
d. Maritime Breeding Bird Survey—nesting birds 8 June 1987 or 6 Aug 1987
e. Maritime Breeding Bird Survey—P. Bryson, 2 Aug 1990
f. A. Crowell, observations, August 1993
g. A. Crowell, observations, 10-12 June 1994
h. R. Fielding, observations, 20 August 1996
i. A. Hebda.C Ewing November 1996
j. A. Davis, A. Hebda and F. Scott, observations and songs, 14-17 July 1997
k. M. Elderkin, observations, 1997

Order GAVIIFORMES

Family Gaviidae

Red-throated Loon, *Gavia stellata* (Pontoppidan)	f.
Common Loon, *Gavia immer* (Brunnich)	j.

Order PELECANIFORMES

Family Sulidae

Northern Gannet, *Sula bassanus* (Linnaeus)	f.

Family Phalacrocoracidae

Double-crested Cormorant, *Phalacrocorax auritus* (Lesson)	f.j.

Order ANSERIFORMES

Family Anatidae

American Black Duck, *Anas rubripes* Brewster	f.
Common Eider, *Somateria mollissima* (Linnaeus)	a.b.(nest)e.f.g.j.
Black Scoter, *Melanitta nigra* (Linnaeus)	g.
Red-breasted Merganser, *Mergus serrator* Linnaeus	b.

Order CICONIIFORMES

Family Ardeidae

Great Blue Heron, *Ardea herodias* Linnaeus	h.

Order FALCONIFORMES

Family Cathartidae

Turkey Vulture, *Cathartes aura* (Linnaeus)	i.

Family Accipitridae

Osprey, *Pandion haliaetus* (Linnaeus)	f.
Northern Harrier, *Circus cyaneus* (Linnaeus)	f.

Family Falconidae

Peregrine Falcon, *Falco peregrinus*	f.k.
Sharp-shinned Hawk, *Accipiter striatus* Vieillot	f.

Order CHARADRIIFORMES

Family Charadriidae	
Semipalmated Plover, *Charadrius semipalmatus* Bonaparte	e.
Family Scolopacidae	
Greater Yellowlegs, *Tringa melanoleuca* (Gmelin)	f.
Spotted Sandpiper, *Actitis macularia* (Linnaeus)	g.j.
American Woodcock, *Scolopax minor* Gmelin	c.h.j.
Family Laridae	
Sub-family Larinae	
Herring Gull, *Larus argentatus* Pontoppidan	b.d.e.(nesting)f.g.h.j.
Great Black-backed Gull, *Larus marinus* Linnaeus	d.e.f.g.h.j.
Family Alcidae	
Black Guillemot, *Cepphus grylle* (Linnaeus)	a.b.e.f.g.h.j.

Order CUCULIFORMES

Family Cuculidae	
Black-billed Cuckoo, *Coccyzus erythropthalmus* (Wilson)	c.

Order APODIFORMES

Family Apodidae	
Chimney Swift, *Chaetura pelagica* (Linnaeus)	f.

Order PICIFORMES

Family Picidae	
Yellow-bellied Sapsucker, *Sphyrapicus varius* (Linnaeus)	f.
Downy Woodpecker, *Picoides pubescens*, (Linnaeus)	f.
Northern Flicker, *Colaptes auratus* (Linnaeus)	f.

Order PASSERIFORMES

Family Tyrannidae	
Yellow-bellied Flycatcher, *Empidonax flaviventris* (Baird and Baird)	c.
Least Flycatcher, *Empidonax minimus* (Baird and Baird)	j.
Eastern Kingbird, *Tyrannus tyrannus* (Linnaeus)	g.
Family Hirundinidae	
Tree Swallow, *Tachycineta bicolor* (Vieillot)	j.
Family Corvidae	
Blue Jay, *Cyanocitta cristata* (Linnaeus)	f.g.i.j.
Common Raven, *Corvus corax* Linnaeus	b.f.g.h.i.j.
Family Paridae	
Black-capped Chickadee, *Parus atricapillus* Linnaeus	f.g.h.j.
Boreal Chickadee, *Parus hudsonicus* Forster	i.j.
Family Sittidae	
Red-breasted Nuthatch, *Sitta canadensis* Linnaeus	f.j.
Family Troglodytidae	
Winter Wren, *Troglodytes troglodytes* (Linnaeus)	f.
Family Muscicapidae	
Sub-family Sylviinae	
Golden-crowned Kinglet, *Regulus satrapa* Lichtenstein	f.j.

