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Biological Inventories of Schoodic and Corea Peninsulas, Coastal Maine, 1996

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FINAL REPORT

Biological Inventories of Schoodic and Corea Peninsulas, Coastal Maine, 1996

June 30, 1999

By:

William E. Glanz, Biological Sciences Department, University of Maine and Bruce Connery, Acadia National Park, Co- Principal Investigators,

With Chapters Contributed by Norman Famous, Glen Mittelhauser, Melissa Perera, Marcia Spencer-Famous, and Guthrie Zimmerman

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12 July 1999

Dr. Allan O'Connell
Cooperative Park Studies Unit
South Annex A
University of Maine
Orono, ME 04469

Dear Allan:

Enclosed are three copies of the Final Report on "Biological Inventories of Schoodic and Corea Peninsulas, Coastal Maine, 1996," for transmission to the National Park Service, New England System Support Office. I am delivering two additional copies to Bruce Connery, one for him as co-principal investigator and the other to be taken to James Miller at the US Navy base in Winter Harbor. This report is the final report for Amendment # 27 to the Cooperative Agreement between NPS and University of Maine (CA 1600-1-9016).

The final version of this report incorporates most of the comments, editing, and suggestions from the reviews submitted to me. Bruce Connery revised the amphibian chapter to include all of Droege's suggestions; his recommendations for monitoring are outlined in the Discussion and Management Recommendations. Hadidian provided detailed editing suggestions, almost all of which were included in the amphibian, mammal and bird chapters. The several "missing" references are now included or corrected in the Literature Cited.

The two detailed reviews of the bird chapter by Ralph and Peterjohn (?) suggested many changes to that chapter. Where more methodological detail was requested, I have questioned Norm Famous (who did not send me any written revisions in response to the reviews) and have included responses to each request. An appendix of scientific and common names of bird species has been added, as urged by Peterjohn. The first reference to each fruiting plant species now includes a scientific name. Additional references are cited for MAPS banding and species of special monitoring concern. In tables where subjective criteria were used for including bird species, I have imposed objective criteria based on quantitative changes in data on those species. Where the reviewers questioned Famous' proposed causes of population changes, I have chosen to retain those tables, but have omitted the purported causal agents from the tables, focusing them only on numerical changes in counts per species. In the Discussion I have rewritten the text to note factors (such as fruit production) that correlate with these changes and present Famous'

evidence for them, but stress that they have not been tested adequately yet. The two reviewers gave conflicting recommendations for future work and techniques to use. I have been selective in incorporating their recommendations, and the final section includes most of Famous' ideas from previous drafts, with additional suggestions offered by both reviewers.

In the bryophyte vegetation chapter, the editing comments by Hadidian have been followed. The chapter introduction has been extensively rewritten in response to comments by Steve Hubner (Navy), to differentiate bryophytes from other plants and to highlight their importance. More details on transect methodology have been added, as requested by ANP reviewers. The draft sent to ANP was missing a page on cover types. The missing text should clarify certain vegetation or site characteristics that were misinterpreted as site names.

In response to the Navy review by Steve Hubner, author contact data have been added following the Acknowledgements on page ix. A summary of all listed species has been added to the Executive Summary, with page references to later text. Listed species are noted in **bold type** in each chapter, but the location of these may be in either Results or Discussion, depending on the author's presentation; refer to the Executive Summary for page numbers. Both federal and state designations are considered for each taxon. Missing pages and inconsistent table designations have been rectified.

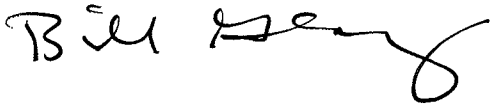
I was unable to fully accomodate the final two requests by Hubner. The file for the massive list of 335 vascular plant species in the 1994 inventory was not loaned to me and could not be scanned from its table format into an intelligible format on my computer. That list was compiled by previous investigators on a separate, previous contract, and was included in that project's final report. We or ANP personnel can add our 62 new site records and 9 new species to that list when the file becomes available.

In response to Hubner's statement that "there are no management recommendations," I have found them in most chapters, and have added some and strengthened others in each chapter. These recommendations will not satisfy his requirements, as none advocate large-scale environmental manipulations by humans. Many involve limiting disturbance to rare or locally important habitats such as open water sites or certain wetland types; hence, if disturbance to a natural site is necessary, we recommend planning and management of that disturbance so that it affects more widespread or less important habitats. Another specifically addresses the spread of alien plants, most of which become established at sites with direct disturbance of the vegetation by humans (see Chapter 7) . The authors here have not outlined massive environmental manipulations to maintain diversity or certain species, largely because no such species or diversity relationships were identified. The status of jack pine woodlands (noted by Hubner) was reviewed in the 1994 study, and monitoring, not burning, was recommended. I admit that their finding of no recent regeneration by jack pine in these stands suggests that burning may eventually be needed, but fire ecology was outside the scope of our 1996 inventory, and the timing of such a burn should be based on a more intensive study. Forest community dynamics was not part of the proposed work in 1996, and it is unfair to expect it be included here. Many other

recommendations (e.g. amphibians) also outline monitoring that would be necessary before management intervention is employed. I must stress that this study was a biological inventory, and with the 1994 data it provides the first inventory for this region. Inventories are the first step in management, to be followed by monitoring, which in turn will indicate whether manipulative interventions are needed. All three steps are part of management; for the Schoodic region, we are just completing step one for most taxa. Finally, as the Big Moose Navy site is small and embedded in a national park, and the Corea site is a designated Maine Critical Area, large-scale environmental interventions by humans would be difficult to undertake and of questionable legality. So I ask that you please accept the "management recomendations" offered here as sufficient for the scope of this study and as a useful first step toward more advanced forms of management.

I will provide Bruce Connery with computer files for the text of this report. If others are needed, I will be happy to provide them. Contact me if you have any questions. Thank you.

Sincerely,



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BIOLOGICAL INVENTORIES OF SCHOODIC AND COREA PENINSULAS, COASTAL MAINE, 1996

EXECUTIVE SUMMARY

This project was designed to complete a preliminary biological inventory of US Navy and Acadia National Park lands on Schoodic and Corea Peninsulas in coastal Maine, with the overall goal of providing the Navy and the National Park Service with natural resource information sufficient for management decisions. In this region, lands administered by these agencies are adjacent to each other and present a unique opportunity to cooperatively assess and manage natural resources. The study was funded primarily by a grant from Department of Defense Legacy 2000 program administered through the National Park Service, and involved researchers and matching funding from Acadia National Park and the University of Maine. Certain vehicle and field personnel expenses also were supported by a grant from the Eastern National Foundation, and additional assistance and support were provided by Acadia National Park, the US Navy Security Group Activity - Winter Harber, and the University of Maine.

Prior to 1994, basic biological information on the Schoodic Peninsula region was scarce. A preliminary biological inventory was undertaken in 1994, which surveyed amphibians and reptiles, terrestrail mammals, and vascular plants (Mittelhauser, et al. 1995). The present project involved intensive studies of three taxonomic groups not studied in the 1994 survey (bats, landbirds, and bryophyte plants) and follow-up studies of amphibians, terrestrial mammals, and vascular plants. Specific objectives were to: (1) compile species lists for taxa not previously studied; (2) update species and habitat information of taxa studied in 1994; (3) identify federal and state-listed endangered or threatened species and other species of local or state-level management concern; and (4) organize available data for further resource management decisions.

The study area included all US Navy lands on Corea Heath and Big Moose Island (approximately 250 hectares) and all Acadia National Park lands on Schoodic Peninsula and Big Moose Island (approximately 800 ha). Corea Heath is designated as a Maine Critical Area, and recognized as a one of the largest and most southerly coastal raised peatlands in North America. The jack pine (*Pinus banksiana)* stands on Schoodic Peninsula, Big Moose Island, and Corea Heath also are designated Maine Critical Areas. Hence the region is of considerable interest in terms of the biology and conservation of its ecological communities.

Amphibians were surveyed using pitfall traps along drift fences, artificial shelters, and three types of search techniques: visual searches, auditory searches and night driving searches. Six amphibian species were found on the three study sites, three salamanders and three frog species. Two of these species were recorded for the first time on Big Moose Island in 1996. Five additional species (three salamanders and two frogs) were recorded within several miles of the study areas, but were absent on the Schoodic and Corea peninsulas, possibly due to a lack of large areas of

suitable habitat on these peninsulas. All six species in the study areas were detected in both the night driving searches and the pitfalls along drift fences. The highest total counts of eastern newts and spring peepers were recorded during night drives, while the drift fences produced the highest counts of redback salamanders, spotted salamanders, and wood frogs.

Small mammals were surveyed using two methods: (1) live-trapping with Sherman live-traps; and (2) captures in the pitfalls along the drift fences used in sampling amphibians. Live-trapping was more effective in sampling small rodents, but the drift-fence pitfalls captured many more shrews. The deer mouse, *Peromyscus maniculatus*, was the most common small rodent species, and the masked shrew, *Sorex cinereus*, was the most common insectivore. Seventeen species of small mammals were recorded, including three species live-trapped that were not recorded in the 1994 surveys: the Hairy-tailed Mole *Parascalops breweri*, the Meadow Vole *Microtus pennsylvanicus*, and the Short-tailed Weasel or Ermine, *Mustela erminea*. Species of larger mammals were inventoried based on observations and previous records. The fisher, *Martes pennanti*, was observed twice on Schoodic Peninsula, and the beaver *Castor canadensis* was noted at both Corea and Schoodic peninsulas, the first confirmed records of these species in the study area. To date, 36 species of non-flying land mammals have been recorded on US Navy and ANP lands in this region.

Bats species were studied using two general techniques: (1) mist-netting to capture bats for direct species identification and community composition; and (2) recording bat echolocation calls along habitat transects using Anabat II bat detectors, to detect areas of concentrated activity by bats and to assess their patterns of habitat use. Six species were identified in the area, four captured in nets and two additional species identified based on distinctive ultrasound calls recorded with the bat detector. We extended the known range of the Small-footed Myotis, *Myotis leibii*, with a capture on ANP lands on Schoodic Peninsula. This species and the two most common species, also in the genus *Myotis*, could not be distinguished by their calls. Wetland habitat with areas of open water had the highest levels of bat activity, with open corridors in forested habitat also receiving extensive use. The wetland connecting the Schoodic mainland with Big Moose Island consistently attracted more bats than other sites.

Bird species present in the region were monitored using three techniques: (1) point counts during the breeding season, with points placed along Breeding Bird Survey routes and in representative habitats; (2) constant effort mist-netting during the breeding season; and (3) fall migration area searches. A total of 96 species were detected during breeding season monitoring in 1995 and 1996, including 43 Neotropical migrant species, and 53 resident species or short-distance migrants. Seventeen species showed major population decreases in breeding density between 1995 and 1996 (among them were Mourning Doves, Swainson's Thrushes, Hermit Thrushes, Robins, and Dark-eyed Juncos), while only 5 species increased substantially between 1995 and 1996. During fall migration area searches from 1994 to 1996, 100 species were tallied, with 78 found at the Corea site and 86 at the Big Moose Island and adjacent Schoodic sites. In contrast to the breeding density trends, fall migration counts showed major increases in 1996 for several species, including Black-throated Green Warbler, Palm Warbler, Yellowthroat, and Song

Sparrow. This trend may reflect renesting by these species during the protracted wet 1996 breeding season. Other species were much higher in 1994, including Robins, Cedar Waxwings, Black-capped Chickadee and Golden-crowned Kinglet. These trends may reflect high fruit and seed availability in that year.

Mosses and other bryophyte plants were not sampled during extensive vegetation surveys in 1994, so these plant groups were the focus of vegetation studies in 1996. Bryophytes were sampled at each site along transects spanning several cover types. Twenty-five cover types were distinguished, 10 terrestrial (upland, well-drained sites), 14 palustrine (wetland sites), and one riverine type. At least 162 bryophyte species were tallied, with 131 of these recorded on ANP Schoodic lands and 125 on the Corea site. True mosses dominated this flora, with liverworts and sphagnum species also common at all three sites. Four species of special interest were noted: *Isothecium eumyosuroides*, a species with a restricted coastal range on east and west coasts of North America; *Dicranum majus* and *Diplophyllum albicans*, two species at the southern extremes of their coastal ranges, and *Splachnum pensylvanicum*, which is found primarily on well-rotted moose dung. During these surveys, vascular plants also were noted, and 62 new records for species at our sites were obtained, including nine species not previously recorded at any site. The vascular plant flora for these sites now includes records for 344 vascular plant species.

Summary of Federal and State Listed Species:

No species of amphibians or terrestrial mammals listed by US or Maine authorities as endangered or threatened were found in this study (see p 8 and p 15). No federally-listed bats were recorded, but all bats are classified as Species of Special Concern in Maine (see p 26 and Maine Inland Fisheries and Wildlife 1994). Six listed bird species are noted on p 46; they include peregrine falcon (US and Maine Endangered, bald eagle (US and Maine threatened), sedge wren and grasshopper sparrow (both Maine endangered), olive-sided flycatcher and vesper sparrow (both Maine Species of Special Concern). No federal or state lists of bryophyte plant species have been approved yet (see p 71), but four bryophyte species of special interest (noted above) and several additional rare species found in the study region are discussed on pp 53-54. Eleven Maine state-listed species of vascular plants were reported in the previous survey of the region (Mittelhauser et al. 1995, Table 10). One of these, Pickering's reed grass *Calamagrostis pickeringii* Gray (Maine endangered) was found at new sites on Big Moose Island during this study (p 72).

Summary of Recommendations for Conservation and Management:

Specific recommendations for conservation and management are given at the end of each inventory chapter, and in the final chapter. The following is a summary of our major recommendations.

Habitat Preservation:

- Continue management practices that preserve the full range of habitat types now present in this biologically diverse region.

- Identify and preserve small or localized habitats that are critical to specific taxa, such as open fresh water sites (as breeding sites for amphibians and foraging sites for bats) and local wetland sites with rare plant species.

Long-Term Monitoring:

- Coordinate long-term monitoring of amphibians with state-sponsored surveys, and identify species with downward population trends or high rates of local extinction.
- Continue support for breeding bird surveys and fall migration monitoring programs, and cooperate with federal efforts to distinguish declining or threatened species.
- Establish periodic monitoring programs for terrestrial mammals, bats, rare vascular plants, and rare bryophyte plant species, and cooperate with state agencies, regional working groups, and recognized authorities on these taxa to identify species and distributional patterns of concern.

Responses to and Management of Human Disturbance

- Limit or avoid disturbance to rare or local habitat types, especially open water and rare wetland habitats, and rare vegetation cover types.
- Monitor animal and plant responses to disturbances of other major habitat types and limit or mitigate disturbance if rare or local species are adversely affected.
- Establish and enforce guidelines for construction and other soil disruptions to limit the spread of invasive non-native plant species.

Cooperation with Federal, State and Local Agencies

- Coordinate monitoring and inventory efforts with state and federal programs.
- Support studies of endangered and threatened species, and species of special concern identified by state or federal agencies.
- Monitor habitat changes in the privately-owned landscape adjacent to ANP and Navy lands, identify losses of habitat that may affect plant and animal populations on federally managed lands, and cooperate with local planning agencies to mitigate harmful effects.

Support of Additional Research

- Initiate or support research on amphibian and bird distributions in the landscapes surrounding ANP and Navy lands, to determine how habitat availablity and fragmentation affect species present in the Schoodic region .
- Support research on roosting habitat needs of bat species present in the region.
- Initiate research on interactions between fruit and seed production by trees and density responses of sciurid rodents and frugivorous birds.
- Encourage studies of the viability and persistence of rare plant populations in the region, emphasizing patterns of reproductive success and limitations imposed by rare habitats.
- Initiate or support inventories of invertebrate taxa in the Schoodic region, including aquatic insects, spiders, and butterflies and moths.

Public Education Efforts

- Make biological inventory results available to the public, in public displays, information brochures, and educational programs.
- Encourage use of ANP and US Navy lands for environmental and conservation education.

ACKNOWLEDGEMENTS

This research was supported largely through funds from the US Navy/Department of Defense Legacy 2000 program to the US National Park Service, which awarded grants to Acadia National Park, to the University of Maine, and to Norman Famous. We thank the staff of the Naval Security Group Activity - Winter Harbor for their support and cooperation during this study. James Miller, environmental specialist of NSGA-WH, was very helpful in providing information, guidance, and liaison support. The courteous assistance of numerous US Navy security officers was greatly appreciated.

We also thank Eastern National Park and Monument Association for a grant in support of the bat research, and Acadia National Park for considerable logistic support during the study. We thank the many Acadia National Park personnel who offered cooperation and assistance during this study. In particular, David Manski provided valuable support and encouragement, and Bill Weidner reported many observations useful to our work. The following current and former students at the University of Maine provided able assistance in field work throughout the summer: Victor Baisley, Elizabeth Chase, Nickolay Hristov, and Stephanie Mazerolle.

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CHAPTER 1: INTRODUCTION

Inventories of biological diversity are essential elements of any resource management or conservation program. Such inventories identify species present across habitat types, and provide baseline standards for measuring population and environmental changes in the future (Heyer et al. 1994, Likens 1989, Wilson et al. 1996). They are a necessary first step in understanding ecological relationships and genetic diversity (Wilson 1988) and also draw attention to specific management problems, such as rare or localized species, threatened species or habitats, and conflicts with other management goals (Goldsmith 1991, Williams 1994).

In coastal Maine, the Mount Desert Island region of Acadia National Park (ANP) has been studied extensively for more than a century (Greene et al. 1992), but neighboring regions have received much less attention. A natural resource inventory of the Schoodic and Corea peninsulas was initiated in 1994 by personnel from Acadia National Park, the US Navy Security Group Activity - Winter Harbor (NSGA-WH), and the College of the Atlantic (Mittelhauser et al. 1995). The inventory was supported by a grant from the Department of Defense Legacy 2000 program and by the participating organizations. Navy and National Park Service lands are adjacent or in close proximity in this region, and possible coordination of natural resource management between US government agencies was a priority concern in this program. The 1994 inventories focused on amphibians and reptiles, mammals, and vascular plants, and the results are detailed in Mittelhauser, et al. (1995). The report concluded that additional data were needed to complete inventories of certain animal groups (including amphibians and some mammals), and other taxa (such as bats, migratory birds, and bryophyte plants) also were in need of attention.

In response to the recommendations of the 1994 inventories, ANP, NSGA-WH, and personnel from the University of Maine proposed additional biological inventories for the Schoodic region. Funding was obtained from the DOD Legacy 2000 program, the participating agnecies and institutions, and several additional sources for field work during 1996. The objectives of this study were:

- Extend the previous amphibian and terrestrial mammal surveys to obtain more complete species lists and a greater range of seasonal data on species occurrence and abundance.
- Compile previous data on breeding and migratory data collected by Norm Famous in this region, and extend his studies on ANP and NSGA-WH lands to obtain more complete inventories of the landbird communities there.
- Initiate new inventories of bats and bryophyte vegetation on these lands.
- For each of the above animal and plant groups, identify federal and Maine-listed endangered or threatened species and species of management concern.

Each of the above objectives required field inventories using techniques appropriate to the taxon being studied and sampling schedules during a suitable season during 1996. Inventories for bats, landbirds, and bryophyte plants were designed to compile species lists for taxa present and characterize their distribution across the ecological communities present in the study area. The inventories of amphibians and small terrestrial mammals were conducted in the ecological communities sampled in 1994, but included more sampling at specific sites and habitats targeted for species not recorded previously. Special efforts were directed toward species listed as endangered or threatened by federal and Maine state agencies, and toward species of special concern in Maine as identified by Maine Department of Inland Fisheries and Wildlife (1994) and by the Maine Natural Areas Program (1994a and 1994b).

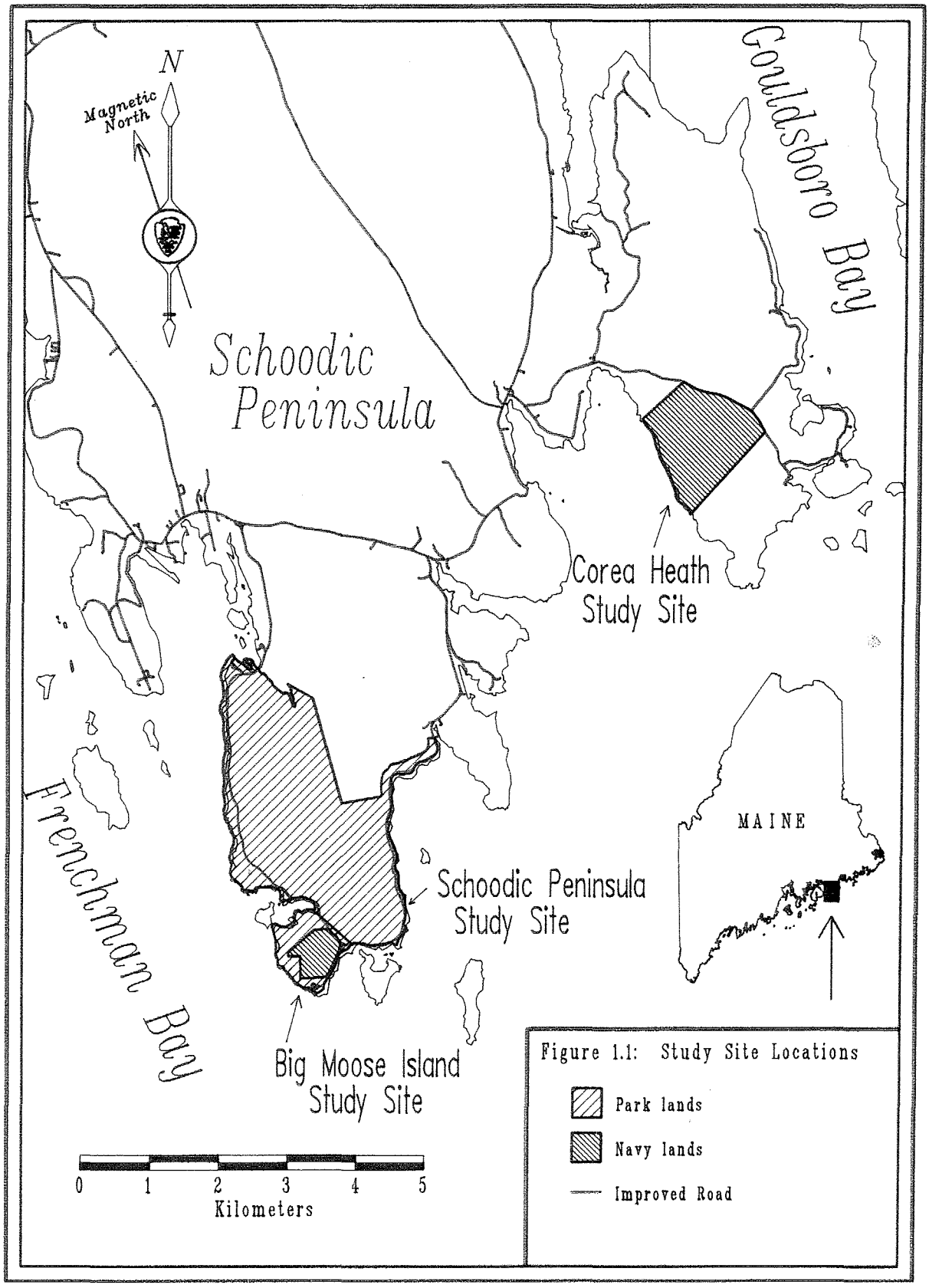
STUDY SITES

The study areas for these inventories were located on Schoodic Peninsula, coastal Maine, between Frenchman Bay and Gouldsboro Bay (Figure 1.1). Almost all the sites included were Navy and NPS lands in three areas: Navy lands at Corea Heath; ANP and Navy lands on Big Moose Island; and ANP lands on Schoodic Peninsula. Additional survey points for the bird studies were placed adjacent to or between these sites. The three primary study sites hereafter will be designated as Corea, Big Moose Island, and Schoodic, and are described below.

Corea Heath

The Corea Heath study site is located in the village of Corea, town of Gouldsboro, and consists of 191.4 ha between Route 195 and the shoreline, all of which are administered by the US Navy. The site includes several roads and numerous buildings and other structures, and several antennas constructed by the Navy. Most areas disturbed by humans are along the primary access road extending south from Route 195 to the large antenna in the center of the property.

A large (112 ha) peatland, Corea Heath, occupies most of the central and eastern portions of the property (Figure 1.1). The Corea Heath peatland is one of the most southerly and largest coastal raised peatlands in North America, and has been designated as a critical habitat by the Maine Natural Areas Program (1994a). Coastal raised peatlands are a rare wetland vegetation type, and are characterized by an extensive peat layer elevated above the water table (Worley 1981). The heath is bordered on the east and southeast by jack pine woodland, another rare vegetation type in Maine. Additional areas of spruce-fir forest, successional forest, shrublands, and recently disturbed herbaceous vegetation are also present. Several small streams flow outward from the heath, and a small pond is located west of the main antenna. Mittelhauser et al. (1995) provide additional background information on the major vegetation communities present at this site and on patterns of disturbance by humans in the area.


N
Magnetic North
Schoodic Peninsula
Gouldsboro Bay
Corea Heath Study Site
MAINE
Schoodic Peninsula Study Site
Frenchman Bay
Big Moose Island Study Site
0 1 2 3 4 5
Kilometers
Figure 1.1: Study Site Locations
Park lands
Navy lands
Improved Road

Big Moose Island

The Big Moose Island study site was formerly an island immediately southwest of southern tip of Schoodic Peninsula, separated from the mainland by a brackish marsh. A paved road was built to Big Moose Island over this marsh, and it now connects Big Moose Island to the Schoodic Peninsula loop road. The presence of the road has limited tidal influences on the marsh; this has favored sediment accumulation between the road and the Schoodic mainland, creating a vegetated wetland approximately 600 m long now that now connects Big Moose Island to the mainland. We designated areas to the south and west of the Schoodic Loop Road as the Big Moose Island study site, and areas to the north and east of the loop road as the Schoodic study site (Figure 1.1).

Mittelhauser et al. (1995) outlined history of management of this site by the US Navy and ANP. Currently, the US Navy administers approximately 40 ha of land in the center Big Moose Island, and the remaining peripheral area (about 32 ha) is administered by ANP (Figure 1.1). The administrative, maintenance, and residential areas of the NSGA-WH base occupy most of the Navy lands, with small blocks of natural habitats interspersed among the building complexes. The peripheral (mostly ANP) areas are predominantly the spruce-fir forest characteristic of coastal Maine (Davis 1966), but much of this has been cut or disturbed in the recent past. Also present are patches of northern white cedar forest along seepages and seasonal streams on the north side, and an area of jack pine forest on the southern extremity of the site.

Schoodic

The National Park Service administers approximately 800 ha of land on the mainland portion of the Schoodic Peninsula. The 1994 inventories focused on the southernmost 250 ha of this area, from Schoodic Head southward (Mittelhauser, et al. 1995). In 1996 we included all ANP lands on the mainland portion of this peninsula in our Schoodic study area (Figure 1.1).

Spruce-fir forest dominates most of this area, but jack pine stands can be found on the seaward flanks of Schoodic Head. Seasonal and permanent wetlands are scattered throughout the area, including the extensive brackish wetland connecting it to Big Moose Island in the south, and several heath and sphagnum bogs in the north. Streams are larger than on Big Moose Island, but few are permanently flowing and none are more than 1 km long.

The Schoodic Loop Road follows the coastline of this site, along the western, southern, and eastern sides of the peninsula. A seasonal road extends from the west to the south-central portion of the area, providing access to Schoodic Head, a ranger cabin, and several wetland areas. A power line, extending to Big Moose Island, bisects the area from north to south, and provides additional access to the north-central regions of the site

CHAPTER 2: AMPHIBIAN INVENTORY

by Bruce Connery and Glen Mittelhauser, Acadia National Park

HISTORIC INFORMATION

The first inventory of amphibians and reptiles on Schoodic Peninsula was conducted during the summer of 1994 (Mittelhauser et al. 1995). No earlier inventories or studies of the amphibians on the Schoodic Peninsula had been conducted (Greene et al. 1992). In The Atlas of the Amphibians and Reptiles of Maine (Hunter et al. 1992), no amphibians were reported from the Schoodic Peninsula, and only the common garter snake (*Thamnophis sirtalis*) was noted from the area. Mittelhauser et al. (1995) applied several widely-used amphibian inventory techniques (Heyer et al. 1994) to identify six species in the first Schoodic region inventory, and they recommended additional inventory efforts using a combination of techniques throughout the activity periods of the known and expected species.

METHODS

The methods used to inventory amphibians can be grouped into five categories: visual searches, auditory searches, night driving, pitfall trapping, and artificial shelters. Descriptions of methods used within each category are provided below. In addition to these methods, we also recorded species observed or heard while traveling to and from other inventory efforts on distribution maps. Inventory site locations, with Universal Transverse Mercator (UTM) coordinates, are given in Appendix 1. Data sheets, journals, and distribution maps are found in Connery (1997), which is archived in the Resource Management Division, Acadia National Park.

Visual Searches

We used several visual encounter techniques (Heyer et al. 1994) to search habitats of particular interest. At several ponds and wetlands we conducted visual searches to determine the presence of certain species and to complement other techniques being employed in these habitats. We also employed visual encounter searches on streams in the Schoodic Head study site. These surveys were conducted along the entire stream course by looking under appropriate stream substrate types and in habitats along the shore. All search efforts were quantified for future comparisons. We did not quantify visual encounter searches that we conducted while walking through suitable habitats en route to or during other inventory work, although we did record these species on species distribution maps.

Auditory Searches

Auditory or call searches involved listening and counting calling male frogs at designated wetlands or at sites with standing water. The search time ranged from a minimum of 10 minutes to 1.5 hours per search. Both day and night searches were conducted intermittently from mid-April to mid-July. We became familiar with frog and toad calls by listening to a professionally produced

tape (Elliott 1994). To quantify our efforts, we recorded the number of person hours spent listening (Heyer et al. 1994) at each wetland or site with standing water.

Night Driving

We used night driving (Heyer et al. 1994) to locate species crossing roads. This technique involved slowly driving or walking search routes on warm rainy nights. We identified routes on maps and used vehicle odometers to determine the amphibian locations along these routes. Beginning and ending search times were recorded to determine the number of person hours per route. We plotted species presence by route on distribution maps (see Connery 1997).

Pitfall Trapping

We used straight-line drift fences with pitfall traps to capture amphibians (Vogt and Hine 1982, Heyer et al. 1994). Fences were placed in or adjacent to wetlands from April 1 through June 29, 1996. We constructed drift fences of polyethylene plastic that measured from 15 to 25 meters (m) long by 50 centimeters (cm) high and were supported by wooden stakes every 3 m. Appendix 1 lists dimensions of the drift fences. The lower edge of the plastic was buried approximately 10 cm into the ground to prevent animals from passing underneath the fence. Two pitfall traps were located every 5 m on opposite sides of the drift fence. We constructed the pitfall traps from No. 10 metal cans (15.5 cm diameter x 17.5 cm deep) and positioned the lip of the can to be flush with the ground surface (Vogt and Hine 1982). At sites with deeper soils, pitfall traps were doubled in depth by joining two No. 10 metal cans (35 cm deep), which were sealed at the joint with silicon and covered with duct tape. We made anti-escape funnels from margarine bowls with the bottom removed and fitted these in the top of each pitfall trap to decrease escape opportunities. Pitfalls traps were filled with 3 cm of water to drown mammal predators. We checked the traps every two or three days. The period from the time the trap was opened to the time it was checked was described as a trap period, which was either two or three days. We applied Heyer's et al. (1994) description of one trap period to determine the total number of trap periods and total trapping effort.

Artificial Shelters

We made artificial shelters to attract amphibians in semi-saturated habitats that were unsuitable for pitfall traps or that we believed had species that were difficult to capture or locate with the other techniques (Hunter et al. 1992). Shelters were constructed of either split cedar logs of various widths (12 cm to 30 cm) and approximately 60 cm long or boards of kiln-dried spruce that measured 40.6 cm. by 27.5 cm. by 4.1cm . We established transects with ten stations spaced 10 meters apart. One or two shelters were placed on soil or below ground surface after clearing the surface vegetation at each station. We defined a shelter period as the time the shelter was set to the time it was monitored (Heyer et al 1994), and used this definition to determine the total number of shelter periods and total search effort. We monitored the shelter transects during or after precipitation events, which ranged from several days to a few weeks.

Identifications and Voucher Specimens

We used field guides by Conant and Collins (1991), Hunter et al. (1992), Hunter (1984), Klemens (1993), and Tyler (1994) for species identification and to determine the habitats to search for targeted species. We listened to cassette tapes (Elliot 1992, 1994) to learn frog and toad calls.

Amphibians killed on the roads and mortalities from traps were collected as voucher specimens. We also included photographs of live specimens in the voucher collection and in the field data notebook. Voucher specimens are listed in Appendix 2 and are stored in the Natural History Museum of the Resource Management Division, Acadia National Park, Bar Harbor, Maine.

RESULTS

We conducted 38.25 hours of visual encounter searches, 210.7 hours of auditory searches, and 17.8 hours of night driving searches in the three study sites (Table 2.1). The auditory searches included 167.5 hours by biologists conducting nighttime bat surveys.

Table 2.1. Amphibian searching effort[1] by study site, Schoodic Peninsula, Maine, 1996.

Inventory Method	Survey Period	Total Search Hours per study site		
		Big Moose Island	Corea Heath	Schoodic Peninsula
Visual Searches	5/14-9/24	2	6.25	30
Auditory Searches	5/14-8/06	22.4	53.8	134.5
Night Driving Searches	4/12-7/15	2.8	3.8	11.2

1. Hours represent the effort spent conducting searches and compiling data.

We complemented these techniques by setting drift fences with adjacent pitfall traps a total of 6394 trap periods and artificial wood shelters a total of 31 shelter periods, which totaled over 9500 days. Trapping effort is summarized by inventory method for each study site in Table 2.2.

Table 2.2. Amphibian trapping periods[1] by study site, Schoodic Peninsula, Maine, 1996.

Inventory Method	Survey Period	Total Trap Periods per study site		
		Corea Heath	Schoodic Peninsula	Big Moose Island
Drift Fence Pitfalls[2]	4/01-6/29	2017	3142	1235
Artificial Shelter[3]	5/16-10/8	7 (2420 days)	8 (2740 days)	16 (5500 days)

1. Trap period was defined as the period beginning from the time the trap, pitfall, artificial shelter was set or opened until the time it was monitored by inventory personnel . The trap period was at least 12 hours.
2. A pitfall trap was counted if the trap contained one captured animal, or had evidence that an animal had been trapped and escaped, or had trapped an animal that had been partially consumed by a predator.
3. An artificial shelter was counted if it was available to or contained an amphibian during one trap period.

The total number of amphibians captured or observed was 305 individuals: 165 on the Schoodic Head study site, 99 on the Corea Heath study site, and 41 on the Big Moose study site. Table 2.3 lists six amphibian species identified in the both the 1994 and 1996 inventories. We again identified six amphibian species in the Corea Heath and Schoodic Head study site, but found two new species for a total of five amphibian species in the Big Moose Island study site.

Table 2.3. Amphibians[1] observed or captured in each of the study sites, Schoodic Peninsula, Maine, 1996.

Species	Study Sites		
	Big Moose Island	Corea Heath	Schoodic Peninsula
Ambystoma maculatum Spotted Salamander	Xx	Xx	Xx
Notophthalmus viridescens Red-spotted Newt		Xx	Xx
Plethodon cinereus Redback Salamander	X	Xx	Xx
Pseudacris crucifer Spring Peeper	Xx	Xx	Xx
Rana clamitans Green Frog	X	Xx	Xx
Rana sylvatica Wood Frog	Xx	Xx	Xx

1. Amphibians species found in the 1996 inventory effort are represented by an "X" and those species found in the 1994 inventory effort are represented by an "x".

No federal or Maine-listed species were identified in the study area. In addition to the federal and Maine-listed threatened and endangered species, our inventory techniques and special visual encounter searches were unsuccessful in finding any of the Maine-listed species of special concern. These species are the four-toed (*Hemidactylium scutatum*) and spring (*Gyrinophilus porphyriticus*) salamanders and the northern leopard frog (*Rana pipiens*). We also were unable to find the two-lined (*Eurycea bislineata*) brook salamander that Albright (1986) and Hunter et al. (1992) reported to be locally common in Maine or verify the presence of the blue-spotted (*Ambystoma laterale*) salamander in the study area. However, we did trap a small (less than 3 cm) salamander on the Schoodic study site that had color patterns matching color descriptions of the blue-spotted salamander, but had untypical physical measurements for this species.

We found four species and a total of 18 individuals conducting the visual encounter searches. Auditory searches located the spring peeper (*Pseudacris crucifer)*, green frog (*Rana clamitans)*, and wood frog (*Rana sylvatica*); the wood frog was only heard in the Schoodic Head study site. Project personnel heard calls of the spring peeper at 17 monitoring stations, the green frog at 19 monitoring stations, and the wood frog at one monitoring station from June through September. We recorded observations and call locations for each species distribution maps found in the field notebook (Connery 1997).

Our night driving searches recorded six amphibian species for a total of 106 individuals (Table 2.4). Spotted salamanders (*Ambyostoma maculatum*), wood frogs, and spring peepers were the first species to be recorded on April 16th during the second night drive search. This technique had the highest total count of the eastern newt (*Notophthalmus viridescens)*(42) and spring peeper (31). Per cent mortality (% animals found that were dead from from traffic or dessication) of all individuals observed was 56%, and was 74% for spring peepers and 70 % for yellow-spotted salamanders. Frog species had a higher range of mortality percentages (range 74% to 43%) than salamander species (range 70% to 25%). The night driving search data are summarized in Connery (1997).

The drift fences with adjacent pitfall traps were successful in trapping three frog and three salamander species and captured more individuals (180) than any of the other techniques employed. Four drift fences were operating by April 2 (time block 1), yet we captured only one wood frog during this first trapping time period. We recorded four species (the spotted and red-back salamanders (*Plethodon cinereus*), wood frog, and spring peeper) during the second trapping period, which began on April 16. This technique recorded the highest total count of redback salamanders (48), wood frogs (61), and spotted salamanders (31). The summarized data for each pitfall trap can be found with the field data records in Connery (1997). Pitfall traps also captured 269 small mammals and an unknown number of invertebrates with only a few survivors (mammal data in Chapter 3 and Appendix 5).

Table 2.4. The percentage of live amphibians by species observed during night drive searches, Schoodic Peninsula, Maine, 1996.

Species	Total Number Observed	Number Found Alive	Percentage of Total
Pseudacris crucifer Spring Peeper	31	8	26
Rana sylvatica Wood Frog	13	5	38
Rana clamitans Green Frog	7	4	57
Plethodon cinereus Redback Salamander	8	6	75
Notophthalmus viridescens Red-spotted Newt	42	25	59
Ambystoma maculatum Spotted Salamander	30	10	33

We found only two redback salamanders under the artificial shelters, both on the Corea Heath study site. We employed kiln-dried spruce boards for this search effort from May 31 to September 24th; individual redback salamanders were observed in the fifth (i.e., July 3 to July 11) and seventh (i.e., August 6 to Sept. 24) trapping periods.

DISCUSSION

Our effort completes the second inventory of amphibians as recommended by Mittelhauser et al. (1995) for the study area. **No federal or state-listed amphibian species nor Maine amphibian species of special concern** (Maine Dept. of Inland Fisheries & Wildlife 1994) were found in the study area. We identified six amphibian species, which are common species to coastal Maine habitats (Hunter et al. 1994), and gained additional information on species presence, activity periods, and distribution. Although some inferences of relative abundance of populations might be available by further analyzing the data, we believe further study is needed to identify the relative abundance for all species or for selected species chosen because of their suitability to other monitoring or research efforts.

We identified six amphibian species in the study area, although the red-spotted newt was again not found on the Big Moose Island study site (Mittelhauser et al. 1996). The lack of suitable habitat for adults is apparently the limiting reason for this, as we observed red-spotted newts in areas of the Schoodic Peninsula study site that were directly adjacent to Big Moose Island.

We also were unable to document the presence of some species that we expected to find in the study area. These are the blue-spotted, four-toed, and two-lined salamanders; and the pickerel and gray tree frogs. We believe the lack of large or interconnected areas of suitable habitat within the study area explain why most of these species were not found. Further, complete species inventories often require many years of intensive field effort (Heyer et al. 1994), especially with isolated or low density populations.

Our use of several inventory techniques again proved effective in documenting the diversity of amphibian species in the study area. The different techniques compensate for different seasonal emergence, activity periods, and the habitat preferences of species and greatly assist in defining the distribution of the species throughout the study area. We also believe the longer sampling periods from early April into September were important in identifying species activity periods, species distribution, and verifying those species common to the study area.

Drift fences with pitfall traps were the most successful technique, based on the trapping of six species and a total of 180 individuals. Redback salamanders and wood frogs were the most frequently trapped of the six species. These results agree with the results from the 1994 inventory in which these two species were the most frequently trapped species. However drift fences were not equally efficient in documenting species in each study site. Further, the high non-target species capture and mortality rates, site disturbance, difficulty in selecting sites, and amount of time invested in establishing drift fence pitfall traps make this technique questionable in evaluating its overall suitability for future inventories.

Night driving searches were the second most successful technique based on the identification of six species and the second highest total of observed individuals (106). We found the technique was useful in identifying the seasonality of species by confirming the emergence and activity periods between the spring and summer species. Wood frogs, spring peepers, and spotted salamanders were more frequently observed in spring and species common to warmer conditions

such as juvenile red eft-stage newts and green frogs were more frequently observed during summer night drive searches. The night drive search conducted in the fall recorded reappearances of the spring species along with the summer species, producing the highest number of individuals counted for two species during one search effort. We believe this technique is especially effective for the effort invested by documenting species presence, activity periods, and a coarse assessment of distribution. The data on juvenile eft-stage newts support this interpretation; we did not document this species nor would we have known the distribution and seasonal activity periods through other inventory techniques. Also the technique was suited to the study area because of the network of roads, which may limit its application in study areas with fewer and less-widely distributed roads. We found a higher proportion of dead amphibians during early season (i.e., April & May) night driving searches than we did in succeeding searches during the summer (i.e., June through August). We have no explanations for this observation, but suspect that differences in species behavior, air and surface temperatures, or densities of the species are possible answers.

Artificial shelters (Fitch 1987) were again unsuccessful in identifying new species or preferred habitats. We believe this technique would be more effective in long-term monitoring efforts where the shelters were in place for two or more seasons and where shelter placement could address specific questions about the ecology of species or assess the importance of a habitat to one or more species.

We believe that our survey techniques, sampling design, and coverage of the study area enabled us to identify the most common and abundant species. We believe it is unlikely that additional species or populations existed on these sites in 1996, although all wetlands were not surveyed and a small population of another species may reside in one of these isolated wetlands in the study area. Also, other species may be found in the future, as it is possible that individuals from populations further inland may occasionally disperse and temporarily occupy areas in the study area. Only a multi-year monitoring program would be able to determine what, if any, additional species occur intermittently in the study area. The scarcity of suitable habitats and the cool, short, summer season in the Schoodic region appear to explain the low number of species and their patchy distribution within the study sites. We believe this effort satisfies the inventory objectives.

RECOMMENDATIONS

Recent declines in amphibian populations in many regions of the world have prompted and calls for long-term monitoring and studies of population change (Wake 1991, Blaustein et al. 1994). Although the results of our study provide information on the species present on Schoodic Peninsula and in the study area, they are not suitable for tracking population trends and distributions with the statistical rigor that is required of a long-term monitoring program. An assessment of population parameters (i.e. density, reproductive success, etc.) for the most important species needs to completed before a long-term monitoring program can be designed and implemented. Further, the Schoodic Peninsula comprises less than 15 % of the park's total management area and because the future of the Navy base is unknown, a population assessment for this small peninsula or study area is unlikily. Instead , we recommend that the park complete population assessments for the most important species for all park areas, including park lands and

the Navy base on Schoodic Peninsula. At the conclusion of the assessment, the park should consider habitats and amphibian populations from Schoodic Peninsula for inclusion in a long-term monitoring program. The objectives of the monitoring program should mimic or cooperate with state, regional, or national amphibian assessment programs and support local species and habitat management and conservation programs.

Until the assessment is conducted and a long-term monitoring program has been developed and implemented, the park and Navy are encouraged to repeat a portion of the surveys conducted with this investigation in tracking the presence and distribution of species through time.

Further, it is important that the park and Navy support and cooperate with all agency or department, or state, or national research efforts assessing amphibian ecology, species - habitat associations for coastal wetlands, and threats to populations and habitats.

We recommend the following efforts:

Long-term Monitoring and Research :

* Conduct a comprehensive assessment of one or more amphibian species to determine the relative abundance of populations for all park areas, including the Schoodic Peninsula study sites. The objectives would be to establish a baseline of population parameters and the foundation for a statistically designed long-term monitoring program. Inviting several amphibian specialists to assist in developing the investigation would ensure statistical rigor in the design and analysis, proper detection levels and time periods, and other considerations involved in a statistically valid monitoring program. The investigation also may serve as the first phase of the long-term monitoring program.

* Until the assessment is conducted and a long-term monitoring program has been developed and implemented, the park and Navy should collaborate in monitoring for shifts or changes in the presence or distribution of amphibian species in the study area. The objective of the monitoring would be to detect the loss of a species or more than a 50% reduction of a species' distribution in the study area (i.e., a total absence of a species for a study site or the loss of a species at 50% or more of the survey routes or call sites where it was documented in 1996, both criteria being *detection thresholds*). Because of current funding and staffing limits, we suggest that the monitoring be conducted using volunteers, employees, or both, to conduct night driving searches on established inventory routes and calling surveys at established calling stations every ten years. We recommend night driving routes 1, 2, 4 through 7 (Survey routes 3, 8, 9, and 10 would need permission from private land owners and the Navy to be included) and calling stations SUCH 1, 2, 3, 5, CAR 1, and BM 1, which are fully described in Appendix 1 or delineated on maps in the field data notebook (Connery 1997). The surveys would follow methods used in the 1996 investigation (i.e., weather conditions, survey times and durations, etc.) and each survey would be conducted twice in three amphibian activity periods. The periods are defined as *spring* (mid-April to mid-May), *early summer* (mid-May to mid-June), and *summer* (mid-June to the end of July). If one or more of the detection thresholds are found to have been surpassed, a review of environmental conditions and human activities on a local and

regional scale should be conducted to determine probable cause(s), a course of action, and appropriate follow-up assessments of species or habitats. The interim monitoring program also would conduct complete species searches of the streams, following methods described from this investigation, in the Schoodic study site every ten years. If a stream salamander species is located during one of these searches in the study site, the investigators will review and if necessary make recommendations on further survey efforts in documenting and tracking these species.

* Cooperate or participate in peer-reviewed scientific activities that address amphibian ecology or conservation, especially in coastal environments. Research efforts that address amphibian ecology and associations with coastal environments, or suitable methods to monitor populations (i.e., density, sex and age ratios, etc.), or determine specific threats to species or their habitats would be of paramount value for conservation efforts.

Management Program:

* Cooperate with state and federal agencies managing the collection or harvesting of species for commercial operations or private collections until information on population dynamics are known.

* Discourage further disturbance in any natural area in the study site, especially wetlands and large tracts of natural areas.

* Cooperate with local land-use planning and management efforts to avoid isolating amphibian populations in the study area through wetland conversions or destruction, land-use development, or genetic isolation.

* Educate and encourage workers and residents about amphibian activity periods and how their activities will contribute to the conservation of these species.

CHAPTER 3: TERRESTRIAL MAMMAL INVENTORY

by William E. Glanz, University of Maine

INTRODUCTION

Although non-flying mammals are well-documented in New England (Godin 1977) and in coastal Maine (Manville 1942, 1960), few studies have focused on the mammals of the Schoodic region. Connery et al. (1990) conducted preliminary trapping studies of small mammals there, in studying potential vectors of Lyme disease. Mittelhauser et al. (1995) documented 31 mammal species during the first biological inventory of the area in 1994, a total that includes most mammal species likely to occur in the Schoodic region. Some species widespread in Maine, however, were not recorded, such as the meadow vole *Microtus pennsylvanicus* and the ermine *Mustela erminea*. Furthermore, many mammal species fluctuate greatly in numbers from year to year, and some less common species could easily have been missed in one summer of fieldwork. Our objectives here were to follow up the 1994 inventory by (1) conducting additional trapping studies of small mammals, focusing on species not recorded in the region or at certain sites, (2) accumulate observations of any additional mammal species not recorded previously, and (3) initiate the first intensive survey of bats in the region. This chapter reports only on the non-flying mammal species; bat studies are presented in the following section (Chapter 4) and bat sampling sites are given in Appendix 3.

METHODS

The primary mammal survey techniques employed were live-trapping along designated transects (Wilson, et al. 1996) and pitfall-trapping in conjunction with the amphibian studies. Additional observations of mammals or sign were obtained incidental to this field work or to other studies.

Live-trapping Methods:

Eighteen live-trapping transects (Calhoun 1959) were established across most of the major habitat types in the region, eight on ANP Schoodic lands, and five each on the Navy Corea and Big Moose Island sites. Several transects on Corea and Schoodic lands were placed across stream courses and wet or grassy habitats to increase chances for capturing certain shrew and vole species not recorded previously at these sites. Transects were similar in length and trap intervals to those in the 1994 inventory; each transect was 100 m long, with eleven trap stations at 10 m intervals. Appendix 4 provides maps of transect locations and UTM coordinates for the first and last station of each trapping transect. Two Sherman live-traps (H.B. Sherman Co., Tallahassee, FL) were set within 2 m of each station, usually one small trap (17cm X 6 cm X 5 cm) and one medium (24 cm X 9 cm X 8 cm) trap. Traps were baited with a peanut butter and oatmeal mixture in late afternoon or evening, and checked the following morning. Polyester fiber batting was placed in the traps for bedding. Traps on each transect were set for four nights per trapping session, weather permitting. Each transect was trapped for three sessions between late May and mid-August 1996.

Data recorded from each mammal captured included trap location (by transect and station), species, sex, weight, body length, and tail length. To compare trapping success with other studies, the number of trap-nights was determined; a trap available for capturing an animal for one night was recorded as one trap-night. Traps tripped by larger animals or unknown forces were excluded from this count.

Drift-fence Pitfall Trapping:

The pitfall traps along drift fences employed in the amphibian studies also were used in sampling small mammals. See Chapter 2 on amphibians for drift fence sampling design and Appendix 1 for sampling locations. All mammal carcasses found in these pitfall traps were placed in tightly-sealed plastic bags, marked with location and date, and frozen for later identification and measurement.