Sub-family Turdinae	
Swainson's Thrush, *Catharus ustulatus* (Nuttall)	g.j.
American Robin, *Turdus migratorius* Linnaeus	j.
Family Bombycillidae	
Cedar Waxwing, *Bombycilla cedrorum* Vieillot	j.
Family Vireonidae	
Red-eyed Vireo, *Vireo olivaceus* (Linnaeus)	j.
Family Emberizidae	
Sub-family Parulinae	
Northern Parula, *Parula americana* (Linnaeus)	f.
Magnolia Warbler, *Dendroica magnolia* (Wilson)	c.f.
Yellow-rumped Warbler, *Dendroica coronata* (Linnaeus)	g.j.
Black-throated Green Warbler, *Dendroica virens* (Gmelin)	b.f.j.
Blackpoll Warbler, *Dendroica striata* (Forster)	f.
Black-and-white Warbler, *Mniotilta varia* (Linnaeus)	f.
American Redstart, *Stegophaga ruticilla* (Linnaeus)	g.j.
Mourning Warbler, *Oporornis philadelphia* (Wilson)	c.
Common Yellowthroat, *Geothlypis trichas* (Linnaeus)	f.j.
Sub-family Emberizinae	
Field Sparrow, *Spizella pusilla* (Wilson)	f.
Savannah Sparrow, *Passerculus sandwichensis* (Gmelin)	c.f.
Song Sparrow, *Melospiza melodia* (Wilson)	f.
Swamp Sparrow, *Melospiza georgiana* (Latham)	f.
White-throated Sparrow, *Zonotrichia albicollis* (Gmelin)	f.j.
Sub-family Icterinae	
Common Grackle, *Quiscalus quiscula* (Linnaeus)	j.
Brown-headed Cowbird, *Molothrus ater* (Boddaert)	j.
Family Fringillidae	
Sub-family Carduelinae	
Red Crossbill, *Loxia curvirostra* Linnaeus	j.
Pine Siskin, *Carduelis pinus* (Wilson)	j.
American Goldfinch, *Carduelis tristis* (Linnaeus)	f.

Appendix 9
List of other sources

Video

Bollinger, Edward A. 1934. Footage of Isle Haute as it was in the 1930s. Public Archives of Nova Scotia.

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"Isle Haute: The Floating Island". http://www.deltastar.nb.ca/caledonian/folk.html

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Audio

As it Happens, CBC Radio, July 31, 1997. Bob Grantham talks about Isle Haute. 13 mins.

Freygood, Stephen. *Information Morning*, CBC Radio, ????????

Appendix 10
List of Figures, Illustrations and Tables

Fig. 1: *Mr. Don Keith with his wife Joan and the advance crew.*

Fig. 2: *Base camp on the island.*

Fig. 3: *Isle Haute as sketched by JFW Des Barres in the 1770s*

Fig. 4: *The Isle Haute lighthouse and visitors, circa 1900.*

Fig. 5: *The author in one of the treasure pits.*

Fig. 6: *Archaeological excavation at Isle Haute.*

Fig. 7: *Stone artifacts recovered from Isle Haute.*

Fig. 8: *Bob Grantham sports the latest in geological fashion. Safety was a key factor in working on the island. Hard hats, safety glasses, visibility-vest, and steel-toed boots were essential gear.*

Fig. 9: *Fractured columns of basalt are visible along the north shore.*

Fig. 10: *Native copper occurs on the northeast end of the shoreline otcrop. It occurs as sporadic blebs on the columnar joint surfaces.*

Fig. 11: *Map showing the distribution of Triassic and Jurassic formations in the Bay of Fundy.*

Fig. 12: *Isopach map showing thicknesses of North Mountain Basalt in the Fundy Rift Basin.*

Fig. 13: *Distribution of the Newark Supergroup in eastern North America.*

Fig. 14: *1995 aerial photo of the island.*

Fig. 15: *Dogwood*, Cornus alternifolia.

Fig. 16: *The ravine running down to the salt pond.*

Fig. 17: *Indian Cucumber-root*, Medeola virginiana.

Fig. 18: *Toothwort*, Dentaria diphylla.

Fig. 19: *Unique arctic-alpine flora can be found on cliff faces.*

Fig. 20: *1951 air photo of Isle Haute. Note extensive burned areas to the east of the cultivted zone near the lighthouse.*

Fig. 21: *Lichens on basalt.*

Fig. 22: *Plan of Isle Haute showing areas covered during searching (dashed lines), and locations of beating and sweeping samples (solid circles).*

Fig. 23: *Plan of east end of Isle Haute showing locations of leaf litter samplesL1 (young mixed woods along trail), L2 (older hardwood dominated woods in ravine) and locations of pitfall traps (Px).Pitfall traps P1–P8 were set on cobble and gravel beach; P21–P24 were set in spruce-alder woods. Traps P22 and P24 were baited with rancid beef liver.*

Fig. 24: *Plan of centre portion of Isle Haute showing location of pitfall traps (Px). Pitfall trap P14 was placed at the base of the foundation of the old lighthouse. Traps P15–P16 were placed in waterlogged soil surrounding the small pond.*