RESULTS

Most field work on mammals was devoted to capturing and identifying small mammals sampled in live-trapping and drift fences. Quantitative summaries of live trapping and drift fence results are presented separately below, including summaries of new records for each study site and species not documented in the region previously. Additional information on larger mammals is provided next, emphasizing newly-recorded species for the Schoodic region. Specimen records, with measurements and collection dates, are provided in Appendix 5. A summary of all mammal species recorded in the combined 1994 and 1996 inventories, including the bat species described in the Chapter 4, is given in Appendix 6. **No Federal or Maine endangered or threatened species of mammals were captured** or observed on the study areas. **None of the terrestrial mammal species recorded are currently classified as species of special concern in Maine** (Maine Department of Inland Fisheries and Wildlife 1994), although several bat species are so listed (see next chapter).

Live-trapping:

In 2744 trap-nights of live trapping, 126 small mammals were captured, of 13 different species (Table 3.1). The two most common species in this sample were deer mice, *Peromyscus maniculatus* (29 individuals) and meadow voles, *Microtus pennsylvanicus* (23). *Peromyscus* were identified using external features alone (Choate, 1973); mice of this genus in New England can be differentiated definitively using electrophoretic techniques (Aquadro and Patton, 1980), but funding and time limitations prevented use of this method. Of 35 *Peromyscus* individuals captured, most were clearly *P. maniculatus* (by proportional tail length and adult pelage coloration), but six were identified as the white-footed mouse, *Peromyscus leucopus*. Interestingly, no meadow voles were noted at any of these sites during the 1994 inventory. This species shows pronounced population cycles, and 1996 was probably a high year. Live-trapping also documented woodland jumping mice (*Napaeozapus insignis*) on ANP Schoodic lands; in 1994 they were found only on Big Moose Island. New site records are noted in Table 3.2.

Twenty-four shrews in the genus *Sorex* were captured, 17 of which died in the trap. These 17 *Sorex* specimens were identified to species: 14 were masked shrews *S. cinereus* and 3 were smoky shrews *S. fumeus*. The remaining 7 were released and simply classified as *Sorex* spp. The larger-

bodied short-tailed shrew (*Blarina brevicauda*) was recorded 11 times, including at the Corea site, where it was not captured in 1994.

Table 3.1. Total Numbers of Each Small Mammal Species Captured Using the Two Inventory Techniques in 1996.

Species	Live-trapping	Drift Fences
Short-tailed Shrew *Blarina brevicauda*	11	10
Masked Shrew *Sorex cinereus*	14	214
Smoky Shrew *Sorex fumeus*	3	23
Water Shrew *Sorex palustris*	--	4
Unidentified *Sorex* shrews	7	--
Pygmy Shrew *Sorex (Microsorex) thompsoni*	--	11
Star-nosed Mole *Condylura cristata*	--	1
Hairy-tailed Mole *Parascalops breweri*	1	--
Red-backed Vole *Clethrionomys gapperi*	6	--
Meadow Vole *Microtus pennsylvanicus*	23	1
Deer Mouse *Peromyscus maniculatus*	29	1
White-footed Mouse *Peromyscus leucopus*	6	--
Woodland Jumping Mouse *Napaeozapus insignis*	8	--
Meadow Jumping Mouse *Zapus hudsonius*	14	4
Red Squirrel *Tamiasciurus hudsonicus*	3	--
Short-tailed Weasel *Mustela erminea*	1	--

Two additional species not previously recorded from the Schoodic region were captured in live-traps. A hairy-tailed mole *Parascalops breweri* was caught and released on 27 June in dense shrubs above the shoreline on Transect MM3 on Big Moose Island by Victor Baisely and Stephanie Mazerolle. The animal's coloration, lack of a nose-star, and proportionately short tail (28% head-body length) distinguished it from the star-nosed mole *Condylura cristata*, and its size (head-body length 105 mm, tail 30 mm, weight 33g) distinguished it from other insectivores. This species is inconspicuous and poorly-known in the northeastern portion of its range (Hallett 1978). It has been recorded from only one other site in eastern Maine (Mount Desert Island), and also

from Charlotte County, New Brunswick (Hall 1981). No specimens are available from these sites, however, and further studies to confirm its distribution are needed, especially since our record is based on field data on a live mole observed in a handling bag, and then released. A short-tailed weasel or ermine, *Mustela erminea,* was captured on 3 July at the Corea site. This is the most common weasel species in Maine (based on specimen records), and is distinguished from the long-tailed weasel *Mustela frenata* by its smaller size and proportionately smaller tail. It inhabits a wide variety of habitats, and often is found where voles are abundant. Interestingly neither it nor the meadow vole was recorded in 1994, but the long-tailed weasel was reported.

Table 3.2. Species occurrence of small mammals at the three Schoodic region sites in 1996. [1]

	Corea	Big Moose	Schoodic
Short-tailed Shrew *Blarina brevicauda*	L*	D	L,D
Sorex shrews	L	L	L
Masked Shrew *S.cinereus*	D	D	D
Smoky Shrew *S. fumeus*	D	D	D
Water Shrew *S. thompsoni*	D*		D*
Pygmy Shrew *S. palustris*	D	D	D*
Hairy-tailed Mole *Parascalops breweri*		L*	
Star-nosed Mole *Condylura cristata*			D*
Red-backed Vole *Clethrionomys gapperi*		L	
Meadow Vole *Microtus pennsylvanicus*	L*	L*	D*
Deer Mouse *Peromyscus maniculatus*	L,D	L	L
White-footed Mouse *Peromyscus leucopus*			L
Woodland Jumping Mouse *Napaeozapus insignis*			L*
Meadow Jumping Mouse *Zapus hudsonius*	D		L,D
Red Squirrel *Tamiasciurus hudsonicus*		L,O	O
Gray Squirrel *Sciurus carolinensis*		O*	
Eastern Chipmunk *Tamias striatus*		O	O
Snowshoe Hare *Lepus americanus*			O
Short-tailed Weasel *Mustela erminea*	L*		

[1] Inventory Techniques: Live Trapping = L, Drift Fence = D, Observed = O; * = new species record for that site

Pitfall Capture Results:

In 6394 pitfall-trap periods, 269 small mammals were captured, including 262 shrews, one mole, and 6 rodents (Table 3.1). Of the shrews, 214 were masked shrews *Sorex cinereus.* No new species for the Schoodic region were recorded using this sampling method, but several species were captured at sites where not previously found. The water shrew *(Sorex palustris)*, previously reported only at the Big Moose site, was found at the Corea and ANP Schoodic sites in 1996, but not at Big Moose. Other new records for the ANP Schoodic sites include the pygmy shrew, *Sorex (Microsorex) thompsoni,* and the star-nosed mole, *Condylura cristata.* Table 3.2 summarizes species occurrence from live-trapping and pitfall capture records in 1996, including new species recorded at each study site.

Larger Mammals:

Two new species of larger mammals were added to the Schoodic region list, the fisher (*Martes pennanti)* and the beaver *(Castor canadensis)*. Two sightings of fishers were noted, the first in late June on the loop road about 1 km south of Fraser Point, the second in early August on a trail near Schoodic Head. A beaver was found dead by Glen Mittelhauser near the NE end of the Loop Road in late June 1996. Beaver and beaver sign also were observed at the Corea site in the moat around the main antenna throughout the summer of 1996. Thirty-five species of non-flying wild mammals have been recorded on ANP and US Navy lands in this region (see Appendix 6), including several large species (bobcat, fisher, moose) considered by Crowell (1986) to be transient or of doubtful occurrence on nearby Mount Desert Island.

DISCUSSION

The inventories of non-flying mammals in 1996 resulted in the addition of five species to the known mammalian fauna of the Schoodic study areas (hairy-tailed mole, meadow vole, beaver, short-tailed weasel, and fisher). Of these, meadow voles and beaver are common at inland sites in central Maine, and were considered likely to be present in the Schoodic area. As the preferred habitat of each (grassland for meadow voles, permanent streams for beaver) is uncommon on ANP and US Navy lands, it is not surprising that the 1994 surveys did not record them. Meadow voles and related species of *Microtus* often show 2- to 5-year cycles of abundance (Taitt and Krebs 1985), and it is likely that 1996 was a year of high abundance, as meadow voles were the second most-commonly captured rodent species in the live-trapping efforts. They also were trapped in many habitats, including coastal shrublands on Big Moose Island, broken-canopy forest and grassy trails on Big Moose and ANP Schoodic lands, and wet alder thickets and heath bogs at Corea. Beaver are increasing in many areas of Maine, and they may cause the area of flooded wetlands in the Schoodic region to increase if they become established along the few permanent and semi-permanent streams. The fisher and short-tailed weasel are predators that occur in a variety of habitats throughout Maine. Both are relatively rare and infrequently observed, but are likely to be found with extensive field work. The hairy-tailed mole is near the northeastern limit of its range, and has been documented at only one other site in Maine.

Including the six bat species documented in the next chapter, 41 land mammal species have been recorded among the three Schoodic Region study sites (see Appendix 6). This total exceeds that

of ANP lands on Mount Desert Island (Crowell 1986), probably because rare or infrequent species (e.g. fisher) have easier access to the mainland sites in the Schoodic Region than to an island site like MDI. One small mammal species, the smoky shrew *(Sorex fumeus),* has been collected at all three Schoodic Region study sites but has not yet been reported from MDI. Few additional native terrestrial mammal species are likely to be found at the Schoodic sites. The rock shrew *Sorex dispar* has been trapped in mountainous areas of western and northern Maine, and also in lowland areas of eastern New Brunswick, but not along the Maine coast (Kirkland 1981). The woodchuck *(Marmota monax)* is present in fields and roadsides north of the study area, and may eventually be observed along the Schoodic loop road. The southern flying squirrel *(Glaucomys volans)* is known from very few confirmed records in Maine and the Maritime provinces of Canada (Cameron 1976; Godin 1977); it may occur in the Schoodic area. The mountain lion or puma *(Felis concolor)* was extirpated from Maine prior to 1920, but may be recolonizing the state, and occasional unconfirmed sightings are reported in coastal regions of Maine (Reynolds 1995).

The capture data on small mammals (Tables 3.1 and 3.2) can be useful as general measures of relative abundance and community composition. Clearly, shrews of the genus *Sorex* are a major component of these mammal communities, and the masked shrew may be the most abundant mammal species. *Sorex* shrews, however, are poorly sampled by standard Sherman live-traps, and any future studies of their importance will need to employ pitfall traps or other techniques specifically designed for these very small species. Among rodents, deer mice appear to be the most common species, but other species may be common one year and may not even be detected in other years. Of the three species of small microtine rodents present, red-backed voles and southern bog lemmings were recorded at all three sites in 1994, but the meadow vole was not found at any of these. Conversely, in 1996 meadow voles were trapped at all three sites, red-backed voles at only one site, and southern bog lemmings were not recorded at all (Table 2). As the differences between 1994 and 1996 indicate, the small mammals of a site can vary greatly between years in species composition and abundance, and any generalizations about these small mammals in these ecological communities must be based on studies spanning several years.

Although no trapping efforts were directed toward the larger rodents, several types of evidence suggest a widespread decline in sciurid rodents (squirrels and their relatives) between 1994 and 1996 in the region. Red squirrels, the most common tree squirrel in 1994, were recorded infrequently and rarely trapped in 1996. N. Famous (see bird chapter of this report) noted calls of red squirrels during his breeding bird and fall migration surveys, and observed a similar decline in squirrel abundance. Chipmunks were recorded at all three sites in 1994, but not trapped at any in 1996, although they were seen rarely at a deciduous forest trap line at the Corea site and on ANP Schoodic lands. Gray squirrels, seen on ANP Schoodic land in 1994, were not reported there in 1996, but one was seen on Big Moose Island. The diets of these three species are dominated by tree and shrub seeds, and their abundance often responds to fluctuations in seed production by trees (masting cycles).

Large mammals are generally rarer than small mammals, and require different sampling techniques. Our data on such species are based on incidental observations and previous records, and are inappropriate for assessing relative abundance. Nevertheless, many observations have

accumulated during the two surveys and from park visitors and staff, and as summarized above, virtually all the large mammal species likely to occur there have now been documented.

RECOMMENDATIONS

Although the 1994 and 1996 surveys have produced a reasonably complete species list of terrestrial mammals, several species may yet be detected. Furthermore, many of the species documented have specific habitat peferences and may be sensitive to natural and human-induced habitat changes in the region. We recommend establishment of a long-term monitoring plan to assess potential changes in the mammal community through time and to provide data for use in future management decisions. Specifically, we recommend the following:

Long-term Monitoring and Research on Mammals:

* Because of its mainland location and diversity of habitats, the mammalian fauna of the Schoodic region is very diverse, probably exceeding the species total for MDI. Periodic monitoring efforts will be needed to ensure that this diversity is being preserved. Efforts at 5- to 10-year intervals may be sufficient to detect long-term trends in species presence and overall distribution of most species.

* As the species composition and abundance of small mammals varies greatly among years, any monitoring efforts of these species should span two or more years, and should use trapping or capture methods that sample both rodents and insectivores. Such studies of small mammals could be linked to monitoring of habitat change, human impacts, and occurrence of mammal-borne diseases.

* The population density responses of squirrels and chipmunks to seed production by trees need further study, both to test the importance of these interactions and to examine linkages with tree population dynamics and with seed-eating birds.

* Monitoring rare species will always be difficult. A well-publicized system for archiving observations of rare mammals would be helpful, including sightings by visitors, ANP and Navy personnel, and records obtained incidental to other studies. In particular, more information on rare carnivores, flying squirrels, and moles is needed, to determine if viable populations of the rarest species exist on Navy and ANP lands.

Management Recommendations:

* Further disturbance of natural habitats should be discouraged; any major habitat alterations should be reviewed by environmental and natural resource personnel for potential effects on rare species and the natural movement of these animals between

suitable habitat patches. Damage to rare habitats should be minimized, especially to wetlands and streams, to maintain sufficient area for rare species such as water shrews.

* Surveys of the presence and spread of beaver on Schoodic watersheds may be needed, as the population may expand sufficiently to affect trails and roads. If beaver damage occurs, careful review of site characteristsics will be needed to evaluate whether beaver dam removal is warranted. Consideration of potential for damage by beavers should be included in plans for siting of trails and roadways.

* As the privately-owned lands adjacent to ANP and Navy lands are developed, both monitoring and habitat preservation efforts may need to be expanded, to ensure that sufficient contiguous habitat remains on Schoodic Peninsula for key species, and that corridors of suitable habitat persist for wide-ranging species.

* ANP and Navy resource managers should coordinate activities with Maine Department of Inland Fisheries and Wildlife, to identify mammal species of concern and critical research and management actions for the conservation of these species.

* Educational efforts would be useful to alert ANP and Navy personnel and their families to the presence of rare or unusual mammal species, and the habitats and other resources upon which they depend.

Chapter 4 (pages 22 – 27) was removed for sensitivity purposes

CHAPTER 5: INVENTORIES OF BIRDS

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INTRODUCTION and BACKGROUND

Long-term declines in many migrant North American breeding birds have occurred over the last several decades. Attention was first drawn to the fate of many long-distance or Neotropical migrant species, which breed in the US and Canada but winter in Central and South America (Askins et al. 1990, Rappole and McDonald 1994). Several investigators then determined that many short-distance migrants that winter primarily in the US and northern Mexico may also be declining, especially grassland species (Smith et al. 1993, Vickery 1992) and populations of certain forest-nesting species breeding in highly fragmented forests of the northeastern US (Peterjohn and Sauer 1994).

With the exception of anecdotal accounts presented in various old and recent Maine publications (e.g., the old Maine Field Naturalist, Maine Bird Notes, Maine Ornithologist, the Guillemot), population trends of most breeding and migratory landbirds in coastal Maine are poorly known. This study was designed to document baseline population levels for breeding and migrating birds on the Schoodic and Corea peninsulas, at the Winter Harbor and Corea US Navy facilities and the Schoodic Point section of Acadia National Park. Because of short term variations in population densities, a multi-year description of bird populations is presented here.

This study began as a long-term bird monitoring project, initiated by Norm Famous in 1993 to track disjunct populations of birds breeding in and migrating through boreal habitats along the western shores of to the Bay of Fundy in eastern Maine and coastal New Brunswick, Canada . Breeding season point counts and fall migration area search counts were established at US Naval facilities in Winter Harbor, Corea, and Cutler (3 areas) and on private land on Roque Island, Jonesport, Maine (Famous 1994). Breeding season point count routes were established at 25 other sites along the Maine and New Brunswick coastlines (Famous 1994, 1995). In 1995, funding for bird monitoring work at the Winter Harbor and Corea US Navy facilities was merged with the biological inventory project funded by the DOD Legacy 2000 program, conducted by ANP and the University of Maine and described in this report.

Many boreal habitats and their breeding bird populations are poorly monitored by large scale monitoring program such as the US Geological Surveys's Breeding Bird Survey (BBS). These habitats include mature maritime spruce-fir forests, jack pine woodlands, several bog and fen communities, and coastal shrublands. Major portions of the breeding ranges of target species for this study (especially fall migrants) are located primarily in inaccessible boreal habitats in the extreme northern US and northern Canada. Coastal Maine, however, has extensive areas of these habitats that are suitable for studying and monitoring these boreal bird species.

Four years of monitoring have been completed in the present study (Famous 1994, 1995). Four monitoring techniques were used: 5 minute breeding season point counts (4 years); 3 minute Breeding Bird Survey point counts (2 years on bases, 4 yrs. elsewhere), constant effort mist netting (1 yr.), and fall migration area searches (4 yrs.). This report presents the preliminary results of the last 3 years of fall migration area search counts, 2 years of a new Breeding Bird Survey route, and one year of MAPS banding (Monitoring Avian Productivity and Survivorship).

STUDY AREAS AND METHODS

As standard census methods for birds (such as the Breeding Bird Surveys) require large sampling areas, the study area for bird inventories included the Corea, Schoodic, and Big Moose study sites described in Chapter 1 and also adjacent roadside habitats in Winter Harbor and Prospect Harbor that connect these sites. These study sites are representative of coastal forests and wetlands studied previously by the author (Famous 1994, 1995) in eastern Maine. The coastal sections of eastern Hancock County and Washington County support some of the southernmost populations of several boreal nesting bird and plant species. This boreal affinity is caused by a southward extension of cool, fog-shrouded coniferous forests and wetlands within a 5-10 mile wide corridor along the coast. Cold summer water temperatures and warm humid continental air mix to produce extensive periods of fog and cool temperatures during the growing season. In this narrow zone disjunct populations of more northern plant and bird species occur. Examples of such boreal birds include blackpoll warbler, boreal chickadee, spruce grouse, gray jay, and merlin, while examples of plant species include Hooker's iris (*Iris setosa*), baked-apple berry (*Rubus chamaemorus*), and marsh felwort (*Lomatogonium rotatum*) (Olday et al., 1983, Famous and Campbell 1984). All of these species are found in the Schoodic region study area.

Plant communities characteristic of the study areas include coastal plateau bogs, jack pine (*Pinus banksiana*) woodlands, treeless coastal headlands, and maritime spruce-fir forests dominated by red spruce (*Picea rubens*), white spruce (*P. glauca*), and balsam fir (*Abies balsamea*). These maritime forests contain extensive arboreal or epiphytic lichen populations, and large successional stands of mountain ash (*Pyrus [Sorbus] americana*), a species very important to many migrating birds and resident mammals who eat its fleshy fruits. The most important frugivorous bird species include cedar and Bohemian waxwings, American robin, and hermit thrush.

Breeding Season Point Counts (New Breeding Bird Survey Route):

A new breeding bird survey (BBS) route was established along public roads and trails from Winter Harbor to Big Moose Island, then through portions of the remainder of ANP on Schoodic Peninsula to Prospect Harbor and to the Corea US Navy facility. General procedures for standardized BBS routes (outlined in Robbins, et al. 1986) were followed, with two exceptions: a) BBS routes consist of 50 roadside stops evenly spaced 0.5 miles (0.8 km) apart. In our three study areas, few continuous roads were available for such a scheme. Instead, many points along the BBS route were clumped in the three study sites, spaced as little as 200 m apart, and existing

trails as well as roadside stations were used. Locations of the BBS survey stations are listed in Appendix 7, with stations on the three major study sites mapped in Figures A7.1 to A7.3. The stations were sampled during the height of the breeding season, starting at 0.5 hr before sunrise, primarily by noting species' vocalizations heard. b) BBS surveys record all species detected within a 0.25 mile radius of each point, but here the detection radius was limited to 100m, to standardize for area sampled and observer variability (see comments below).

The new BBS route can be divided into 4 sections (see Appendix 7 for specific count locations):
1) Roadside stations outside of Acadia National Park and US Navy facilities, along Rt. 186 in WinterHarbor and Birch Harbor, along Rt. 186 between Prospect Harbor and Corea, and the two-way section of the Schoodic Peninsula Loop Road prior to Frazier Point,
2) Roadside stations along the one-way section of Schoodic Peninsula Loop Road after Frazier Point and one side road, all of which stations are within Acadia National Park,
3) Roads and trails at US Navy facility on Big Moose Island, and
4) Access roads and trails at the US Navy facility at the Corea Heath unit.

Counting stations were placed in spruce and spruce-fir forests, pine-spruce woodlands, mixed forests, scrublands, bogs, and fens. Ecologically stable habitats were chosen, that is sites with mature forests relatively free from recent major disturbance by spruce budworm, lumbering, windthrow, fire, and other agents that result in large canopy openings. The general structure and composition of these forests have remained roughly constant for decades.

Protocol for the breeding season point counts was adapted from the Breeding Bird Survey (BBS) and spot mapping methods. Rather than simply listing all birds detected regardless of distance during a 3-minute interval, we mapped all birds within a 100 m (fixed-radius) circle. Birds beyond 100 m were placed outside the circle in the direction detected. A fixed-radius circle reduces differences among observers whose identification skills decrease with distance and during windy conditions. Identification errors and omissions increase dramatically beyond 90-100 meters.

The point count procedure involved mapping the distribution of birds within a 100 m radius circle. Each bird sighting was plotted on a map of the point count circle, using symbols in the spot mapping method (Robbins 1970). Locations of all birds within 100 m were mapped within 2 concentric 50 m and 100 m circles. Those beyond 100 m were placed outside the circles in the general direction of occurrence. Mapping aided in differentiating simultaneously singing birds, and allowed assessment of vegetation characteristics of the birds' habitat. Rattle calls of red squirrels (*Tamiasciurus hudsonicus*), which are territorial calls similar in function to many bird songs, were also mapped, permitting year-to-year monitoring of this mammal on the BBS route.

MAPS (Monitoring Avian Productivity and Survivorship) Banding

To assess survivorship and reproductive success in bird populations of the area, birds were captured and banded following MAPS protocols outlined in DeSante and Burton (1997). MAPS banding was conducted at 10 day intervals between June 8, 1996 and August 29, 1996 at the

Winter Harbor Activity Group facility on Big Moose Island,. Birds were captured in mist nets, banded, and examined for age and indications of breeding. MAPS banding locations are plotted in Appendix 7, Figure A7.4. Banding effort is measured in net hours; one net hour consists of one 30 m long net (2 m tall) left open for 1 hour. A typical banding day consists of about 50 net hours tallied from ten 30 m nets, opened around sunrise and closed 5 hours later.

Fall Migration Area Search Counts:

Nine area searches for birds were conducted at 10 day intervals during August to October 1994-1996. Sixteen 50 m radius circles were searched at each of the Corea and Big Moose Island naval facilities, in wooded and shrub-dominated habitats. Area search circles were placed at least 100 m apart. All 16 search circles per site were sampled for 10 minutes each, between 6:30 and 11:30 AM, on each of the nine count days. Weather variables recorded included wind speed class, temperature, cloud cover, and precipitation. Permissible weather conditions followed BBS recommendations; surveys were not conducted during continuous rain or heavy winds. Maps of fall migration area search locations are given in Appendix 7, Figure A7.5 and Figure A7.6.

The search procedure involved moving throughout the search area mapping all bird locations and related behaviors on standard data sheets. The mapping procedures were similar to those used for the breeding season mapping method described above. Birds were detected by calls, movement, and responses to 'pishing' while the observer moved around within the circle. This differs from the point count method where the observer remains stationary at center circle. Pishing was conducted for 1 to 3 minutes, with greater time spent pishing when no birds were in sight. No new flocks were counted after 10 minutes. When necessary, species identifications within a flock continued after the 10 minute period expired. Red squirrel territorial calls and butterfly sightings also were tallied. Squirrel numbers are reported in this chapter; butterfly data are available from the author.

Detection of individual birds and flocks during fall migration was primarily by sound, especially in forested and tall shrub habitats. Visual detections were more common in open shrub and graminoid (grass, sedge and rush) dominated habitats, and included some birds flying over the count circle. The locations of all birds were recorded on census maps during three time intervals: 0-3 min., 3-5 min. and 5-10 min. Distinctive habitat features such as edges, gaps, cover types, water inclusions, roads/trails, and structural features were also mapped. Distance to birds was determined either by using rangefinder binoculars (Leica Geovids, on loan to the project from Leica corporation), visual estimates using binoculars, or auditory estimates. The Leica Geovids were very effective and accurate in open and semi-open habitats, where a clear path between the censuser and bird was available for the laser beam. The beam could be reflected off the bodies of larger birds such as herons, hawks, and gulls. Binoculars, contributed by Bausch and Lomb and Zeiss, were used in locating the birds for distance estimates when the Geovids were unavailable.

Area search locations were selected based on access, potential for visual detection, and proximity to high-use areas. Edges and wetlands were present at most area search locations. Table 5.1 presents the number of area search locations by habitat cover types at Big Moose Island and

Corea Heath. Spruce and spruce-fir were the dominant habitat cover types at Big Moose, while stunted conifers, ericaceous bogs, and shrubland predominated at Corea.

Table 5.1. Number of fall migration Area Search locations (50 m radius circles) that included specific habitats and cover types on the two study areas.

Habitat/Cover Types	Big Moose Island	Corea Heath
Spruce/Spruce-Fir	10	2
Stunted Coniferous	5	6
Jack Pine/Coniferous Woodland	5	6
Forest Fen/Forested Bog	-	-
Mixed Forest	3	2
Bog	5	-
Meadow/Edge	1	+
Scrub Shrub/	2	2
Wooded Heath/Wooded Thicket	-	-
Total Number of Area Search Locations	16	16

The area search locations are categorized by microhabitat type and fruit availability in Table 5.2. If several trees of species bearing fleshy fruits were noted in the search circle, they are tallied here. Many fall migration area search locations were also used as breeding season point count sites to help evaluate seasonal habitat use and flock composition during late August and September.

Table 5.2 Number of fall migration Area Search locations with selected microhabitat features and fruit sources on the Big Moose Island and Corea Heath study areas.

Microhabitats Sampled	Big Moose Is.	Corea Heath
Freshwater Pools	0	2
Intertidal Strand Lines	4	0
Ericaceous Shrubs	4	14
Speckled and Green Alder (*Alnus*) Thickets	4	8
Weedy Edge	1	2
Dirt Road Edge (weedy)	3	1
Paved Road Edge (weedy edges)	2	6
Rocky Shoreline	3	3
Fleshy Fruits (e.g. Mountain Ash, Gooseberry)	1	7
Mountain Holly *(Nemopanthes mucrinata)*	5	8
Total Area Search Locations	16	16

Note: One to 3 microhabitat types per area search location. The numbers in each column are the number of area search locations containing this microhabitat feature. Different bird species utilize different microhabitat features and these measures provide a rough indicator of species diversity.

RESULTS

Breeding Season Point Counts (New BBS Route):

Ninety-six bird species were tallied on 50 BBS stops and 10 additional breeding season point counts (Table 5.3). This total included 43 Neotropical migrants and 53 residents and short-distance migrants (following criteria outlined in introduction, using classifications of Finch 1991 and Smith, et al. 1993). The number of species varied between and within year counts. Seventy-one species were tallied on July 11, 1995 and 78, 67, and 63 were tallied on June 1, June 18 and July 3, 1996, respectively. The combined results of both years are presented in Table 5.3.

The most abundant long-distance migrant on all counts was the black-throated green warbler. The numbers per count were exceptionally high for this species, which reaches some of its highest breeding densities in coastal maritime coniferous and mixed forests of Maine and New Brunswick (Famous, unpublished data). Other very common long distance migrants included common yellowthroat, Nashville warbler, magnolia warbler, alder flycatcher, and Swainson's thrush. The most common short-distance migrants included yellow-rumped warbler, white-throated sparrow, golden-crowned kinglet, hermit thrush, mourning dove, dark-eyed junco, and American crow.

Table 5.3. Schoodic Point Breeding Bird Survey Route: Total birds per route and total stops where each species was recorded for each survey of the BBS route 1995-96.

	Birds per Route				Stops per Route			
Species	July 11, 1995	June 1, 1996	June 18 1996	July 3, 1996	July 11, 1995	June 1 1996	June 18 1996	July 3, 1996
Double-crested Cormorant	2	5	-	4	2	3	-	2
Great Blue Heron	1	1	3	2	1	1	2	2
Common Eider	41	98	33	34	4	5	4	4
Osprey	3	2	1	2	3	1	1	2
Sharp-shinned Hawk	1	-	-	-	1	-	-	-
Killdeer	1	-	-	-	1	-	-	-
Willet	-	7	1	-	-	2	1	-
Common Snipe	-	-	1	-	-	-	1	-
Ring-billed Gull	-	-	1	-	-	-	1	-
Herring Gull	44	228	98	14	15	10	16	12
Greater Black-backed Gull	4	22	-	-	3	3	2	2
Laughing Gull	-	3	5	5	-	2	3	3
Black Guillemot	7	-	2	2	1	-	2	2

	Birds per Route				Stops per Route			
Species	July 11, 1995	June 1, 1996	June 18 1996	July 3, 1996	July 11, 1995	June 1 1996	June 18 1996	July 3, 1996
Mourning Dove	38	19	25	21	24	15	25	18
Chimney Swift	-	4	-	-	-	3	-	-
Belted Kingfisher	4	-	-	-	2	-	-	-
Yellow-bellied Sapsucker	-	1	1	-	-	1	1	-
Downy Woodpecker	1	-	1	1	1	-	1	1
Pileated Woodpecker	-	1	-	-	-	1	-	-
Northern Flicker	1	-	3	3	1	-	2	2
Eastern Wood-pewee	-	1	-	-	-	1	-	-
Olive-sided Flycatcher	1	-	-	-	1	-	-	-
Yellow-bellied Flycatcher	5	3	3	2	5	3	3	2
Alder Flycatcher	8	25	19	23	6	12	18	10
Willow Flycatcher	-	1	1	1	-	1	1	1
Least Flycatcher	-	1	-	-	-	1	-	-
Great Crested Flycatcher	1	-	-	-	1	-	-	-
Eastern Phoebe	-	1	-	-	-	1	-	-
Eastern Kingbird	-	1	1	1	-	1	1	1
Tree Swallow	1	2	-	-	1	2	-	-
Bank Swallow	-	-	1	-	-	-	1	-
Cliff Swallow	3	2	-	-	2	1	-	-
Barn Swallow	5	3	1	-	2	2	1	-
Gray Jay	-	1	1	-	-	1	1	-
Blue Jay	5	1	4	2	4	1	3	2
American Crow	28	13	18	27	16	12	13	15
Common Raven	3	1	1	10	2	1	1	6
Black-capped Chickadee	6	8	7	12	5	5	6	8
Boreal Chickadee	6	1	1	2	4	1	1	2
Red-breasted Nuthatch	6	2	1	3	5	2	1	2
Brown Creeper	1	1	-	1	1	1	-	1
House Wren	-	1	1	-	-	1	1	-

	Birds per Route				Stops per Route			
Species	July 11, 1995	June 1, 1996	June 18 1996	July 3, 1996	July 11, 1995	June 1 1996	June 18 1996	July 3, 1996
Winter Wren	9	2	8	3	9	2	7	2
Golden-crowned Kinglet	32	33	19	24	20	20	13	18
Ruby-crowned Kinglet	1	2	-	1	1	2	-	1
Veery	1	1	-	-	1	1	-	-
Bicknell's Thrush	-	1	-	-	-	1	-	-
Swainson's Thrush	34	3	17	20	22	2	12	18
Hermit Thrush	46	9	12	23	24	9	10	17
American Robin	30	10	14	8	20	9	10	17
Gray Catbird	2	2	9	2	2	2	6	1
Cedar Waxwing	11	5	5	6	7	4	5	3
European Starling	6	5	-	-	1	2	-	-
Solitary Vireo	20	6	18	12	14	5	14	12
Red-eyed Vireo	8	7	6	8	7	2	2	8
Tennessee Warbler	-	-	1	-	-	-	1	-
Nashville Warbler	26	18	36	35	20	13	25	22
Northern Parula	10	6	13	13	8	5	9	11
Yellow Warbler	3	3	1	3	1	2	1	2
Chestnut-sided Warbler	7	5	5	4	5	4	5	4
Magnolia Warbler	31	33	36	35	20	21	23	20
Cape May Warbler	1	1	2	-	1	1	2	-
Black-throated Blue Warbler	-	1	2	1	-	1	2	1
Yellow-rumped Warbler	61	72	45	46	35	36	28	36
Black-throated Green Warbler	106	105	118	105	36	40	41	39
Blackburnian Warbler	8	13	9	10	3	7	6	8
Palm Warbler	14	14	6	16	8	8	4	9
Bay-breasted Warbler	3	2	1	-	3	2	1	-
Blackpoll Warbler	-	6	1	1	-	5	1	1
Black-and-White Warbler	15	14	12	13	12	13	11	11

	Birds per Route				Stops per Route			
Species	July 11, 1995	June 1, 1996	June 18 1996	July 3, 1996	July 11, 1995	June 1 1996	June 18 1996	July 3, 1996
Mourning Warbler	-	1	-	-	-	1	-	-
Wilson's Warbler	1	3	3	5	1	3	3	4
Canada Warbler	1	2	-	-	1	2	-	-
American Redstart	13	33	23	21	9	16	13	15
Ovenbird	10	7	3	10	7	5	3	5
Common Yellowthroat	81	54	65	68	24	22	24	27
Scarlet Tanager	-	1	-	-	-	1	-	-
Rose-breasted Grosbeak	-	-	-	1	-	-	-	1
Chipping Sparrow	2	2	2	2	2	2	2	2
Savannah Sparrow	5	-	-	3	4	-	-	2
Song Sparrow	12	3	6	9	10	3	4	5
Lincoln's Sparrow	6	7	4	5	1	7	3	4
Swamp Sparrow	1	-	-	-	1	-	-	-
White-throated Sparrow	47	22	18	33	23	11	13	20
Dark-eyed Junco	33	16	18	14	22	13	16	9
Red-winged Blackbird	-	1	-	-	-	1	-	-
Common Grackle	2	3	5	7	2	1	2	2
Brown-headed Cowbird	4	5	-	1	3	3	-	1
Purple Finch	1	17	6	11	1	10	5	8
House Finch	2	2	1	1	1	2	1	1
Red Crossbill	-	-	3	-	-	-	2	-
White-winged Crossbill	1	-	1	2	1	-	1	1
Pine Siskin	6	6	6	4	6	4	6	3
American Goldfinch	18	12	5	10	8	9	4	7
Evening Grosbeak	2	1	-	-	1	1	-	-
House Sparrow	-	1	-	-	-	1	-	-
Red Squirrel (Mammal)	49	1	2	6	29	1	2	6
Total Species by Route	71	78	67	63				
TOTAL SPECIES = 96								

Total landbird individuals counted in the July surveys decreased from 844 in 1995 to 705 in 1996. Table 5.4 lists bird species showing large population decreases or increases between 1995 and 1996. Species are categorized as decreasing if at least ten individuals were counted in 1995, and if the count for July, 1996 decreased by at least 25%. Nine species showed such declines, all of which were short-distance migrants or residents. Numbers of red squirrels detected (49 squirrels in 1995, 6 in 1996) also declined concurrently (see Table 5.3). Five species showing at least 25% increases in numbers of birds from 1995 to 1996 (and at least ten individuals in July 1996) also are presented in Table 5.4, including three species of Neotropical migrants.

Table 5.4. Breeding bird species showing major decreases (left) **or increases** (right)**on the Schoodic Point Breeding Bird Survey Route** between 1995 and 1996, based on data presented in Table 3. See text above for numerical criteria used for inclusion.

Species with Decreases Major 1995 to 1996	**Species with Major Increases 1995 to 1996**
Mourning Dove	Alder Flycatcher
Golden-crowned Kinglet	Black-capped Chickadee
Swainson's Thrush	Nashville Warbler
Hermit Thrush	American Redstart
American Robin	Purple Finch
Solitary Vireo	
White-throated Sparrow	
Dark-eyed Junco	
American Goldfinch	

The most frequently sampled species in each area (averaging 5 birds/survey or more for that section of the BBS route) are presented in Table 5.5. Black-throated green warbler was the most abundant species on Big Moose Island, the Schoodic section of ANP and along Rts 195 and 186. Common yellowthroat was the most common species in the Corea Heath area. Other common species associates in the first three areas included white-throated sparrow, Nashville warbler, magnolia warbler, and yellow-rumped warbler. The most common associates at Corea Heath were black-throated green warbler, palm warbler, Lincoln's sparrow, Nashville warbler, and hermit thrush.

Unusual species tallied on the BBS route included willets (nesting in a bog) and a willow flycatcher at Corea Heath, nesting blackpoll warbler and gray jay on Big Moose Island, a late migrating oldsquaw along Schoodic Loop Road, and a migrating Bicknell's thrush at the top of Schoodic Head.

Table 5.5. Most common breeding species by sampling area on Breeding Bird Survey route
(Following the four route sections outlined in Methods; see Appendix 7 for locations).

Corea Heath	Routes. 195 and 186, Winter Harbor to Prospect Harbor
Common Yellowthroat	Black-throated Green Warbler
Black-throated Green Warbler	Yellow-rumped Warbler
Alder Flycatcher	American Goldfinch
Nashville Warbler	American Crow
American Redstart	White-throated Sparrow
White-throated Sparrow	Magnolia Warbler
American Robin	Nashville Warbler
Lincoln's Sparrow	American Robin

Big Moose Island	Schoodic Section ANP
Black-throated Green Warbler	Black-throated Green Warbler
Yellow-rumped Warbler	Yellow-rumped Warbler
Golden-crowned Kinglet	Swainson's Thrush
White-throated Sparrow	Golden-crowned Kinglet
Swainson's Thrush	Blackburnian Warbler
Magnolia Warbler	White-throated Sparrow
Boreal Chickadee	Magnolia Warbler
Nashville Warbler	Nashville Warbler

MAPS Banding (Monitoring Avian Productivity and Survivorship) Banding

MAPS banding was conducted at 10 day intervals between June 8, 1996 and August 29, 1996 at the Winter Harbor Activity Group facility on Big Moose Island. A total of 475 net hours of banding took place on 11 days. The 158 birds captured during MAPS banding included 127 different individuals comprising 27 species; 31 were recaptured on site a week or more after banding. The most frequently captured (and recaptured) species were the black-throated green and yellow-rumped warblers. Sixteen different birds of these two species were captured resulting in 9 black-throated green warbler recaptures and 7 yellow-rumped recaptures at least 1 week later. Other frequently captured species included magnolia warbler (13 birds, 3 recaptures), hermit thrush (10/1), dark-eyed junco (9/1), Swainson's thrush (8/2), and common yellowthroat (7/2). One ruby-throated hummingbird was captured and released without banding. Interestingly, it was captured at the same time in the same net as a winter wren.

The first hatch-year birds (birds hatched in 1996) were captured on July 2 (hermit thrush), July 10 (winter wren and hermit thrush), and July 18 (yellow-rumped warbler and 2 hermit thrushes). All of these are short-distance migrants which spend their winters primarily within the US (although some populations may winter further south) and typically arrive on their breeding grounds 3 to 6 weeks ahead of long-distance or Neotropical migrants which winter primarily in Central and South America. Other hatch-year short distant migrants banded include dark-eyed junco (4

birds), golden-crowned kinglet (3), boreal chickadee (2), downy woodpecker (2), common flicker (2), and one each of white-throated sparrow, winter wren, cedar waxwing, and American robin.

The first hatch-year Neotropical migrants were banded on July 27 (common yellowthroat) and August 2 (2 magnolia warblers). Common Neotropicals banded included black-throated green (25 total captures), yellow-rumped (23), magnolia (16) warblers, Swainson's thrush (10), and common yellowthroat (9). The Neotropical migrant species with the highest numbers of hatch-year birds banded were black-throated green warbler (7), yellow-rumped warbler (6), common yellowthroat (5), and magnolia warbler (4). Of the hatch-year birds banded, 32 were Neotropical migrant species, and 20 were short-distance migrants.

The greatest diversity of species and number of individual birds captured was on August 29, the last day of banding on Big Moose Island. Thirty-one birds comprising 20 species were captured. This high one-day total likely was caused by the capture of fall migrants on their way south. Non-breeding individuals included four flycatchers and one each of red-eyed vireo, northern waterthrush, and sharp-shinned hawk (hatch year bird). The four American redstarts captured on August 23 and 29 were also probably migrants or wandering residents from elsewhere on the Schoodic peninsula.

Fall Migration Area Searches

From August through October, 1994-96, 272 fall migration point counts were conducted at the 32 locations on the Winter Harbor and Corea Naval facilities noted in Methods and described in Appendix 7. One hundred total species were tallied with 86 recorded at Winter Harbor and 78 at Corea. Count data are presented in Appendix 8.

The most abundant migrants counted at Big Moose Island and Corea Heath are presented in Tables 5.6 and 5.7. Species are included if at least 15 individuals were counted at that site in one year. The species are categorized by patterns of population change. Numbers were designated as "high" in one year if that count exceeded the lowest year count by a factor of 1.5X; possible causes for these patterns are discussed below. Habitat selection during the fall migration paralleled habitat selection during the breeding season, in that forest-breeding species were usually more common at Big Moose Island, while shrub- and wetland-breeding species were more common at Corea Heath. The most common Neotropical (long-distance) migrants at Big Moose Island included black-throated green warbler, Swainson's thrush, and magnolia warbler, while the most common Neotropical migrants at Corea included common yellowthroat, palm warbler, and American redstart. The most common short-distance migrants at both sites were the yellow-rumped warbler, American crow, white-throated sparrow, and golden-crowned kinglet. Black-capped chickadee, cedar waxwing, and American robin were also abundant.

Preliminary analysis shows contrasting changes in numbers of birds per year for several species (e.g., large increase in yellow-rumped warbler, decreases in white-crowned sparrow and snow

bunting). Some abundance changes during the migration can be correlated with changes in breeding season population densities within the entire eastern Maine region (e.g., decreases in bay-breasted warbler and white-throated sparrow). The fall migration was more protracted in 1994 than 1993 due to the mild fall weather conditions. Hard frosts did not occur in 1994 until late November along the immediate coast.

Table 5.6. Most frequently sampled fall migrants on Big Moose Island area search counts

	1994	1995	1996
High numbers in 1994			
American Crow	156	50	56
Cedar Waxwing	60	6	40
Yellow-rumped Warbler	199	190	128
White-throated Sparrow	121	92	101
Winter Wren	17	10	6
Hermit Thrush	31	19	26
Dark-eyed Junco	79	59	50
High numbers in 1995			
Black-capped Chickadee	42	379	130
Golden-crowned Kinglet	100	247	101
Ruby-crowned Kinglet	17	23	8
American Robin	8	15	8
Solitary Vireo	7	17	15
Red-eyed Vireo	5	26	14
Black-and white Warbler	8	18	9
Common Yellowthroat	8	42	36
Red Squirrel	52	104	22
High numbers in 1996			
Black-throated Green Warbler	28	40	81
Magnolia Warbler	11	3	15
Song Sparrow	11	10	26
No apparent short-term trend			
Common Flicker	8	7	12
Northern Parula	15	15	15
Palm Warbler	10	15	9

Many black-throated green warblers and common yellowthroats counted during late August and early September were probably locally produced. The breeding season in 1996 was especially late, likely due to nest failures due to an extended period of cold wet weather during June, followed by re-nesting. Nest failure rates for tree, bank, and cliff swallow were extremely high in many coastal and inland locations in Maine (90% at many sites). The number of black-throated green warbler broods detected during the last two weeks of August was very high compared to the previous three breeding season. Most golden-crowned kinglets and possibly cedar waxwings detected before mid September were probably locally produced.

The numbers of many bird species eating fleshy fruit (e.g. American robin, cedar waxwing, hermit thrush) decreased dramatically from 1994 levels as did red squirrel numbers (see Appendix 8 for count data). These decreases may be related to the exceptionally dry summer which appeared to reduce flower production or the development of most fleshy fruits in some plant species.

Table 5.7 Most frequently sampled fall migrants on area search counts on Corea Heath.

	1994	1995	1996
High numbers in 1994			
American Crow	294	143	82
American Robin	272	60	8
Yellow-rumped Warbler	230	167	153
Cedar Waxwing	70	20	72
High numbers in 1995			
Golden-crowned Kinglet	5	37	0
Black-capped Chickadee	25	139	0
Red Squirrel	7	39	1
White-throated Sparrow	86	211	191
Hermit Thrush	16	24	18
Northern Flicker	12	24	6
American Goldfinch	18	35	29
High number in 1996			
Common Yellowthroat	110	156	305
Palm Warbler	60	57	121
American Redstart	7	2	26
Lincoln's Sparrow	1	5	18
Song Sparrow	7	17	60
Savannah Sparrow	12	14	19
Swamp Sparrow	16	12	31

DISCUSSION

Breeding Bird Surveys

Species diversity found on the new Breeding Bird Survey route (96 total species) was high, but not exceptionally high for eastern Maine BBS routes (N. Famous, unpublished), probably because of the relative uniformity of forested habitats sampled here. High species diversity is nearly always associated with high habitat diversity on such surveys.

Nesting densities (as reflected in number of birds per point count) within individual habitat types were similar to those recorded at 25 other areas sampled in coastal Maine and Coastal New Brunswick (Famous 1994). Species with unusually high densities included palm warbler, blackburnian warbler (common at 4 stops), and black-throated green warbler (the consistent number of stops with 2 or more birds). By contrast, species with lower densities than expected included all swallows, American robin, northern parula, yellow warbler, solitary vireo, and several

flycatchers. The lower swallow, robin, and yellow warbler numbers are probably related to the general lack of residential habitat, active farming habitat, and reverting shrub dominated farmland. In 1996, all swallows were absent on the July 3 survey. The extended cold and wet May-June period resulted in an extremely high nest failure rate for swallows throughout coastal and central Maine. Reduced insect activity and reduced insect numbers probably prompted the nest failures.

MAPS Banding

Most Neotropical migrants are insectivorous, and they include flycatchers, swallows, warblers, and vireos as well as other species groups. As a group, many of them have been suffering long-term declines due to changes in quality of either their winter or summer habitats, or both (Robbins et al. 1989, Peterjohn and Sauer 1994). MAPS banding techniques are one way to directly address the breeding success in their summer range. Loss of habitat may limit breeding success of many species as well as habitat fragmentation and cowbird parasitism. Typical short-distance migrants include most finches, sparrows, jays and crows, wrens, and Parids (chickadees, titmice, and tits), among others. A number of short-distance migrants also have declining populations, which may be linked with loss of habitat.

The 1996 breeding season for many Neotropical migrants nesting in the Schoodic area was more extended than most previous seasons, probably due to early season nest failures caused by prolonged cold, wet weather in June and early July. An unusually high number of family groups was still present from mid-August through mid-September. For example, I encountered several family groups of black-throated green warblers during fall migration area counts conducted during August. The same trend occurred at the Corea and Cutler naval facilities and on Roque Island in Jonesport (N. Famous, unpublished data). September migration banding at the Cutler facility and on Roque Island yielded many very juvenile birds, especially Swainson's and hermit thrushes and juncos (the last two species probably being multiple brooded).

The MAPS banding and migration banding complemented the timed fall migration point area counts in that many silent, secretive, and/or inconspicuous species were captured, which helped assess unknowns and provided a comparison between what was observed and what was captured in the lower vegetation strata. The constant fall migration area point counts detect a small portion of the birds passing through and are biased toward birds emitting occasional quiet vocalizations. Species which do not give contact notes or regular alarm notes are infrequently located in dense forested habitats. Most flycatchers, vireos, tanagers, many thrushes (but not hermit thrushes), and a few warblers and sparrows are silent most of the time, and hence more likely to be captured in mist nets than detected by vocalizations. Continued MAPS banding at the 3 MAPS banding sites will help evaluate productivity and survivorship of breeding species that are among the most common species on fall area searches. At least 5 years of MAPS banding and recapture data, however, will be needed for conclusive and statistically robust estimates of productivity and survivorship. During final revisions of this report, the fourth banding season (1999) was underway. Return rates of Schoodic region birds are among the highest for MAPS banding stations in the northeastern US.

Fall Migration Counts

The fall migration offers a method independent of breeding season measures for monitoring population trends in Neotropical and short distance migrants. Population trends based on migration counts have been shown to mirror BBS generated trends (McCracken et al. 1993) and, along with winter monitoring, are the only methods available for several northern-nesting species not monitored adequately by the BBS, because of limited access to their boreal, subarctic, and arctic nesting areas (e.g., white-crowned sparrow, blackpoll warbler, water pipit, merlin, sharp-shinned hawk and most shorebirds; Dunn 1992, Blancher et al. 1993). Migration monitoring of these species is a joint priority of the Canadian Wildlife Service (Dunn 1992), Partners in Flight, and the North American Migration Monitoring Program (Blancher et al. 1993). A combination of area search counts and mist netting is the optimal method for fall migration monitoring. Populations of over 50 breeding species (including 34 Neotropical migrants) can be monitored well, including breeding populations of merlin, blackpoll, palm, bay-breasted, and black-throated green warblers, boreal chickadee, Swainson's thrush, and Lincoln's sparrow. The Schoodic Point area is an excellent site for such monitoring, as it is utilized by a steady flow of migrant landbirds during the fall migration. Their also is no indication that large concentrations of migrants are trapped by weather conditions due to the geography of the area, which might bias surveys.

Generally, species within different subgroups or 'guilds' sharing similar resources during the same season (fall migration or winter season) responded in similar ways. For example, the highly frugivorous cedar waxwing and American robin were very abundant during fall 1994 when high mast crops of mountain ash, winterberry, and witherod were present. Also, kinglets, chickadees, and even red squirrels had concurrent high or 'flight' years in 1995, probably reflecting the high food availability during fall and winter 1994/95 (and attendant higher survival rates).