Fig. 25: *High densities of frogs exist in the pond.*

Fig. 26: *Since there were no ponds on the island, one was excavated on the east side of the plateau, so the frogs could lay their eggs.*

Fig. 27: *Salt pond as seen from the east end with cobble barrier beach on right. Note coloured banding on cobble slope indicating changes in water levels.*

Fig. 28: *Open fields, viewing south from the light tower.*

Fig. 29: *Trail passing through alder flat. Photo taken in November 1996.*

Fig. 30: *Fold-out map of Isle Haute.*

Table 1: *Preliminary results of leaf litter samples.*

Table 2: *Preliminary results of pitfall trap samples from Isle Haute, 1997.*

Table 3: *Bird species of Isle Haute (July 1997).*

Table 4: *Trap-night summary.*

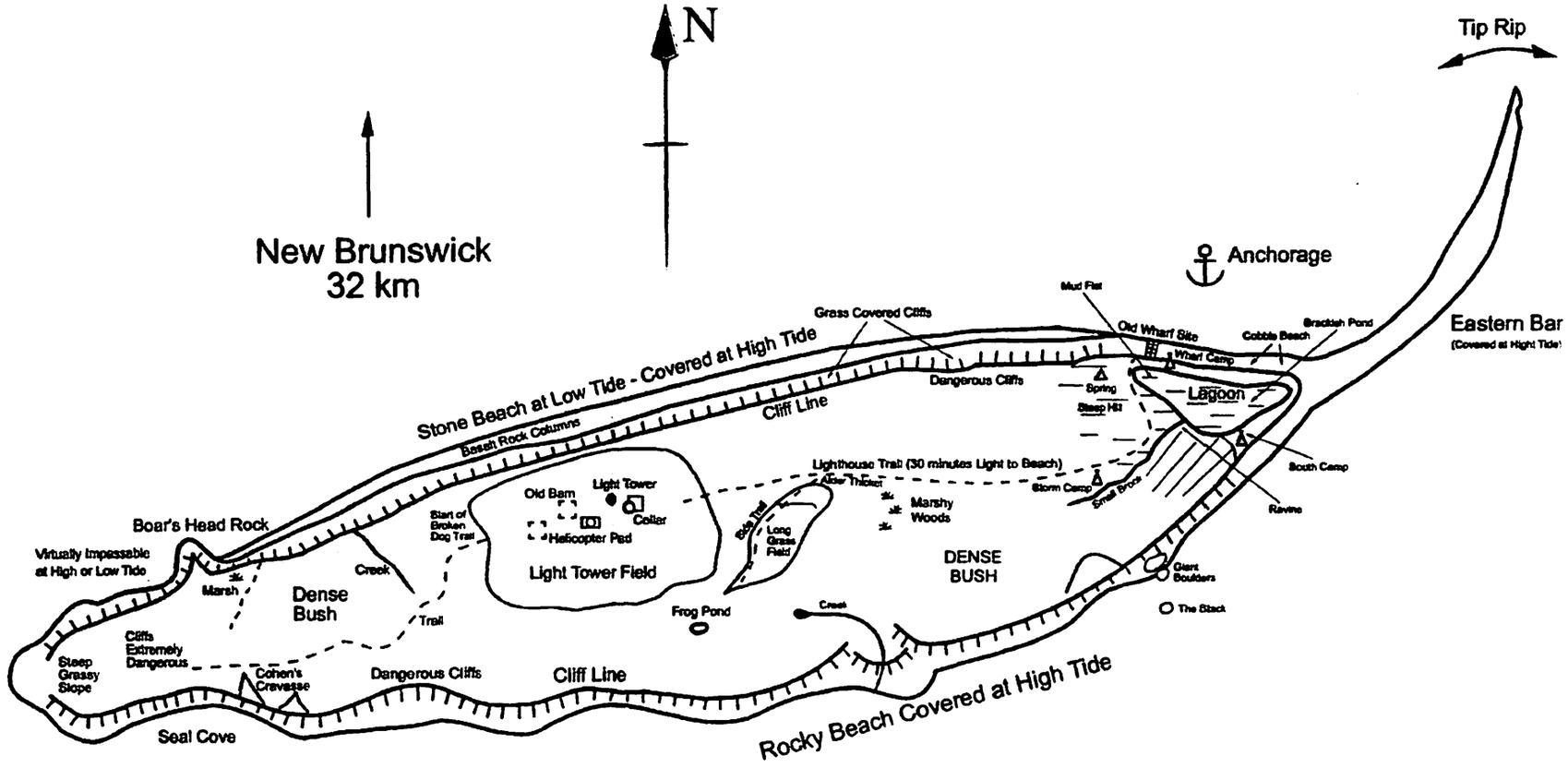

Fig. 30: Map of Isle Haute.