The greatest year-to-year variation in population numbers occurred within the short-distance migrants. Although limited to 4 years of surveys, they appear to have more variable population fluctuations than long-distance migrants. They appeared to be affected more by weather or by changes in fruit production than the more insectivorous long-distant migrants. The most highly variable species sampled in this study included American robin, black-capped chickadee, golden-crowned kinglet, yellow-rumped warblers, cedar waxwings, and several species of sparrow, all of which are short-distance migrants. Among long-distance or Neotropical migrants, Tennessee warbler, red and solitary vireos, black-and-white warbler, and bay-breasted warbler appeared to be the most variable on a the short-term basis (4 years). This population variability emphasizes the critical need for long-term monitoring of populations, their habitats, climatic factors, and annual fruit production, with the latter influencing more the frugivorous species of short-distance migrants more than the primarily insectivorous long-distant migrants.

Sample sizes for some long-distance migrants were small, but when combined with the four other fall sampling areas in Jonesport and Cutler they should yield more statistically meaningful results (larger sample sizes) over the eastern coast of Maine. Also, evaluation of the breeding season trends throughout the more than 35 survey routes within eastern Maine and coastal New Brunswick and comparisons with regional BBS trends will help assess these results.

For species that are poorly monitored by existing breeding surveys on their breeding ranges in northeastern North America, fall migration counts may be the most valuable method for following population trends. Table 5.8 lists most Neotropical and short-distance migrant species sampled in this study that have a high or intermediate potential for being successfully monitored by fall migration counts in the Schoodic and Corea study areas.

Table 5.8. Neotropical and short-distance migrants with a high to intermediate potential for monitoring using fall migration area search counts

SPECIES WITH LARGE SAMPLE SIZES AND HIGHEST MONITORING POTENTIAL

Long Distance/ Neotropical Migrants	Short Distance/ North American Migrants
Black-throated green warbler*[3]	Yellow-rumped warbler*[3]
Palm warbler**[1]	Golden-crowned kinglet*
Common yellowthroat	American robin
Magnolia warbler **[1]	White-throated sparrow
	Black-capped chickadee
	Hermit thrush*[3]
	Dark-eyed junco
	Cedar waxwing
	American goldfinch
	American crow

SPECIES WITH SMALLER SAMPLE SIZES, BUT WITH MONITORING POTENTIAL

Long Distance/ Neotropical Migrants	Short Distance/ North American Migrants
Solitary vireo*[3]	Winter wren*[3]
Black-and-white warbler*[3]	Boreal chickadee*[6]
American redstart*[3]	Song sparrow**[2,4]
Blackpoll warbler**[1; 6]	Ruby-crowned kinglet*[3]
Bay-breasted warbler**[1]	Northern flicker *[4]
Lincoln's sparrow*[3;6]	Purple finch*[5]
	Swamp sparrow*[6]
	White-crowned sparrow*[3; 6]
	Red-breasted nuthatch*[4]
	Pine siskin
	White-winged crossbill*[3]
	Horned lark *[5]
	Snow bunting*[3]
	Water pipit*[3]

**[1] Identified as high priority species by the North American Migration Monitoring Program (Blancher et al. 1993); **[2] High priority species with declines in the Maritimes (Dunn 1991); *[3] Priority species (Blancher et al. 1993); *[4] Declining species in Ontario and Quebec(Dunn 1991); *5 Declining on BBS and undersampled in Northeast; *6 Undersampled; breeding range largely north of areas sampled by BBS.

Fleshy Fruit Production Monitoring and Effects on Bird Populations

Many short-distance migrants are omnivorous but depend heavily on fruit and seed production during the fall and spring migrations, and the area search data show corresponding changes in numbers of the most common species. Some migrating Neotropical migrants (i.e. eastern phoebe, eastern kingbird, and solitary vireo) are also partially frugivorous, but sample sizes for most of these species are too small to assess the relationship between fruit production and survivorship.

Fruit production varied among years as did winter weather severity in the eastern US. Reduced food production in 1995 and 1996 combined with severe winters in large areas of eastern US in 1994 and 1995 combined to reduce numbers of several short-distant migrants. Fleshy fruit production varied according to time of flowering season in 1996. Many early season insect pollinated plants (May and early June) with 'out-crossing' breeding systems had severely reduced fruit production due to long periods of cool and wet weather which reduces pollinator activity. Species affected included mountain ash (*Pyrus [Sorbus] americana*), stinky elderberry (*Sambucus pubens*), and baked-apple berry (*Rubus chamaemorus*). The very early flower of crowberry (*Empetrum nigrum*) did not appear to be affected.

The highest number of fruit eating birds detected on fall area searches occurred in 1994. American robin, cedar waxwing, yellow-rumped warbler, hermit thrush, and American crow numbers were highest among the 4 years of monitoring (1993 area counts were not conducted in October but numbers of individuals per area search were much lower than 1994 numbers). Among the 4 forested survey areas within the larger study (Sprague Neck Woods at the Cutler navy facility, Roque Island in Jonesport, Corea Heath area, and Big Moose Island) the Corea peninsula has the highest densities of fleshy fruits including mountain ash (*Pyrus [Sorbus] americana*), witherod (*Viburnum cassinoides*), chokeberry (*Pyrus [Aronia] melanocarpa*), Juneberry (*Amelanchier* spp.), mountain holly (*Nemopanthus mucronata*), black holly (*Ilex verticillata*), and both huckleberries (*Gaylussacia baccata* and *G. dumosa*). Not surprisingly, the Corea study area and surrounding peninsula was inundated by members of the fruit eating foraging guild in October and November.

Mountain ash fruit production was extremely high in 1994 throughout much of Maine, New Brunswick, and Quebec east of Montreal (Andrae Rocheforte, personal communication; Department of Forestry, Laval University, Quebec City, Quebec Canada). Interestingly, this was the first winter that I have heard of American robins successfully wintering in the wild in interior Maine, New Brunswick, and Quebec (away from cultivated and feral fleshy fruited ornamentals associated with human habitation). Colleagues reported encountering flocks of robins on Mount. Katahdin in the middle of winter (Charles Whitney, personal communication), and in Quebec, American robin and Bohemian and cedar waxwings numbers were among the highest in memory for the lower St. Lawrence River valley and upper estuary (Andrae Rocheforte, personal communication).

By contrast, the fleshy-fruit eating species were much lower during the 1995 fall migration area searches. These decreases were directly related to an exceptionally dry growing season in 1995

which severely reduced or prevented fruit development in most fleshy-fruit bearing shrubs and trees throughout both the breeding season and fall migration. Flower production was also reduced on many herbaceous weedy species, and average size and number of fruits reaching maturity was low (or absent) on wild roses (*Rosa nitida, R. carolina,* and *R. rugosa*), juneberries, blackberries and raspberries (*Rubus* spp.), wild currents (*Ribes* spp.), cherries (*Prunus* spp.), blueberries and lingonberries (*Vaccinium* spp.), bunchberries (*Cornus canadensis*), huckleberries, and chokeberries. Crowberry was one of the few fleshy fruited species with 'normal' fruit set in 1995.

In 1995, unusually high numbers of red-eyed and solitary vireos, golden and ruby-crowned kinglets, black-capped chickadee, and black-and-white warbler occurred during the fall migration. These increases may represent high breeding productivity that year, high overwintering survival the previous winter, or both. Possible causal agents for these patterns are not clear.

Comparison with Seed-eating Mammals: Red Squirrels

Low fruit production in 1995 (both dry and fleshy species) appeared to have adversely affected red squirrel populations on 1996 BBS routes and fall migration area searches. One, 2, and 6 squirrels were counted on 1996 BBS surveys on June 1, June 18, and July 3 These figures are extremely low when compared to the 49 squirrels tallied in 1995.

Extralimital Vagrants During Fall Migration

The number of western vagrants was highest during the 1995 fall migration. Although these birds are interesting to bird watchers, they are probably the result of weather events during migration rather than the product of population irruptions. There is a tendency for extralimital or disjunct breeding to occur following "flight" years, as happened in 1996 with greater numbers of northern cardinals breeding in Maine and New Brunswick, Canada. Historically boreal owls bred several seasons on nearby Grand Manan Island in New Brunswick and bohemian waxwings were found breeding in Quebec province following incursion years. Extralimital breeding should be looked for with clay-colored sparrow, dickcissel, hawk owl, great gray owl, and common redpoll.

The list of western vagrants counted during the 4 years of this study includes dickcissel, lark sparrow, Oregon race of the dark-eyed junco, painted bunting, Connecticut warbler, and orange-crowned warbler. Rarities for the eastern US include sedge wren and grasshopper sparrow. Over the long term, comparisons with BBS trends and breeding bird atlas projects will be needed to assess any significance to their presence.

Federal and State Listed Bird Species

No federal or Maine endangered or threatened species were found breeding on the study sites (Table 5.3), although bald eagles (US and Maine threatened) occasionally are seen in the area. **One Maine Species of Special Concern** (Maine Inland Fisheries and Wildlife 1994) was found on Breeding Bird Surveys, the Olive-sided Flycatcher. Of **fall migrants, the following listed species** were seen: peregrine falcon (**Federal and State Endangered**), sedge wren (**Maine Endangered**, at Corea Heath 1995), grasshopper sparrow (**Maine Endangered**, at Corea Heath, 1995), and vesper sparrow (**Maine Species of Special Concern**).

CONCLUSIONS AND RECOMMENDATIONS

The ANP and US Navy lands support an impressive diversity of breeding and migrant bird species. As their habitat requirements range from mature forests to open grasslands and wetlands, we recommend preservation of the full range of natural cover types in the region, and limitation of further disturbance to rare habitats, such as wetlands. Of particular importance are the open wetlands of Corea Heath, where several listed species were found, and the corridor of forest between open heath/bog and the coast at Corea, where many canopy migrants were noted.

The breeding season and fall migration monitoring programs are effective tools for tracking populations of many poorly monitored species and many declining US and Canadian nesting species (see Table 5.8). Some Neotropical migrants and short-distance migrants show marked variation in numbers among years, which can be interpreted in relation to annual resource changes and long-term changes in needed habitats. Multi-year monitoring studies are needed to establish baseline conditions for an area or habitat type, which can then be used to assess these trends.

The combination of techniques used here (including breeding season counts, banding from breeding to early migration, and fall migration counts) are effective and complementary methods for studying population trends in migratory birds. The results show density trends that are often consistent from breeding and migration data and that can be related to changes in certain resources, as in the responses of frugivorous species to fruit abundance. Although preliminary, higher numbers of birds recorded on breeding season point counts often result in higher population numbers during the following fall migration.

We recommend continuing breeding season and fall migration monitoring in future years. The number of monitoring routes should be increased, to increase sample size for statistical analysis. More complete analysis of vegetation and habitat structure at BBS point counts and fall migration search areas would be useful, to better evaluate habitat use during breeding and migration seasons. Comparisons with other monitoring sites and between seasons would then be possible.

We also recommend MAPS banding be continued, and even expanded to several additional locations in the study area. Banding should also be continued through fall migration at at least one MAPS banding site. Funding for future studies is of concern, and some stable base for assuring long-term support would be advantageous.

The educational value of these studies of bird populations should not be underestimated. Birds are obvious and interesting animals to many citizens, and may function as an example taxon to illustrate the need for conservation of biodiversity. Besides collecting valuable nationwide monitoring data on bird productivity and survivorship in northern boreal forests, the MAPS banding studies can be a contact point with the general public. Observing and participating in the banding activities is a valuable educational opportunity for children and adults. On Big Moose Island in summer 1996, many military personnel and family members participated in the banding process. We strongly recommend these outreach efforts be continued.

CHAPTER 6: BRYOPHYTE VEGETATION INVENTORY

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INTRODUCTION and BACKGROUND

The botanical research of most biological inventories in terrestrial ecosystems usually is focused on vascular plants, particularly the very diverse flowering plants or angiosperms (e.g. Mittelhauser, et al. 1995). At cool, moist sites in Maine, one group of nonvascular plants, the bryophytes, can rival the flowering plants in both biomass and diversity. Bryophytes include the small plants commonly called mosses, peat moss, and liverworts. These tiny perennial plants are simple compared to vascular plants. They have no roots, no true vascular system, and grow in communities on many surfaces including wood and rocks, as well as soil. Peat mosses are the primary sources of the organic matter in peat bogs, and other mosses and liverworts make up an important, but often unnoticed, component of many ecosystems.

Beteen April and October, 1996 an inventory of bryophyte plant species was conducted on the Naval Security Group Activity properties at Winter Harbor and Corea, Maine, and adjacent Acadia National Park lands at Schoodic Point and Big Moose Island (see Figure 1.1 in Chapter 1). This survey was part of the Biological Inventory of Wetlands on Schoodic and Corea Peninsulas in coastal Maine, and it studied a wide range of ecosystems, including 14 wetland community types, 10 upland types and one riverine type. The degree of human disturbance on these ecosystems varied widely, from essentially undisturbed coniferous forests, to areas where fill soils completely controlled the plant communities. Since many bryophytes are pioneer species, disturbed habitats support many species that rarely occur in areas with little human intervention. This study produced a species list for 3 study areas (Corea Heath, Schoodic Point, and Big Moose Island) and a record of the habitat types in which each species occurs.

Corea Heath is a coastal plateau peatland that has experienced disturbance due to construction of communications antennae and associated facilities. Upland areas surrounding the bog are unique in supporting Jack Pine Woodland which has developed on exposed ledges. A similar ecosystem exists at The Nature Conservancy's property at Great Wass Island. Corea Heath is a good example of a coastal platueau bog (Worley 1981), having the typical sedge/moss lawn communty supporting *Scirpus cespitosus* at the highest point of the dome, and clear plant community zonation on the slope. It is also a documented station for state-listed *Calamagrostis pickeringii* Gray, which can be found in abundance in the Open Fen community around the edge of the peatland. Disturbance to communities on the open bog at the top of the dome has left scars that have only partly recovered since construction activities in the late 1950's to early 1960's (Cultural Resource Group, 1995). Upland areas at Corea consist of forests on exposed bedrock and glacial till and developed sites.

Schoodic Point is dominated by upland communitites, with scattered small wetlands forming in shallow depressions and small, first order streams. The southern part of the point has experienced disturbance as a result of the park's road and trail development for recreation, but has little other extensive disturbance history. The dominant community is upland coniferous forest and woodland on glacial till and exposed bedrock. Often having a poorly developed herb and shrub layer, mosses are an integral part of these maritime forests. In spite of well drained soils, high humidity and cool temperatures result in high cover for bryophytes in many areas. Even with high cover, species diversity is often low where microhabitats were uniform. Two cliffs are present at the Schoodic Point study site, the only cliffs among the three study sites. Exposed to wave action on the east and west sides, the coastline consists of small cobble and gravel beaches in bedrock gaps and small bedrock bluffs. Thin folist soils at the edge of wave action and soil in cracks in the rocks of the spray zone are the primary habitat for bryophytes in areas exposed to sea spray.

Big Moose Island has experienced disturbance since the mid 1930's, with increased development pressures on plant communities since the mid 1940's. A network of roads, buildings, paths and parking areas has heavily altered the center of the island. The primary forest community, like Schoodic Point, is upland coniferous forest on glacial till with small areas of exposed bedrock. The island is generally low in elevation, with a gentle slope to the shoreline, whereas Schoodic Point has steeper and more varied topography. Very few wetlands are present, although previous small forested wetlands or scrub shrub wetlands may have been filled during development.

METHODS

Corea Heath, Schoodic Point and Big Moose Island were searched for bryophyte species, noting the occurrence of each species within each cover type. In addition to identifying species in the field, samples were taken to verify field identifications and to identify unknowns when possible. Some samples from each of the three areas were identified only to genus, or remain unidentified because of uncertainties in current bryophyte systematics, incomplete specimens, or additional lab time required to confirm the species. All specimens are currently housed at the author's residence. They will require additional curation at the University of Maine Herbarium, including pH stabilization and permanent labeling, before final deposition in the Natural History Museum, Acadia National Park, and the University of Maine Herbarium by December 1999. Species identified during past surveys of Corea Heath and Schoodic Point by Dr. Howard Crum, University of Michigan, and Dr. Norton Miller, New York State Museum, Albany, New York, were included.

Transects were established along environmental gradients at the Corea, Schoodic and Big Moose Island sites, to maximize the numbers of cover types intersected and to provide a representative sample of the species present in each community encountered. The transects and the cover types sampled are mapped on Figures 6.1, 6.2 and 6.3. Cover types were delineated using color infrared aerial photography provided by Acadia National Park and the Naval Security Group Activity - Winter Harbor, and field checked during site visits. To assess relative abundance and distribution, 1 x 1m plots were placed along transects at the Corea and Schoodic sites. At Corea Heath the transects were laid out roughly equidistant from each other, to sample bryophytes across the entire bog and adjacent communities. Since the large peat bog and its surroundings

terrain form a cohesive unit, laying out equidistant transects intersected all community types several times and captured the variations within most of these communities.

The Schoodic Point study area was mostly forested, with a wider range of topographic features, wetland types, and plant communities than at Corea Heath. This degree of ecological variation forced a more generalized approach to bryophyte sampling there than at Corea Heath. Schoodic Point transects were arranged along access routes, and followed identifiable environmental gradients such as topography and moisture. One plot was placed in each vascular plant community as it was encountered. Replicate plots for each community type were obtained opportunistically, as the habitats were encountered along the transects.

Nomenclature follows Crum (1984) for sphagnum, Conard (1979) for liverworts, Ireland (1982) for true mosses and granite mosses and Andrus, et al (1994) for the *Sphagnum recurvum* group. Since a great deal of variation exists in bryophyte taxonomy due to differing viewpoints among taxonomists, it was necessary to use several different sources. Although the majority of the names will be consistent between authorities, there have been changes that may lead to some confusion for *Sphagnum recurvum*, agg., *S. cuspidatum, S. papillosum, S. lescurii, S. subsecundum*, *Dicranum bonjeanii*, *Isothecium* spp., *Isoptygerium* spp., *Solenostoma* spp., and *Drepanocladus* spp. Vascular plants not identified during the 1994 survey were noted during bryophyte field surveys, and are listed in the following chapter. Searches for state and federally listed plant species were conducted in communities with high potential to support rare plants.

Sampling: Corea Heath:

Six transects were completed, spaced approximately 200 meters apart for transects 1-4, and 300 meters for transects 4-6, running roughly northwest-southeast. Along transects 1-4 (see Figure 6.1) 1x1m plots were established to provide a representative sample of hummock/hollow species associations and relative distribution within each cover type. Plots were placed in cover types as encountered along each transect, but no attempt was made to equate the number of plots with the relative areas of each type within the study area. Percent cover for each species, percent cover of lichens collectively, substrate type, and wetland status were recorded for each plot. Cover types encountered along all six transects were also surveyed for all bryophyte species present. Transects were placed to sample the upland terrain surrounding Corea Heath as well as the wetland complex associated with the heath. Sample units included both disturbed and undisturbed variants for each cover type, if applicable. All cover types identified on the cover type map were sampled at least once.

Sampling: Schoodic Point:

Ten transects were established in the southern portion of ANP lands on Schoodic Point to create a representative sample of cover types in this unit. 1x1 m plots were placed along transects 1-3 (see Figure 6.2) to sample species distribution and abundance. A search of each cover type for all species present was conducted. At each plot percent cover for each bryophyte species, percent cover for lichens collectively, substrate type, and wetland status were recorded. Transects 1-3 were placed along topographical gradients that represented environmental gradients typical of the

ecosystems present on Schoodic Point. Transects 4-10 were walk-through searches of individual cover types. Cover types identified on the cover type map but not surveyed included Forested Fen, Mud Bottom, Intertidal, Open Water, Early Successional, Mixed Coniferous-Hardwood Forest, Spruce Woodland, and Forested Bog. Forested Fen, Mud Bottom and Forested Bog were mot sampled due to the small amount of these types on the unit; Intertidal and Open Water were types that would not support bryophyte growth; and Early Successional and Mixed Coniferous-Hardwood Forest contained species that were represented by other types in the study area. Rocky Headwater Stream was sampled but not shown on the map due to scale. Spray Zone areas were sampled but not described as a transect.

Sampling: Big Moose Island:

Both Navy and Park lands were searched for bryophyte species within all cover types identified. No plots were established, but instead the island was divided into areas which were searched individually. One type sampled, Northern White Cedar Swamp, was not found in the aerial photo interpretation. The cover type map shows only part of the island, since complete coverage for this study site was not available. Since human activities are greater at this study site compared with Corea Heath and Schoodic Point, much of the area surveyed was disturbed, filled or otherwise developed. Table 6.5 includes disturbed cover types for this reason.

Cover Type Descriptions:

Cover types were separated into 3 major categories: terrestrial, palustrine, and riverine. Terrestrial and palustrine types contained both disturbed and undisturbed analogs. Those types listed under "disturbed" are disturbed by definition and require no modifier, while all other types may be either disturbed or undisturbed. Palustrine cover types are in 2 groups: peatland and mineral soil. Peatland types are separated into ombrotrophic and minerotrophic types and categorized by dominant groups of species and groundwater influence. One riverine type was a small, first order stream. Terrestrial areas may include small wetland inclusions, and palustrine areas may include small upland areas, leading to a higher probability for wetland species such as *Sphagnum* to be found in terrestrial cover types with the same applying to upland species in wetland cover types. Riverine areas included the shoreline within 5 feet of the stream bank and included rocks exposed above the high water line, allowing for typically non-riverine species to be included.

The cover type system follows the Natural Heritage Program (NHP) Classification of Ecosystems and Natural Communities (Gawler, S.C., ed. 1991), with peatland types expanded by the use of the Davis-Jacobson system (Davis, et al, 1983). Natural Heritage Program types included: CF, MF, ES, AC, JW, SS, GS, SF, FB, OF, LG, CS, and RS. Davis-Jacobson types included: MB, SL, SH, WH, FF and ST. Types developed to accommodate the needs of this study included: WT, AL, SZ, BB, SU, and DE. Cover types are designated by 2 capital letters, while modifiers are designated by 1 lower case letter. Cover types were organized into three general habitat types, terrestrial, palustrine and riverine, following the National Wetlands Inventory classification system (Cowardin 1987). Modifiers were recorded for cover types as appropriate, but are only shown on the Big Moose Island list. This information, although not included with this report, is

available for Corea Heath, Schoodic Point, and Big Moose Island sample sites in a spreadsheet of species and plot data by each cover type from the author.

Terrestrial Cover Types:

Undisturbed

AL = Acidic Ledge: Essentially horizontal substrate, may contain shallow depressions and wet soil-filled crevices; tree cover sparse or patchy; often contiguous with Jack Pine Woodland.

CF = Coniferous Forest (Spruce/Fir Flats, NHP): Dominated by Red Spruce (*Picea rubens*) or Balsam Fir (*Abies balsamea*); forest on low elevation, moist, flat sites, common associates include Paper Birch (*Betula papyrifera*), Black Spruce (*Picea mariana*), White Spruce (*Picea glauca*), White Pine (*Pinus strobus*), and Jack Pine (*Pinus banksiana*). Soils poorly drained but not saturated or peaty, shrub and herb layers sparse and patchy, mosses are usually abundant.

MF = Mixed Hardwood/Conifer Forest (NHP): Dominated by Red Maple (*Acer rubrum*), Balsam Fir, Red Spruce, and Paper Birch; mosses generally on rotting logs and rocks; soils acidic and moderately to well drained; shrub layer generally moderately to well developed, herb layer sparse.

ES = Early Successional Forest (NHP): Dominated by Trembling Aspen (*Populus tremuloides*) or Grey or Paper Birch (*Betula populifolia*), with Red Maple as a component; associated with recent (within last several decades) disturbance, shrub and herb layers moderately to well developed.

SZ = Spray Zone: Directly influenced by sea spray, within 50 ft. of high tide line

AC = Acidic Cliff (NHP): Essentially vertical, may be wet or dry; non-calcareous resistant rock, soil development minimal; vegetation sparse.

JW = Jack Pine Woodland (NHP): Semi-open, dominated by Jack Pine (*Pinus banksiana*) on ledge outcrops; soils nutrient-poor and excessively well-drained; tree canopy stunted; shrub layer sparse to well-developed, ericaceous.

Disturbed

BB = Blueberry Barren: Active or recently abandoned, may be subject to mowing or burning

SU = Shrub Upland: Generally old fields or cut areas in early stages of secondary succession

DE = Developed: Filled wetland or upland, community growing completely on fill soil or at least soil highly disturbed.

Palustrine Cover Types:

Mineral Soil: less than 0.5m organic soil

SS = Shrub Swamp (NHP): Generally deciduous, Speckled Alder (*Alnus rugosa*) dominated; shrubs tall, often dense.

GS = Graminoid Swale (NHP): Dominated by sedges and grasses; edges may be brackish in this study; Blue-joint Reedgrass (*Calamagrostis canadensis*) usually a dominant, often associated with *Carex stricta.*

SF = Spruce/Fir Swamp (NHP): Dominated by Black Spruce (*Picea mariana*), Balsam Fir, and Larch (*Larix laricina*); Jack Pine, Northern White Cedar (*Thuja occidentalis*), and Red Maple may be an associates; acidic hydric soils, high *Sphagnum* cover, high diversity of other mosses; shrub and herb layers moderate to sparse.

CS = Northern White Cedar Swamp (NHP): Includes forested seepage wetlands containing flowages as well as low-lying areas; N.W. Cedar is dominant but Black Spruce and Balsam Fir are co-dominants; soil mineral or with shallow peat layer.

Peatland: greater than 0.5m organic soil (peat)

MB = Mud Bottom (DJ): NHP = Moss Lawn; dominated by *Sphagnum* mosses and liverworts; some exposed peat; usually ombrotrophic; water table at or just below surface.

SL = Sedge Lawn (DJ): NHP = Plateau Bog Lawn; ombrotrophic; dominated by sedges and *Sphagnum* moss, water table at or just below surface.

SH = Shrub Heath (DJ): NHP = Dwarf Shrub Bog; dominated by ericaceous shrubs less than 1m tall and *Sphagnum* moss; ombrotrophic.

WH = Wooded Shrub Heath (DJ): Ombrotrophic; shrub heath with 25-50% tree species cover, trees may be large or small.

Palustrine Cover Types (continued)

FB = Forested Bog (NHP): Ombrotrophic; tree species cover greater than 50%, usually *Sphagnum* moss dominated; shrub layer ericaceous.

OF = Open Fen (NHP): NHP = Acidic Fen; minerotrophic; grass, sedge and moss dominated, tree cover less than 50%.

FF = Forested Fen (DJ): Minerotrophic; tree cover greater than 50%, may contain deciduous or coniferous species.

ST = Shrub Thicket (DJ): Minerotrophic; dominated by mosses and ericaceous species; shrubs greater than 1m tall.

WT = Wooded Shrub Thicket: Shrub Thicket with 25-50% tree species cover.

LG = Peatland Lagg (NHP): Narrow zone around perimeter of bog separating bog from upland, minerotrophic; Alders, Mountain Holly (*Nemopanthus mucronata*), Winterberry (*Ilex verticilata*), High Bush Blueberry (*Vaccinium corymbosum*) common co-dominants; high *Sphagnum* cover; may contain both minerotrophic and ombrotrophic species.

Riverine Cover Types:

RS = Rocky Headwater Stream (NHP): Small, first order rocky streams with moderate to steep gradients; most of the erosion is headwater, deposition minimal.

Modifiers to Cover Type Designations:

l = High lichen (*Cladina* and *Cladonia* spp.) cover

j = Jack Pine dominated

d = Disturbed

m = Exposed maritime locations, soils usually folists, arboreal lichens may be abundant, cool temperatures and frequent fog.

RESULTS

Four species of special interest were encountered: *Isothecium eumyosuroides* (Gawler et al. 1996) on Schoodic Point and Big Moose Island; *Splachnum pensylvanicum* (Norton Miller, personal communication) on Corea Heath; *Dicranum majus* (Gawler et al. 1996), found at all 3 study sites; and *Diplophyllum albicans* (Gawler et al. 1996) found at Schoodic Point. *Isothecium eumyosuroides* is rare due to a highly restricted oceanic range and is a disjunct between the east and west coasts. *Splachnum pensylvanicum* is rarely encountered due to its microhabitat preference (well rotted moose dung). *Dicranum majus* and *Diplophyllum albicans* are oceanic species at the extreme southern limit of their range.

Although not known to be rare, several other occurrences at these sites were noteworthy. *Solenostoma crenulatum* and *S. gracillimum,* found in disturbed areas, may not be rare, but are small and possibly under-collected. Also of interest was the abundance of *Sphagnum pulchrum* in Open Fen, Sedge Lawn and Moss Lawn communities at Corea Heath. Although not uncommon, it is generally found in lesser amounts in peatlands of eastern, central and northern Maine. The association of *Sphagnum pulchrum* and *S. flavicomans* has been studied in typical Atlantic Coastal Plain peatlands (Eric Karlin, personal communication). This association was commonly found in open fens at Corea Heath. *Dicranum majus* and *Sphagnum angermanicum,* both of which only occur in extreme coastal areas, were also recorded during this study. *Sphagnum*

angermanicum was found in Scrub Shrub, Forested Fen, Wooded Shrub Heath, Shrub Heath, Sedge Lawn, and Peatland Lagg. *Dicranum majus* occurred in Jack Pine Woodland, Peatland Lagg, Coniferous Forest, Acidic Ledge, Mixed Coniferous/Hardwood Forest, and Northern White Cedar Swamp communities.

Also distinctive is the occurrence of *Sphagnum pylasii* found in both palustrine and terrestrial communities at Corea Heath and Schoodic Point. This species has a very limited range in Maine, being found most abundantly at Corea Heath and Schoodic Point, with the only other sites known to the author are at Eagle Hill Wildlife Research Center in Steuben, Maine, and Great Wass Island, Beals, Maine. This interesting species was found in the spray zone as well as other minerotrophic sites, and was common in Jack Pine Woodland/Acidic Ledge sites. Its presence in the spray zone suggests a small amount of tolerance to salinity, previously documented only to occur in *Sphagnum fimbriatum* (Wilcox and Andrus 1987). All other sphagnum species are not tolerant of saline conditions.

Results: Corea Heath

At Corea Heath 30 cover types along six transects (dilineated on Figure 6.1) were sampled, 6 of which were combinations of 2 types (15 terrestrial, 14 palustrine, 1 riverine). The total number of individual cover types represented totaled 23. The total number of areas surveyed numbered 67 (Figure 6.1). Plots established along 4 transects sampled 22 cover types (9 terrestrial, 13 palustrine) of which 5 were combination types, ultimately representing 20 individual cover types. The total number of 1x1m plots was 55.

Many of the peatland cover types were represented by both disturbed and undisturbed analogs. Since the overall species composition was not strongly influenced by disturbance, cover types were not listed with a "d" in the species list although this information was recorded, and is available as a spreadsheet file. The same applies to cover types modified with an l, m, or j (see Cover Type descriptions above).

As a result of sample plots and area surveys, the total number of bryophyte species identified for Corea Heath was 125 (Table 6.1). Of these 72 were true mosses (Bryidae), 29 were liverworts (Hepaticae), 1 was a granite moss (Andreaeidae), and 23 were sphagnum (Sphagnidae). The species list (Table 6.1) included 37 samples not identified to species; 30 of these were identified to genus or subsection within a genus, and seven were unknown species not identified to genus. Further laboratory comparisons may permit species identification of some of these specimens, but given current bryophyte taxonomy and limited sample material, some may remain unidentifiable, or possibly are undescribed species. The breakdown of species into groups includes 98 species growing in terrestrial communities, of which 36 were found only in terrestrial sites. Eighty-four species were found in palustrine communities, with 25 being found only in wetland conditions. Within the riverine community, 17 species were identified, with only 1 being restricted to these conditions exclusively (Table 6.1).

Twelve species occupied wide enough niches to be found in all three habitats (terrestrial, palustrine, riverine). In terrestrial and palustrine areas 48 species were shared, 3 species had

terrestrial and riverine sites in common and no species were found in both palustrine and riverine sites.

Twenty-eight species were determined to be dominant, abundant or frequently occurring (Table 6.2) with the vast majority being *Sphagnum* spp.(10) or *Dicranum* spp. (5). Of the remaining common species, 4 were liverworts, 4 were *Polytrichum* spp., and 3 were others. Due to the small size of bryophytes, species considered to be dominant or common were based on frequency of occurrence (i.e. *Cephalozia* spp.) and/or abundance (i.e. *Sphagnum magellanicum*).

The most noteworthy species found at Corea Heath included *Sphagnum pulchrum, S. pylasii,* and *Splachnum pensylvanicum*. Of the plant communities present, the Jack Pine Woodland/Acidic Ledge cover types supported the most unusual combinations of bryophytes. This pattern is in keeping with the uniqueness of that ecosystem as a whole. In part, this is due to the large areas of exposed bedrock at these sites, combined with shallow depressions where water and organic material can accumulate and nutrients can become concentrated due to evaporation.

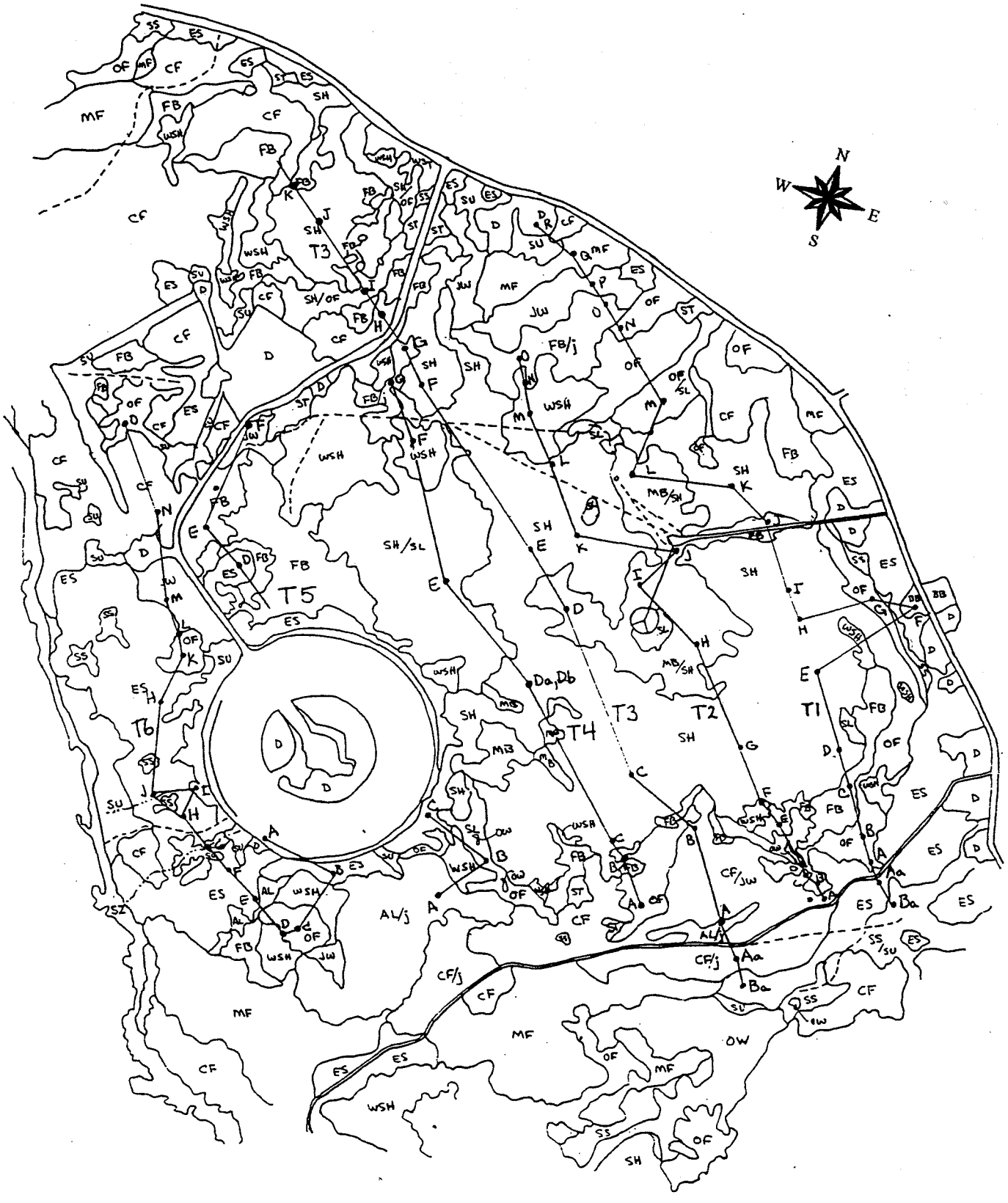


Figure 6.1 Corea Heath cover type map
Bryophyte transects and plot locations

Table 6.1. Corea Heath bryophyte species list. Cover types where each species was found are indicated under each of the three general habitats. Refer to Methods section for cover type designations.

COREA HEATH SPECIES LIST	TERRESTRIAL	PALUSTRINE	RIVERINE
Andraea rupestris Hedw.	CF		
Amblystegium sp.	BB,ES	SS	RS
Amphibium/Grimmia	AL,JW		
Atrichum angustatum (Brid.)B.S.G.	ES,DE		
A. undulatum (Hedw.)P.Beauv.	DE		
Aulacomium androgynum (Hedw.) Schwaeg.	CF,SU		
A. palustre (Hedw.)Schwaeg.	SU,BB,JW,CF	FB,SF,LG,OF,FF,ST,SS,SH	
Bazzania trilobata (L.) S. Gray	CF	FB,LG,WH	
Bazzania sp.		SF	
Brachythecium sp.	MF		
Brotherella recurvans (Michx.)Fleisch.	SU,CF	LG	
Bryum pseudotriquetrum (Hedw.) Gaertn.	BB	FB,OF	
Bryum sp.	SU,BB,JW,AL,DE		
Callicladium haldanianum (Grev.)Crum	SU,MF,CF,DE,ES		RS
Calepojega sp.		SS,SH,FB	
Campylium sp.		SS	
Cephaloziella sp.		SH,FB,WH	
Cephalozia spp.	CF	SH,SL,OF,MB,FB,WH,ML	
Ceratodon purpureus (Hedw.)Brid.	DE,AL,JW		
Cladopodiella fluitans (Nees.)Joerg.		SH,SL,MB,SH,OF,ML,FB	
Dicranella cerviculata (Hedw.)Schimp.		LG	
D. heteromalla (Hedw.) Schimp.	SU,ES,DE		
Dicranum condensatum Hedw.	JW,AL,ES		
Dicranum flagellare Hedw.	JW,FB,BB,MF,CF,AL		
D. fuscescens Turn.	JW,SW,BB,CF,SU,MF	FB	RS
D. leioneuron Kind. ex Mac.	AL,JW	FB	
D. majus Sm.	JW	LG	
D. montanum Hedw.	JW,SU,MF,CF		
D. ontariense Peters.	JW,SU,MF,CF,AL	SF,LG	RS
D. polysetum Sw.	CF,SU	SF	
D. scoparium Hedw.	JW,CF,SU,ES,BB,MF	SS,FB,LG,WH	RS
D. spurium Hedw.	BB,JW,AL,CF		
D. undulatum Brid.	JW,AL,CF,SU	SH,SF,OF,FF,FB,WH	
Dicranum sp.	CF,ES,DE	FB,SS	
Ditrichum sp.	DE		
Drepanocladus uncinatus (Hedw.)Warnst.		LG	
Drepanocladus sp.		ML,SH	
Eurhynchium pullchellum (Hedw.)Jenn.			RS
Frullania asagrayana Mont.	SU		
F. eboracensis Gott.	MF		
Grimmia/Racomitrium	BB		

COREA HEATH SPECIES LIST	TERRESTRIAL	PALUSTRINE	RIVERINE
Gymnocolea inflata (Huds.) Dum.	AL,JW	OF,SH,SL	
Hedwegia ciliata (Hedw.)P.Beauv.	SU,JW,BB,AL,MF		
Hylocomium splendens (Hedw.)B.S.G.	SU,CF	FB,SF	
Hypnum cupressiforme	SU		
var. filiforme Brid.			
Hypnum imponens Hedw.	JW,ES,SU,DE,AL,MF, CF	SS,WH,SH,LG,SF,FB	RS
H. lindbergii Mitt.		SH	
H. pallescens (Hedw.)P.Beauv.	SU,CF		
Hypnum sp.	SU,MF,CF		RS
Isothecium sp.	SU,MF,CF		
Jamesoniella autumnalis (DC)Steph.	DE,SU	SS	
Kurzia setacea (Web.)Grolle.		FB,WH,SH,MB,OF,SL,ML	
Leucobryum albidum (Brid. ex P.Beauv.) Lindb.	JW,AL,CF,SU,ES	SF	
L. glaucum (Hedw.)Angstr. ex Fries.	JW,SU,MF	SS,FB	RS
Lepidozia reptans (Dum.) Dum.	SU,CF	SF,SS,LG	
Lophozia ventricosa (Dicks.) Dum.	CF		
Lophozia sp.	CF,SU	FB	
Marsupella emarginata (Ehrh.)Dum.		SS	
Mnium hornum Hedw.	SU	SS	
Mnium sp.	SU	SS	
Mylia anomala (Hook.)S.Gray		SH,FB,WH,SL,ML,OF	
Orthotrichum sp.	JW,SU		
Odontoschisma denudatum (Nees ex Marl.) Dum.	JW	LG,SH	
Odontoschisma sp.		SF	
Pallavicinia lyellii (Hook.)Carruth.		SS	
Pellia epiphylla (L.) Corda.		SS	
Plagiothecium cavifolium (Brid.) Iwats.	JW,SU,BB	SS	
Platygerium repens (Brid.)B.S.G.	SU	SS	
Pleurozium scherberi (Brid.)Mitt.	JW,MF,CF,SU,DE,BB,AL	FB,SF,SS	
Pogonatum pensylvanicum (Hedw.)P.Beauv.	ES,DE		
Pogonatum sp.	BB,JW,AL		
Pohlia nutans (Hedw.)Lindb.	DE		
P. wahlenbergii (Web & Mohr.) Andrews	DE		
Polytrichum commune Hedw.	SU,MF,BB,CF,JW,DE,AL,ES	SS	
P. juniperinum Hedw.	JW,SU,MF,CF,AL,ES,DE		RS
P. piliferum Hedw.	SU,AL,BB,JW,DE	FB	
P. strictum Brid.	JW,SU,CF,AL	ST,SS,FF,OF,FB,SF,SH,WH,SL	
Pottiaceae	DE		
Ptilidium ciliare (L.)Hampe	JW,AL,SU,DE,BB,CF,ES	SS,FB	RS
P. pulcherimum (G.Web.) Hampe	JW,CF	SF	
Racomitrium sp.		SS	
Radula complanata (L.)Dum.		LG	

COREA HEATH SPECIES LIST	TERRESTRIAL	PALUSTRINE	RIVERINE
Rhytidiadephus triquetrus (Hedw.)Warnst.	SU	SS	
Riccardia latifrons Lindb.		SH	
Scapania nemorosa (L.)Dum.	SU	SS	
Scapania sp.	SU	SS	
Solenostoma crenulatum Mitt.	DE		
Sphagnum angermanicum Melin.		SS,FF,WH,SH,SL,LG	
S. capillifolium (Ehrh.)Hedw.	JW,SU,CF,AL	SS,OF,FF,SF,SH,LG	RS
S. compactum de Cand. ex Lamarck & de Cand.	AL		
S. cuspidatum Ehrh. ex Hoffm.		MB,SH,OF,WH,SL,FB	
S. fimbriatum Wils. ex Wils. & J.D. Hooker		SS,SH	
S. flavicomans (Cardot)Warnst.	ES	FB,WH,ML,LG,SS,OF,SH,SL, MB,SF	RS
S. fuscum (Schimp.)Kling.		FB,WH,SH,OF,SL,ML	
S. girgensohnii Russ.	SU,CF	SS	RS
S. imbricatum Horns. ex Russ.	SU	WH,SH,FB,OF	
S. magellanicum Brid.	CF,SU,ES	SS,WH,SF,SL,ML,OF,FB,SH, FF,ST,LG	RS
S. quinquefarium (Lindb. ex Braith.)Warnst.		LG	
S. palustre L.	SU	SS,LG,SF	RS
S. papillosum Lindb.	ES,JW,AL	OF,FB,SH,MB,ML,FF,ST.WH	
S. pulchrum (Lindb. ex Braith.)Warnst.	ES,JW,AL	SL,ML,LG,SH,WH,FB,SS,OF, MB,FF,SF,ST	
S. pylasii Brid.	AL,JW	MB,OF,FF	
S. recurvum, agg.	JW,SU,CF	LG,SS,FB,FF,SF,ST.SH,SL	
S. rubellum Wils.	SU,ES	WH,ML,ST,LG,SS,SH,SL, FB,MB,OF,FF	
S. russowii Warnst.	SU	ST,SS	
S. strictum Sull.	JW,AL		
S. tenellum (Brid.)Borg.	JW,AL,SU	FF,ST,FB,MB,SH,SL,FF, WH,ML	
S. torreyanum Sull.		ML,SH,SL	
Section Sphagnum	CF,SU	SS,FB,SF,SH	
Section acutifolia	CF	ST,SH	
Sphagnum sp.		SH,SL	
Splachnum pensylvanicum	ES	ST	
Tetraphis geniculata Girg. ex Milde	JW	LG	
T. pellucida Hedw.	SU,MF,CF	SS,FB,SF	RS
Thuidium delicatulaum (Hedw.)B.S.G.	MF,CF,SU	SS	
Ulota coarctata (P.Beauv.) Hamm.	MF	LG	
U. crispa (Hedw.) Brid.	MF,SU	SS,LG	
U. hutchinsiae (Sm.) Hamm.	SU	SS	
unid moss on tree	DE		
unid on tree	MF		
unid flat moss	CF		
unid liverwort	CF,DE,ES	SF,LG,SH	
unid thallose liverwort		SH	

COREA HEATH SPECIES LIST	TERRESTRIAL	PALUSTRINE	RIVERINE
unid mat moss	AL,JW		
unid moss w/ insert capsules	DE		

TABLE 6.2: Dominant or frequently occurring bryophyte species at Corea Heath and vicinity by numbers of communities in general habitat types.

	Terrestrial	Palustrine	Riverine
Aulacomnium palustre	4	8	
Cephalozia sp.	1	7	
Cladopodiella fluitans		7	
Dicranum flagellare	6		
D. fuscescens	6	1	1
D. ontariense	5	2	1
D. scoparium	6	4	1
D. undulatum	4	6	
Hypnum imponens	7	6	1
Kurzia setacea		7	
Leucobryum albidum	5	1	
Mylia anomala		6	
Pleurozium scherberi	7	3	
Polytrichum commune	8	1	
P. juniperinum	7		
P. piliferum	5	1	
P. strictum	4	9	
Ptilidium ciliare	7	2	1
Sphagnum capillifolium	4	6	1
S. cuspidatum		6	
S. flavicomans	1	10	1
S. fuscum		6	
S. magellanicum	3	11	1
S. papillosum	3	8	
S.pulchrum	3	12	
S. recurvum	3	8	
S. rubellum	2	11	
S. tenellum	3	9	

Results: Schoodic Point

At Schoodic Point 8 transects were searched for bryophytes, covering 13 cover types (5 terrestrial, 7 palustrine, 1 riverine; see Figure 6.2). Of these 1 was a combination of 2 types, resulting in 13 individual cover types. Transects 1-3 (Figure 6.2), established along environmental gradients, were used to establish 1x1m plots which resulted in sampling of 11 cover types, 2 of which had modifiers. Seventeen separate plots were completed in addition to the survey of each cover type for all species present. Additional sampling along transects 4-8 yielded two more cover types, one of which had a modifier.

The total number of species found within the Schoodic Point study area numbered 131, of which 81 were true mosses, 27 were liverworts, 1 was a granite mosses, and 22 were sphagnum (Table 6.3). Of these species the vast majority (107) occurred in terrestrial communities, with 65 found at upland sites only. Forty-two species were found in palustrine communities, with 7 in wetlands only. Of the 29 riverine species only 10 were found in stream sites exclusively. Twenty-seven species shared terrestrial and palustrine habitats, 11 shared terrestrial and riverine sites, only 2 shared palustrine and riverine sites, and 6 species inhabited all three habitat types (Table 6.3). As was the case with Corea Heath, approximately 25 species remain to be verified or identified, if current bryophyte taxonomy and samples material permit. Of these, 21 have been identified to genus or section within a genus.

Of the dominant/common species (Table 6.4), *Aulacomnium androgynum* is noteworthy since it is much less common elsewhere. The combination of oceanic exposure, predominantly terrestrial communities, and organic soils apparently created ideal conditions for this species. Species listed as dominant are primarily commonly occurring rather than abundant at this site. The cover types with the highest bryophyte cover would be peatland areas (see methods above) and maritime spruce-fir forest (CF/m).

Within the Schoodic Point study area, the most diverse cover type was Acidic Cliff along transect 7. The most unique cover type in terms of bryophyte species present was the Open Fens along transect 4. *Isothecium eumyosuroides* was found several times in the Schoodic Point study area, usually on rocks in coniferous forests.

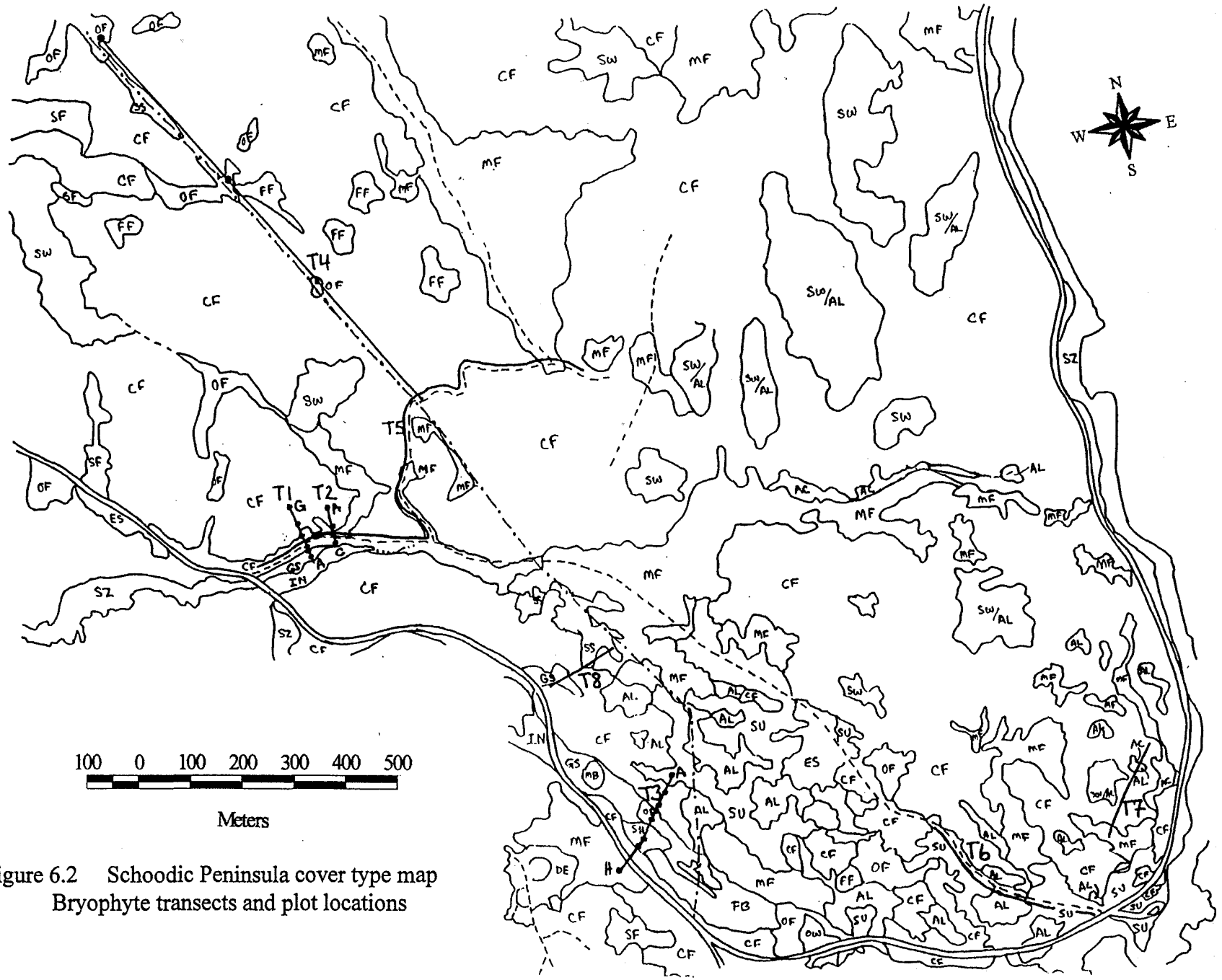


Figure 6.2 Schoodic Peninsula cover type map
Bryophyte transects and plot locations

Table 6.3. Bryophyte species list for Acadia National Park lands on Schoodic Point, and cover types where found. (See Methods for cover-type codes).

SCHOODIC POINT SPECIES LIST	TERRESTRIAL	PALUSTRINE	RIVERINE
Anastrophyllum michauxii (Web) Buch & Evans	DE,CF		
Andraea rupestris Hedw.	AC		
Anomodon sp.	CF		
Atrichum undulatum (Hedw.) P. Beauv.	DE,CF		
Atrichum sp.	SU	SS	
Aulacomium androgynum (Hedw.) Schwaeger	DE,CF,AC,SU	SF	
A. palustre (Hedw.) Schwaeger	SU,DE	SH,GS,SF	RS
Bazzania tricrenata (Wahl.) Lindb.	AC	SF	
B. trilobata (L.) S. Gray	CF,AC,DE,SU		
Brotherella recurvans (Michx.) Fleisch.	CF		
Bryum pseudotriquetrum (Hedw.) Gaernt.	AL		
Bryum sp.	AL,GS,SU		
Callicladium haldanianum (Grev.) Crum	SU,CF,DE	SS	
Callicladium/Platygerium		SS	
Calliergon stramineum (Brid.) Kindb.	GS		
Calypogeja sp.	AC,CF,DE,SU		RS
Campylium sp.	AC		
Cephalozia sp.		SF,SH,ST	RS
Cladopodiella fluitans (Nees) Joerg	CF		
Dicranella heteromalla (Hedw.) Schimp	DE,CF,SU		RS
Dicranum condensatum Hedw.	CF,AL		
D. flagellare Hedw.	CF,AC,DE		RS
D. fuscescens Turn.	DE,CF,AC	SF	
D. majus Sm.			RS
D. montanum Hedw.	CF,AC		
D. ontariense Peters.	DE,CF,AC,SU	SF	
D. polysetum Sw.	CF		
D. scoparium Hedw.	SU,CF,AC,DE		
D. spurium Hedw.	CF,DE,AL		
D. undulatum Brid.			
Dicranum sp.	AL,CF,AC,SU		
Diplophyllum albicans (L.) Dum.	CF		
D. apiculatum (Evans) Steph.	CF		
Diplophyllum sp.	AC		
Ditrichum/Dicranum	SU		
Ditrichum lineare (Sw.) Lindb.	CF,DE		
D. pusillum (Hedw.) Hampe	CF,DE		
Drepanocladus uncinatus (Hedw.) Warnst.	DE,CF		
Frullania asagrayana Mont.	CF,SU		
F. eboracensis Gott.	AC		
Grimmia sp.	CF,DE		RS
Gymnocolea inflata (Huds.) Dum.	DE,CF		
Herzogiella/Chrysophyllum	DE,CF		

SCHOODIC POINT SPECIES LIST	TERRESTRIAL	PALUSTRINE	RIVERINE
Hylocomium splendens (Hedw.) B.S.G.	CF,AC	ST	
Hypnum cupressiforme Hedw.	CF	SF	
H. cupressiforme var. filiforme Brid.	SU,CF,AC,DE	SF	
H. fertile Sendtn.	DE,CF		
H. imponens Hedw.	DE,CF,AC,SU	ST	
H. lindbergii Mitt.	DE,CF		
H. pallescens (Hedw.) P.Beauv.			
Hypnum sp.	SU		
Isoptegeryium elegans (Brid.) Lindb.	DE,CF		
Isothecium eumyosuroides Brid.	AC,CF,DE	SF	
Jamesoniella autumnalis (D.C.) Steph.	CF,SU,AC	SF	
Kurzia setacea (Web.) Grolle.	AC		
Lepidozia reptans (L.) Dum.	CF,AC,DE	SF	
Leucobryum albidum (Brid. ex P.Beauv.)Lindb.	SU,CF		
L. glaucum (Hedw.) Angstr. ex Fries.	SU,CF,AC,DE		RS
Leucobryum sp.	AL		
Lophozia attenuata	DE,CF		
L. heterocolpos (Thed.)Howe	DE,CF		
L. bicrenata (Hoffm.) Dum.	DE,CF		
L. ventricosa (Dicks.) Dum.	AC		
Marsupella emarginata (Ehrh.) Dum.			RS
M. sphacelata (Gieseke) Dum.			RS
Mnium hornum Hedw.	SU,CF,AC,DE	SF,ST	RS
Mnium sp.	AC		RS
Mylia anomala (Hook) S. Gray		SH	
Neckera pennata Hedw.	CF		
Nowellia curvifolia (Dicks.) Mitt.	CF,AC		
Oncophorus wahlenbergii Brid.	CF,DE	SF	RS
Odontoschisma denudatum (Nees. ex Marl.) Dum.	CF,DE	ST	
Paraleucobryum longifolium (Lindb. ex Limpr.) Loeske			RS
Plagiothecium calvifolium (Brid.) Iwats.	CF,AC	SF	
Platygerium repens (Brid.) B.S.G.		SF	
Pleurozium scherberi (Brid.) Mitt.	SU,CF,AC,DE	SH,ST	
Pogonatum pensylvanicum (Hedw.) P.Beauv.	DE,CF		
Pogonatum sp.	DE,CF		
P. bulbifera/rothii	CF,DE		
Pohlia nutans (Hedw.) Lindb.	AC,SU	SF	
Polytrichum commune Hedw.	CF,DE,AC	GS	RS
P. juniperinum Hedw.	DE,SU,AC,CF		
P. piliferum Hedw.	AL		
P. strictum Brid.	CF		
Ptilidium ciliare (L.) Hampe	AC,CF		
P. pulcherimum (G.Web.) Hampe		ST	
Racomitrium fasciculare (Hedw.) Brid.			RS
R. heterostichum (Hedw.) Brid.	SU		

SCHOODIC POINT SPECIES LIST	TERRESTRIAL	PALUSTRINE	RIVERINE
Racomitrium sp.	DE,CF		
Riccardia latifrons Lindb.	CF,DE		RS
Scapania nemorosa (L.) Dum.	CF		RS
S. undulata/paludosa			RS
Scapania sp.	SU		
Solenostoma gracillimum (Smith) Schust.	DE,CF		
Sphagnum affine Ren. & Card.			RS
Sphagnum capillifolium (Ehrh.) Hedw.	CF,SU,DE		
S. compactum deCand. ex Lamarck & deCand.			RS
S. fallax		OF	
S. fimbriatum Wils. ex Wils. & J.Hook.	DE,CF	SS,GS,PL,ST	
S. flavicomans (Cardot) Warnst.	CF,DE	PL,SH,OF	
S. fuscum (Schimp.)Kling.	CF,DE	SH	
S. girgensohnii Russ.	AC,DE,CF		RS
S. lescurii Sull.	DE,CF		
S. magellanicum Brid.	AC,DE,CF	GS,SH,ST,SS,SF,PL,OF	RS
S. majus/torreyanum	CF,DE	OF	
S. palustre L.	DE,CF		RS
S. papillosum Lindb.	CF,DE	GS,OF	
S. papillosum var.sublaeve Warnst.ex Roll.	DE,CF		
S. pulcrum (Lindb. ex Braith.)Warnst.	CF,DE	GS	
S. pylasii Brid.	CF,DE		
S. recurvum, agg	DE,CF	OF,SS,PL,SH,ST	RS
S. rubellum Wils.	CF,DE	GS,SH	
S. russowii Warnst.	CF,DE,AC	OF	
S. strictum/squarrosum	CF		
S. strictum Sull.	DE,CF		
S. subsecundum Nees ex Storm		GS	
S. tenellum (brid.)Borg.	CF,DE		
Section sphagnum	DE,CF	OF	
Sphagnum sp.		SS	RS
Tetraphis pellucida Hedw.	CF,AC	SF	
Thuidium delicatulum (Hedw.)B.S.G.	DE,CF		RS
Ulota crispa (Hedw.)Brid.	SU,AC		
U. hutchinsiae (Sm.) Hamm.	AC,SU		
Ulota sp.	SU		
Unid, twisted seta	CF		
unid		SS	
liverwort 1			RS
unid moss			RS

TABLE 6.4: Dominant or frequently occurring bryophyte species at Schoodic Point by number of communities in general habitat types.

	Terrestrial	Palustrine	Riverine
Aulacomnium androgynum	4	1	
A. palustre	2	3	1
Bazzania trilobata	4		
Dicranum flagellare	3		1
D. fuscescens	3	1	
D. ontariense	4	1	
D. scoparium	4		
Hypnum cupressiforme var. *filiforme*	4	1	
H. imponens	4	1	
Leucobryum glaucum	4		1
Mnium hornum	4	2	1
Pleurozium scherberi	4	2	
Polytrichum commune	3	1	1
P. juniperinum	4		
Sphagnum fimbriatum	2	4	
S. flavicomans	2	3	
S. magellanicum	3	7	1
S. recurvum, agg.	2	5	1

Results: Big Moose Island

Within the Navy and Park lands that make up Big Moose Island, 10 areas were surveyed (Figure 6.3). Within the 10 areas, 11 cover types were sampled, of which 1 was a combination type and 4 were disturbed or maritime, yielding 8 individual cover types (6 terrestrial, 2 wetland). Due to the importance of disturbance on the bryophyte communities at this site, types with modifiers were included on the compiled list (Table 6.5). Of the identified cover types, all were sampled.

Table 6.5. Bryophyte species list for Big Moose Island and cover types where each was found. List includes surveys of both both US Navy and Acadia National Park lands.

BIG MOOSE ISLAND, PARK AND NAVY LANDS		
SPECIES LIST	TERRESTRIAL	PALUSTRINE
Amblystegium sp.	CF/d	
Andraea rupestris Hedw.	AL/d,CF/d	
Atrichum undulatum (Brid.) P.Beauv.	CF/d	
Atrichum sp.	DE,AL/d	
Aulacomnium androgynum (Hedw.) Schwaeg.	AL,AL/d,SZ	
A. palustre (Hedw.) Schwaeg.	CF/d,CF,DE,JW/AL,CF/m,SZ	
Bazzania denudata (Torrey ex Gott et al) Trev.	CF/d,AL	

Table 6.5. Species List for Big Moose Island (continued)		
SPECIES	TERRESTRIAL	PALUSTRINE
B. tricrenata (Wahl.) Lindb.	AL/d	
B. trilobata (L.)S.Gray	CF/d,AL/d,CF,MF,CF/m	CS
Bazzania sp.	CF/m	
Bryum psuedotriquetrum (Hedw.) Gaertn.	CF	CS
Bryum spp.	CF/d,DE,MF,SZ,JW/AL	
Callicladium haldanianum (Grev.)Crum	AL/d,MF	
Calypogeja sp.		CS
Cephalozia spp.	CF,JW/AL	CS
Ceratodon purpureus (Hedw.)Brid.	CF/d,DE,JW/AL	
Cladopodiella fluitans (Nees) Joerg	JW/AL	
Climacium dendroides (Hedw.)Web & Mohr.	DE	
Dicranella cerviculata (Hedw.)Schimp.	CF/d,	
D. heteromalla (Hedw.)Schimp.	MF,CF/m	CS
Dicranum bonjeanii De Not. ex Lisa	DE,JW/AL	
D. flagellare Hedw.	CF/d,DE,CF,JW/AL,CF/m,SZ	
D. fuscescens Turn.	CF/d,JW/AL	CS
D. majus Sm.	CF/d,AL/d,CF,MF,CF/m	CS
D. montanum Hedw.	CF/d	
D. ontariense Peters.	CF/d,AL/d,MF	
D. polysetum Sw.	CF/d	
D. scoparium Hedw.	CF/d,AL/d,CF,MF,CF/m	CS
D. spurium Hedw.	JW/AL	
D. undulatum Brid.	CF	
Dicranum spp.	DE,AL/d,CF/d,JW/AL,CF/m	
Diphyscium foliosum (Hedw.) Mohr.	JW/AL	
Ditrichum lineare (Sw.) Lindb.	CF/d,DE	
Drepanocladus spp.	CF/d,JW/AL,SZ,CF/m	
Gynocolea inflata (Huds.) Dum.	CF/d,JW/AL	
Herzogiella striatella (Brid.)Iwats.	AL/d,AL	
Hylocomnium splendens (Hedw.)B.S.G.	CF/d,MF	
Hypnum cupressiforme Hedw.	AL/d	
H. imponens Hedw.	CF/d,AL/d,CF,CF/m	
H. lindbergii Mitt.	CF/m	
H. pallescens (Hedw.)P.Beauv.		CS
Hypnum spp.	DE,AL/d,CF,MF,JW/AL,CF/m	
Isothecium eumyosuroides Brid.	AL	
Jamesoniella autumnalis (DC)Steph.	CF/d,AL/d,JW/AL	
Kurzia setacea (Web.)Grolle	CF/d,AL/d	
Lepidozia reptans (L.)Dum.	CF/d,MF,CF/m	CS
Leucobryum albidum (Brid. ex P.Beauv.)Lindb.	JW/AL	
L. glaucum (Hedw.)Angstr. ex Fries.	CF/d,AL/d,CF,MF,JW/AL,CF/m	
Lophozia ventricosa (Dicks.)Dum	CF/d,AL/d,CF/m,AL	CS
Lophozia sp.	MF,AL	CS

Table 6.5: Species List for Big Moose Island (continued)		
SPECIES	TERRESTRIAL	PALUSTRINE
Mnium hornum Hedw.	CF/d,DE,CF,CF/m,AL	CS
Mnium spp.	DE,AL/d,SZ	CS
Odontschima denudatum (Nees ex Marl)Dum.	CF/d,CF/m	
O. prostraum (Sw.) Trev. ,	JW/AL	
Pellia epiphylla (L.)Corda		CS
Pleurozium scherberi (Brid.) Mitt.	CF/d,DE,AL/d,CF/m	
Pogonatum urnigerum (Hedw.)P.Beauv.	CF/d	
Pohlia nutans (Hedw.)Lindb.	CF/d,DE	
P. wahlenbergii (Web & Mohr.) Andrews	DE	
Polytrichum commune Hedw.	CF/d,AL/d,MF	
P. juniperinum Hedw.	CF/d,AL/d,DE,JW/AL,AL	
P. piliferum Hedw.	DE	
P. strictum Brid.	CF/d,CF,	CS
Polytrichum sp.	AL/d	
Ptilidium ciliare (L.)Hampe	CF/d,DE,AL/d,MF,CF/m,AL	CS
Racomitrium sp.	AL/d,JW/AL	
Rhytidiadelphis triquetrus (Hedw.)Warnst.	MF	CS
Riccardia latifrons Lindb.		CS
Scapania nemorosa (L.)Dum.	CF/d,AL/d,	CS
Sphagnum capillifolium (Ehrh.) Hedw.	CF/d,CF,CF/m	CS
S. cuspidatum Ehrh. ex Hoffm.	CF/d	
S. fimbriatum Wils. ex Wils. & J.D. Hooker	SZ,CF/m	OF
S. flavicomans (Cardot)Warnst.	CF,JW/AL	CS
S. girgensohnii Russ.	CF/d,AL/d,CF,	CS
S. imbricatum Horns. ex Russ.	CF/d,CF	
S. magellanicum Brid.	CF/d,CF	CS
S. pulchrum (Lindb. ex Braith.)Warnst.	JW/AL	
S. pylasii Brid.	JW/AL	
S. recurvum, agg.	CF/d,CF	CS,OF
S. russowii Warnst.	CF/d,CF,JW/AL	
S. strictum Sull.	CF/d	
S. tenellum (Brid.)Borg.	JW/AL	
Sphagnum spp.	CF/d,JW/AL	CS
Section Sphagnum	CF/d,CF,CF/m	
Thuidium delicatulum (Hedw.)B.S.G.		CS
Tetraphis geniculata Girge. ex Milde.	CF/d	
T. pellucida Hedw.	CF/d,JW/AL	CS
Unid. moss(es)	DE,SZ,JW/AL	CS
Unid liverwort(s)	DE,JW/AL	

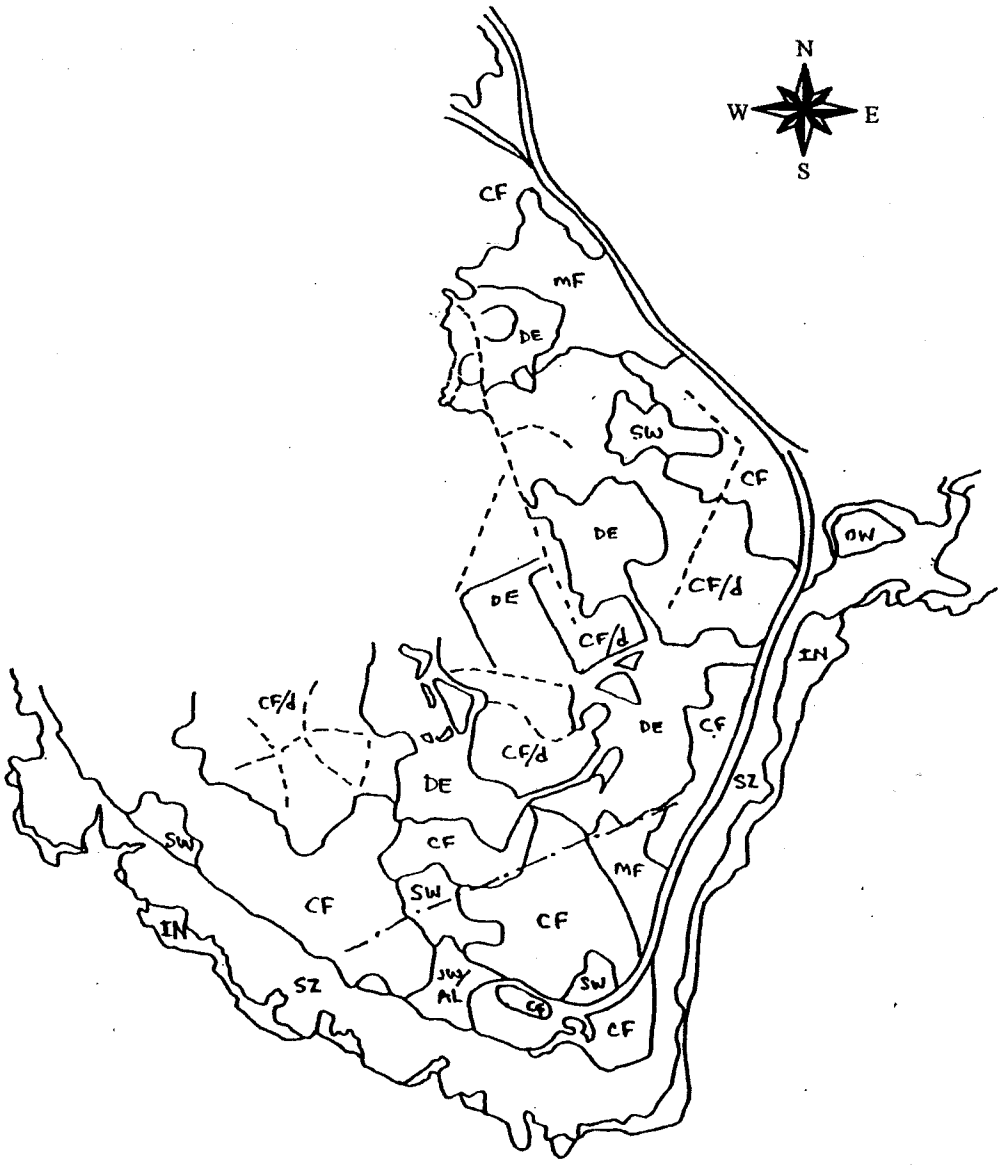
The total number of species identified for Big Moose Island was 89 (Table 6.5), with 53 true mosses, 20 liverworts, 15 sphagnum, and 1 granite moss. The lower numbers for this study area

in part result from a less intensive survey, but are also due to the lower diversity of cover types. Of the species identified, 84 occurred in terrestrial types, with 59 found in terrestrial only. Thirty palustrine species were found, with only 4 restricted to wetlands exclusively. Species that shared both terrestrial and palustrine habitats numbered 25. No riverine cover types were surveyed on the island. Of the 89 species collected, 17 require further study for species identification or verification, if possible. Fifteen of these have been identified to genus or section within a genus.

The majority of the upland coniferous forest had been disturbed either by hiking trails at the very least and construction and roads at the most extreme (see Figure 6.3 below). Areas with hiking trails but no other evidence of disturbance were considered to be undisturbed. Also, large areas of the island had been subjected to filling and other disturbance for building and road construction. Since many bryophytes are pioneer species, this habitat supported the most unique flora for the island. The high potential for continuing disturbance precludes preservation of these areas. *Isothecium eumyosuroides*, found growing on a disturbed acidic cliff, was the most important find for this study area. The Jack Pine Woodland/Acidic Ledge associated with the Park land property was similar in species composition to areas surveyed at Corea Heath (see above), including small patches of *Sphagnum pylasii*. Also distinctive was the frequency of *Dicranum majus*, found in 6 different cover types (Table 6.6). All other species found commonly on Big Moose Island are typical dominants for the east coastal Maine region.

TABLE 6.6: Dominant or frequently occurring bryophyte species at Big Moose Island by number of communities in general habitat types.

	Terrestrial	Palustrine
Aulacomnium palustre	6	
Bazzania trilobata	5	1
Bryum spp.	5	
Dicranum flagellare	6	
D. majus	5	1
D. scoparium	5	1
Drepanocladus sp.	4	
Hypnum imponens	4	
Hypnum spp.	6	
Leucobryum glaucum	6	
Lophozia ventricosa	4	1
Mnium hornum	5	1
Pleurozium scherberi	4	
Polytrichum juniperinum	5	
Ptilidium ciliare	6	1



100 0 100 200 300 400

Meters

Figure 6.3 Big Moose Island cover type map
Bryophyte transects and plot locations

CONCLUSIONS and RECOMMENDATIONS

Although many countries have developed a rare bryophyte list and have established protection guidelines, the United States has not made the necessary surveys and **no comprehensive list of rare or endangered bryophytes is available at this time**. Dr. Bruce Allen of the Missouri Botanical Garden has been working on bryophyte flora of Maine and has developed a list of species of special interest (Gawler 1996). Likewise, work completed by Dr. Norton Miller of the New York State Museum at Albany has identified many rare and important species (Gawler 1996). Work of other bryologists working in the northeast region have helped to identify bryophyte communities that should be considered for some measure of conservation. This survey has produced a list of species found at sites with oceanic exposure and at a coastal plateau peatland. Consequently, identification of important areas and records for less common species can have significant importance in future comprehensive studies as well as land use planning. ANP and US Navy resource managers should cooperate with these bryophyte authorities and any state or federal programs to identify and preserve sites with rare bryophyte species.

The most diverse cover types were acidic cliffs at Schoodic Point and jack pine woodlands at Corea Heath and Big Moose Island. The most unique areas were the open fen at Corea Heath and jack pine woodlands. The most interesting species were *Splachnum pensylvanicum*, *Isothecium eumyosuroides*, *Dicranum majus*, the abundance of *Sphagnum pulchrum*, the association of *S. pulchrum* and *S. flavicomans*, the abundance of *S. pylasii*, the frequency of *Aulacomnium androgynum*, *S. angermanicum*, *Solenostoma* spp., and *Diplophyllum albicans*. In general, the coastal plateau peatland, Corea Heath, is a rare ecosystem in the region and elsewhere The bryophytes associated with the ombrotrophic portion of it are not unusual, but those found along the more minerotrophic edges of the peatland are of interest.

Protection of jack pine woodlands and open fens at Corea Heath would help to preserve *Sphagnum pylasii* found there in shallow depressions. Protection of open fens at Corea Heath would preserve *Sphagnum pulchrum* lawns and *S. pulchrum/S. flavicomans* associations. Also, likely associates in these fens are *Sphagnum angermanicum* and *Splachnum pensylvanicum* around the edges, as well as the state-listed vascular species, *Calamagrostis pickeringii* (see Green 1987). Preserving areas ideal for *Isothecium eumyosuroides, Dicranum majus, Aulacomium androgynum* and *Diplophyllum albicans* is more difficult, since these occur in coniferous forests which encompass a large land mass. The occurrence of *Solenostoma gracillima* and *S. crenulatum* at highly disturbed sites precludes protection efforts, and there is no certainty that the species warrant it.

CHAPTER 7: ADDITIONS TO VASCULAR PLANT LIST OF THE SCHOODIC REGION, COASTAL MAINE

by Marcia Spencer Famous and Melissa Perera

Mittelhauser et al. (1995) compiled a list of 335 vascular plant species recorded in the 1994 surveys or previously. During the 1996 bryophyte vegetation surveys of cover types at each study areas, vascular plant species encountered at each site were compared to the species list in the 1995 report (Appendix 8 in Mittelhauser et al, 1995). Those not documented previously for that site were noted. On Big Moose Island, Acadia National Park and Navy lands were differentiated in 1995, and that distinction is followed here. The 62 new site records are presented in Table 7.1. The majority of these plant species were located in habitats listed as "other," which included primarily roadside and other disturbed sites. Overall, 8 new species were found at Corea Heath, 9 at Schoodic Point, 21 on the Big Moose Island Navy lands, and 32 on Big Moose Island ANPark lands. At Corea Heath one was a wetland species and 7 were in other habitat. At Schoodic Point 4 were wetland species while 5 were in other habitats. On Big Moose Navy lands 21 were in other habitat, with 1 of the 21 also in a wetland. On Big Moose ANP lands 27 were in other habitat, 4 were shoreline species and 1 was found in a wetland as well as along the shoreline. Among these site records are 8 species not previously recorded at any of the sites, raising the Schoodic regional vascular plant total to 343 species.

Occurrence and Management of Non-native Species

It is noteworthy that 17 of the 62 species listed here were introduced to North America from other continents, including 2 of the 8 new species for the Schoodic Region. All these non-native species were found in "other" habitat types, primarily roadsides and sites with human disturbance. This highlights the degree of penetration by introduced weeds along corridors of human activity into this otherwise largely native flora. Revegetation of disturbed sites with native species would assist in limiting further spread of non-native species. Mittelhauser et al (1995; Appendix 10) categorized non-native species by their invasive potential. Species characterized as having moderate to high invasive potential should be monitored (e.g. *Rosa rugosa*), especially those that invade natural habitats, such as shorelines and wetlands. Purple loosestrife (*Lythrum salicaria*), an aggressive invader in eastern US wetlands, has not yet been found on ANP or Navy lands. Periodic surveys should be planned to detect and monitor any spread of this species in the region.

Rare and Endangered Species

Of the vascular plants included on this list, only one, *Calamagrostis pickeringii* Gray, was **state listed as endangered** (Greene 1987; Maine Natural Heritage Program 1994b). Although not new within all study areas, the site (area 6, Figure 6.3) on Big Moose Island appears to be an addition to the previously known sites for this species. Found abundantly at Corea Heath, it has also been located in a small fen on the road connecting Prospect Harbor and Winter Harbor, therefore it is not surprising for it to occur on Big Moose Island as well. **Ten additional state-listed plant species** in the study region are noted in Mittelhauser et al (1995: Table 10); none were found at new localities during 1996.

Table 7.1: Additions to the vascular plant floras of the three Schoodic region study sites. Habitats where each was found are noted, using the following habitat classification: S=shoreline, W=wetland, Wd=disturbed wetland, 0 = other habitats, primarily roadsides and similar disturbed habitats. Other codes: * = new species for Schoodic Region vascular plant list, # = new variety for Schoodic Region list, I= introduced species.

Additions to the Vascular Plant List for the Schoodic Region, Maine					
Species	Status	Corea Heath, Navy	Schoodic Point, ANP	Big Moose, Navy	Big Moose, ANP
Achillea millefolium L.	I				O
Alnus rugosa (Du Roi) Spreng.				O	O
Ambrosia artemisifolia L.				O	
Aster lateriflorus (L.) Britt.				O	
Aster novi-belgii L.				O	
Aster radula Ait.					S
Betula populifolia Marsh.				O	
Bromus ciliatus L. *				O	
Bulbostylus capillaris (L.) C.B. Clark		O			
Calamagrostis pickeringii Gray					S,W
Carex nigra (L.) Reichard				O	
Carex scoparia Schkuhr				O	O
Carex trisperma Dew.				O	
Carum carvi L.	I				O
Clintonia borealis (Ait.) Raf.					O
Convolvulus sepium L.					O
Diervilla lonicera Mill.				O	
Dryopteris spinulosa (O.F. Muell) Watt				O	O
Erechtites hieracifolia (L.) Raf. *		O			
Erigeron strigosus Muhl.			O		
Eriophorum virginicum L.			W		
Eupatorium perfoliatum L.			O		

Additions to the Vascular Plant List for the Schoodic Region, Maine					
Species	Status	Corea Heath	Schoodic Pt., ANP	Big Moose I. Navy	Big Moose I., ANP
Euphrasia americana Wettst.					O
Galinsoga ciliata (Raf.) Blake *	I			O	
Gaultheria procumbens L.					O
Glyceria canadensis (Michx.) Trin.			WQ	O, W	
Gnaphalium uliginosum L.					O
Habenaria clavellata (Michx.) Spreng.			Wd		
Hieracium aurantiacum L.	I				O
Juncus gerardi Loisel.					W
Juniperus communis L. var. *depressa* Pursh				O	
Leontodon autumnalis L.	I				O
Linaria canadensis (L.) Dumont					O
Lysimachia terrestris (L.) BSP		O			
Nuphar variegatum Englm. *		W			
Phleum pratense L.	I				O
Plantago major L.	I				O
Plantago major f. *intermedia* (Gilb.) Pilger #	I				O
Plantago oliganthos R. & S.					S
Pyrus americana (Marsh.) DC		O		O	
Ranunculus cymbalaria Pursh. *					S
Rhinanthus crista-galli L.					O
Rosa nitida Willd.			Wd		
Rosa rugosa Thunb.	I				O
Rubus allegheniensis Porter		O			O
Sagina procumbens L.				O	
Salix discolor Muhl.					O
Scirpus microcarpus (*S. rubrotinctus* Fern.) *				O	

Additions to the Vascular Plant List for the Schoodic Region, Maine					
Species		Corea Heath	Schoodic Pt., ANP	Big Moose I. Navy	Big Moose I., ANP
Senecio vulgaris L.	I				O
Solidago canadensis L.		O			
Solidago nemoralis Ait. *		O			
Sonchus asper (L.) Hill	I				O
Spiraea tomentosa L.				O	
Stellaria graminea L.	I		O		
Tragopogon pratensis L. *	I			O	
Trifolium arvense L.	I				O
Trifolium pratense L.	I				O
Trifolium repens L.	I				O
Vaccinium corymbosum L.				O	
Vaccinium vitis-idea L.				O	
Verbascum blattaria L.	I		O		
Vicia cracca L.	I		O		O

CHAPTER 8: GENERAL RECOMMENDATIONS FOR MANAGEMENT AND CONSERVATION

by William Glanz and Bruce Connery

Coupled with the results of the 1994 surveys (Mittelhauser et al. 1995), this study outlines the rich biological diversity of the US Navy and ANP lands on Schoodic and Corea peninsulas in coastal Maine. Each chapter makes specific recommendations for management and conservation of a component of this diversity; here we summarize general recommendations relevant to conservation and management.

Habitat Preservation

The biological diversity of the Schoodic region is related to its great variety of local habitats, some of them rare or unique within Maine. The raised coastal peatlands of Corea Heath are a unique resource, and include wetland plant communities and rare or unusual plant species (see chapters 6 and 7, and Mittelhauser et al. 1995) and animal species (see chapter 5). In spite of a long history of disturbance by humans, this site retains much of its biological diversity, and and the variety of ecological communities there needs to be preserved. In particular, the jack pine woodland and open fen cover types at Corea are noteworthy for their diverse and unique plant species, many near the edge of their geographic range. Wetland habitats elsewhere in the Schoodic region should also be conserved, especially as they provide critical resources for many species: breeding sites for amphibians, foraging sites for bats and wetland birds, and suitable habitat for rare plants. Certain wetlands may be extremely important (see bat, bird and bryophyte plant recommendations), and rare wetland types (enumerated by Calhoun et al. 1994) deserve further study and preservation efforts.

Long-Term Monitoring

To verify that the biological diversity of this region is being preserved, some form of monitoring through time will be needed. For some biological taxa (e.g. small terrestrial mammals, vascular plants, bryophytes), periodic surveys at 5- or 10-year intervals may be sufficient to monitor the persistence of local populations and identify potential threats. Because of annual variations in some taxa, such as small mammals or ephemeral plants, we recommend each monitoring effort span more than one year. Taxa that potentially are declining in numbers (migratory birds, amphibians) or threatened (rare wetland plants) will need more frequent monitoring. We recommend continued monitoring of migratory birds during both the breeding season and the fall migration, using the techniques employed here. Amphibians can be monitored through an expanding network of volunteers coordinated with Maine Department of Inland Fisheries and Wildlife. Rare plants will require frequent checks of existing populations at known sites, and specific suggestions for long-term monitoring of the rarest species are given in Mittlehauser et al (1995: pp 44-45). The spatial distribution and area of rare plant communities, such as the jack pine woodlands, should be monitored, to detect area losses that might warrant direct management actions to preserve them.

Management of and Responses to Human Disturbance

Use of ANP and Navy lands by visitors, park staff, and Navy personnel occasionally will require development and maintenance activities that could affect habitat conditions for important animal and plat species. Private development adjacent to these lands could have even greater impacts on species persistence in the region. Monitoring of animal and plant responses to such disturbance is essential, and disturbance of rare or local habitat types, especially open water and wetlands, should be avoided.

Cooperation with State and Federal Agencies

All inventory, monitoring, and conservation efforts must be planned in relation to federal and state statutes. Future amphibian monitoring should be coordinated with the statewide surveys being organized by Maine Department of Inland Fisheries and Wildlife. Likewise, information on mammal species of concern needs to be shared with MDIFW, and conservation efforts coordinated with them. Current bird population monitoring involves extensive cooperation between federal and state agencies, and individual volunteers. Coordination of such efforts through inter-agency programs such as Partners in Flight will be needed. When bryophytes are added to state and federal rare plant lists, conservation efforts will need to be coordinated with the appropriate state and federal agencies.

Coordination and Monitoring of Adjacent Land-Use Planning

Populations of plant and animal species on ANP and US Navy lands extend onto adjacent privately-owned lands. Species that are rare or patchily distributed (e.g. aquatic breeding sites for amphibians) are of particular concern, as successful sites on private lands may help maintain populations on ANP and Navy lands. Management and preservation of species on federal lands therefore requires coordination with land-use planning in these adjacent communities.

Support of Additional Research

Amphibians: In addition to continued monitoring in cooperation with MDIFW, closer study of the amphibian species present just north of the Schoodic region but not on the peninsulas would help identify critical habitats or resources that are rare in the study area, or suggest additional sites on ANP or Navy land to check for these species.

Mammals: As information on large and rare mammals is difficult to obtain in a short-term study, we recommend a greater effort to gather and collate observations of mammals by park personnel, researchers and visitors. Among smaller mammals, bats and moles deserve additional attention. The roosting and breeding habitat requirements of bats in and near the park should be assessed, and more information is needed on the rarer, solitary bat species. The population fluctuations of rodents in coastal Maine are dramatic, and the numbers of squirrels and chipmunks appear to respond to mast production by trees. Further study of this interaction would be welcome.

Birds: Among the numerous bird species breeding in and migrating through the Schoodic region are many species that may be declining. In addition to a general bird monitoring program, research that specifically targets declining species should be supported. In particular, the relationship between forest fragmentation and responses of bird populations should be studied.

Bryophytes and Vascular Plants: Studies of the viability of rare plant populations in the region are needed; measures of habitat requirements and reproductive success of these species could be combined with monitoring programs to construct flexible conservation strategies for such plants. Development of conservation priorities for bryophyte species should be encouraged, in cooperation with federal, state and nongovernmental organizations. Non-native species of plants will require periodic monitoring to ensure that they do not endanger or alter components of the native flora. Guidelines for soil disruption during construction and revegetation after disturbance should be established to limit further invasions by non-native plant species.

Public Educational Efforts

The success of biological conservation on federal lands depends heavily on support from the general public. Educational displays, field trips, and workshops help inform visitors and local citizens on conservation goals and ongoing studies, and such efforts arevery valuable. The NSGA-WH base should be commended for its support of such programs, and continuation of public educational activities is highly recommended.

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Appendix 1. Amphiban Sampling Location: Maps and UTM coordinates

A. UTM COORDINATES OF AMPHIBIAN DRIFT FENCES BY STUDY SITES, 1996:

The coordinates for END points were collected with a Trimble (Professional model) global position unit and are presented in the following format with the following GPS critical settings:
Datum : NAD-27 CONUS
Coordinate System : Universal Transverse Mercator [19T]
PDOP mask : set at 6 unless noted
SNR mask : set at 6 unless noted

Key to superscripts:

* GPS position was collected near the actual survey point location. Survey point location was calculated by recording angle and distance to actual survey point location with a staff compass and fiberglass tape and solving geometrically.
** SNR mask set at 4, PDOP mask set at 8

LOCATION	ROVERFILE	POINTS	EASTING (STD)	NORTHING (STD)
End Points of Amphibian Survey Points on Schoodic Peninsula				
DF1(E)	R052411c	114 pts**	574232.17	4911725.96
DF1(W)	R052411b	178 pts**	574224.44	4911712.14
DF2(E)	R052411d	338 pts**	574201.20	4911729.88
DF2(W)	R052411e	187 pts**	574191.99	4911715.97
DF3(N)	R062814a*	596 pts	575037 (2.43)	4910391 (2.36)
DF3(S)	R062814a*	596 pts	575051 (2.43)	4910386 (2.36)
DF4(N)	R062813a	186 pts	575157.12 (.66)	4910299.91 (2.25)
DF4(S)	R062813a*	186 pts	575143 (.66)	4910295 (2.25)
DF5(S)	R062811a	84 pts	574047.23 (2.50)	4913210.30 (1.60)
DF5(N)	R062811a*	84 pts	574020 (2.50)	4913222 (1.60)
AS1	R052410a	446 pts	573979.8	4912694
CS1	R052412d*	556 pts	575121.4	4910349
CS2	R071817a*	183 pts	576399.6 (.80)	4912356 (1.07)
CS3	R052410a*	446 pts	573995.5	4912583
CS4	D092712a*	180 pts	573884.1 (.57)	4913011 (.89)
CS5	R061901e*	183 pts	574961.7 (.53)	4910107 (.97)
End points of amphibian Survey Points on Big Moose Island				
DF1(W)	R062815a	266 pts	574571.06 (.98)	4909782.86 (.97)
DF1(E)	R062815a*	266 pts	574584 (.98)	4909790 (.97)
DF2(E)	R052413a	160 pts**	574600.25	4909628.73
DF2(W)	R052413b	166 pts**	574585.48	4909622.74
AS1	R062620a*	209 pts	574348.1 (.34)	4909818 (.53)

AS2	R082714b*	180 pts	574323.1 (1.19)	4909703 (.75)
CS1	R052413a*	160 pts**	574688.8	4909629

End Points of Amphibian Survey Points on Corea Heath

DF1(CEN)	R062808a	353 pts	580760.57 (.50)	4917578.18 (.50)
DF1(S)	R062808b	266 pts	580778.59 (.20)	4917571.33 (.34)
DF1(W)	R062809a	368 pts	580743.63 (.94)	4917569.59 (1.15)
DF2(N)	R062809b	240 pts	580106.58 (3.06)	4916547.67 (1.65)
DF2(S)	R062810a	43 pts	580114.56 (.95)	4916534.49 (1.05)
AS1	V100103c*	229 pts	579883.5 (.68)	4917053 (.96)
CS1	R062822a	253 pts	580913.86 (.68)	4917551.40 (.84)
CS2	V100103c*	229 pts	579904 (.68)	4916959 (.84)
CS3	V100100a*	188 pts	580443.9 (.22)	4916572 (.54)
CS4	R062821b	180 pts	580667.19 (.69)	4917225.34 (.62)

B. AMPHIBIAN SURVEY TRANSECT DESCRIPTIONS BY STUDY SITE, 1996:

SCHOODIC PENINSULA:

DF1 Drift fence is located in the west central wetland complex area of the peninsula to the east of the powerlines. Habitat is raised forested dry ledge between emergent bogs. Fence length totaled 14.9 meters with an azimuth of 39o true. Eight single deep pitfalls traps (no plastic funnels) were placed at roughly 5 meter intervals.

DF2 Drift fence is located in the west central wetland complex area of the peninsula to the east of the powerlines and to the west of DF1. Habitat is edge of emergent bog (many pools of open water of various sizes) with partial canopy cover. Fence length totaled 14.7 meters with an azimuth of 218o true. Eight single deep pitfall traps (no plastic funnels) were placed at roughly 5 meter intervals.

DF3 Drift fence is located south of the ranger cabin road and east of the powerlines. Habitat is forested cedar/black spruce bog with dense stocking of large trees and many small pools of open water adjacent to the fence. Fence length totaled 14.8 meters with an azimuth of 109o true. Eight double deep pitfall traps (with plastic funnels) were placed at roughly 5 meter intervals.

DF4 Drift fence is located south of ranger cabin road, east of the powerlines, and adjacent to (east side) of small pond. Habitat is disturbed area of dry alder upland adjacent to pond. Fence length totaled 14.7 meters with an azimuth of 252o true. Eight single deep pits (plastic funnels added on 4/16/96) were placed at roughly 5 meter intervals untill May 22 when the two northern-most pits were switched to double deep.

DF5 Drift fence is located south of Frazer estuary and east of the powerlines. Habitat is a forested tamarak bog with one small seasonal area of open water. Fence length totaled 30.1 meters with an azimuth of 294o true. Ten double deep pits (no plastic funnels) were placed at roughly 7 meter intervals.

AS1 Artificial shelters were located adjacent to the north end of the powerline pond. Habitat is a forested black spruce bog with no areas of open water. Shelters were placed along two parallel transects each 90 meters long with stations placed every 10 meters. One

shelter was placed at each station for a total of 20 shelters. Parallel transects were 10 meters apart with stations offset by 5 meters.

CS1 Call survey focus location is at a small pond south of ranger cabin road, east of the powerlines. During call surveys, observers would sneak close to but not in view of the north shore of the pond.

CS2 Call survey focus location is the last small pond to the north of the outbound road just before leaving the park. During call surveys, observers would park their vehicle on the left side of the outbound road with the pond full view and listen from the vehicle.

CS3 Call survey focus location is the small pond directly adjacent to (east side of) the powerlines. During call surveys, observers would sneak up to the northwestern side of the pond behind a small clump of trees/shrubs.

CS4 Call survey focus location is the semi-forested bog adjacent to (west side of) the powerlines. During call surveys, observers would sit in the middle of the powerline path just to the north of the bog.

CS5 Call survey focus location is the tidal pond on the east side of the loop road a few hundred meters before the turnoff to Big Moose Island. During call surveys, observers would sit in the small patch of trees between the tidal pond and the loop road.

Night Drive Leg 1

(Northwest Loop Road) (part on town roads and part on park lands): Start at the Acadia National Park turnoff off route 186. Leg follows paved "loop road", around Frazer Picnic Area loop, continues south and ends at the junction with the "dirt road to the ranger cabin". Total distance is 4.1 miles.

Night Drive Leg 2

(Road to Ranger Cabin): (Walking or driving; specify form of mobility on data sheet) start at "the dirt road to the ranger cabin" and follow dirt road to the end at the ranger cabin.

Night Drive Leg 3

(Summit Road): (Walking or driving; specify form of mobility on data sheet) start at "the junction of dirt roads that lead to the ranger cabin or the Schoodic Overlook, follow the road heading north to the end at the Schoodic Overlook Parking Lot.

Night Drive Leg 4

(Southwest Loop Road) (Park lands): Starts at the junction of the "dirt road to the ranger cabin" and the "loop road". Leg continues south to the junction with the "schoodic point overlook road" and continues on this road to the tip of Schoodic Point on Big Moose Island. Note that part of this leg is on Big Moose Island. Total distance is 1.4 miles.

Night Drive Leg 6

(East Loop Road) (Mixture of Park lands and town roads): Begin at the junction of the "Schoodic Point overlook road" and the "loop road" (begin at southern end of triangle where road begins branching east). Leg follows "loop road" and continues all the way to the junction of route 186 at Chipmans store. Total distance is 4.6 miles.

BIG MOOSE ISLAND:

DF1 Drift fence is located south of the ball field trail. Habitat is a forested black spruce bog/seepage area with many large areas of open water and muck. Fence length totaled 14.9 meters with an azmuth of 294o true. Eight single deep pits (no plastic funnels) were placed at roughly 5 meter intervals.

DF2 Drift fence is located southwest of the manmade skating pond west of the road maintenance shed. Habitat is a forested mixed conifer recovering disturbed area. Fence length totaled 14.8 meters with an azmuth of 730 true. Eight single deep pits (no plastic funnels) were placed at roughly 5 meter intervals until June 12 when all pits were switched to double deep pits.

AS1 Artificial shelters were in a bog adjacent to the shoreline on the northwest corner of the island. Habitat is an open bog with seasonal areas of open water. Shelters were placed along two parallel transects each 90 meters long with stations placed every 10 meters. One shelter was placed at each station for a total of 20 shelters. Parallel transects were 10 meters apart with stations offset by 5 meters.

AS2 Artificial shelters were adjacent to the shoreline on the northwest corner of the island. Habitat is a forested upland with dense canopy cover. Shelters were placed along one 90 meter long transect that parallels (roughly 10 meters from) the edge of the forest at the western shore of the island. Two shelters were placed at each station for a total of 20 shelters.

CS1 Call survey focus location is the manmade skating pond west of the road maintenance shed. During call surveys, observers would sneak up and sit directly adjacent to the pond.

Night Drive Leg 4

(Southwest Loop Road) (Park lands): Starts at the junction of the "dirt road to the ranger cabin" and the "loop road". Leg continues south to the junction with the "schoodic point overlook road" and continues on this road to the tip of Schoodic Point on Big Moose Island. Note that part of this leg is on the Schoodic study area. Total distance is 1.4 miles.

Night Drive Leg 5

(Big Moose Navy Base) (All on Navy property): Begin at the junction of the "Loop Road" and Big Moose Island Navy Base enterance. Procede through all paved roads.... Total distance is 1.7 miles.

COREA HEATH:

DF1 Drift fence is located adjacent to route 195. Habitat is open bog, no canopy cover with small seasonal areas of open water. Fence was constructed of two wings, joined in the center. The southeast wing was 19.9 meters long with an azmuth of 1120 true and the west wing was 19.6 meters long with an azmuth of 2380 true (measurements were taken from common point to both transects). Seven double deep pits (located at the ends and at the junction of the two wings) and 13 single deep pits (all with plastic funnels) were placed at roughly 5 meter intervals.

DF2 Drift fence is located west of the antennae complex. Habitat is forested birch upland adjacent to a small stream. Fence length totaled 15.1 meters with an azmuth of 1600 true. Eight double deep pits (with plastic funnels) were placed at roughly 5 meter intervals.

AS1 Artificial shelters is located adjacent to a stream in an area west of the site picnic area adjacent to the globular antennaes. Habitat is very thick vegetation on both sides of a stream ending in an open bog. Shelters were placed along two transects parallelling the stream course each 90 meters long with stations placed every 10 meters. One shelter was placed at each station for a total of 20 shelters. Stations at the two transects were offset by 5 meters.

CS1 Call survey focus location is a small pond-like area directly adjacent to (southwest side of) route 195. During call surveys, observers would park their vehicle adjacent to the pond with the pond in full view and listen from the vehicle.

CS2 Call survey focus location is the small pond west of the site picnic area adjacent to the globular antennaes. During call surveys, observers would sneak up near the east side of the pond to listen.

CS3 Call survey focus location is the beaver pond on the southeast side of the large gravel antennae pad. During call surveys, observers would walk the perimeter of the entire antennae gravel pad, focusing on the beaver pond but also noting species calling from the moat.

CS4 Call survey focus location is adjacent to the decomposing boardwalk near the center of the heath. During call surveys, observers would stop along the decomposing boardwalk where it first reaches the area with the wooden posts (old antennae area).

Night Drive Leg 7

(Route 195) (town roads, part are adjacent to Navy property at Corea Heath): Begin at the junction of route 186 and route 195 (the turnoff to the town of Corea). Leg follows paved road on route 195 and continues past the Corea Heath Navy Station to the large white steepled church on the right side of the road before the town of Corea. Total distance is 3.0 miles.

Night Drive Leg 8

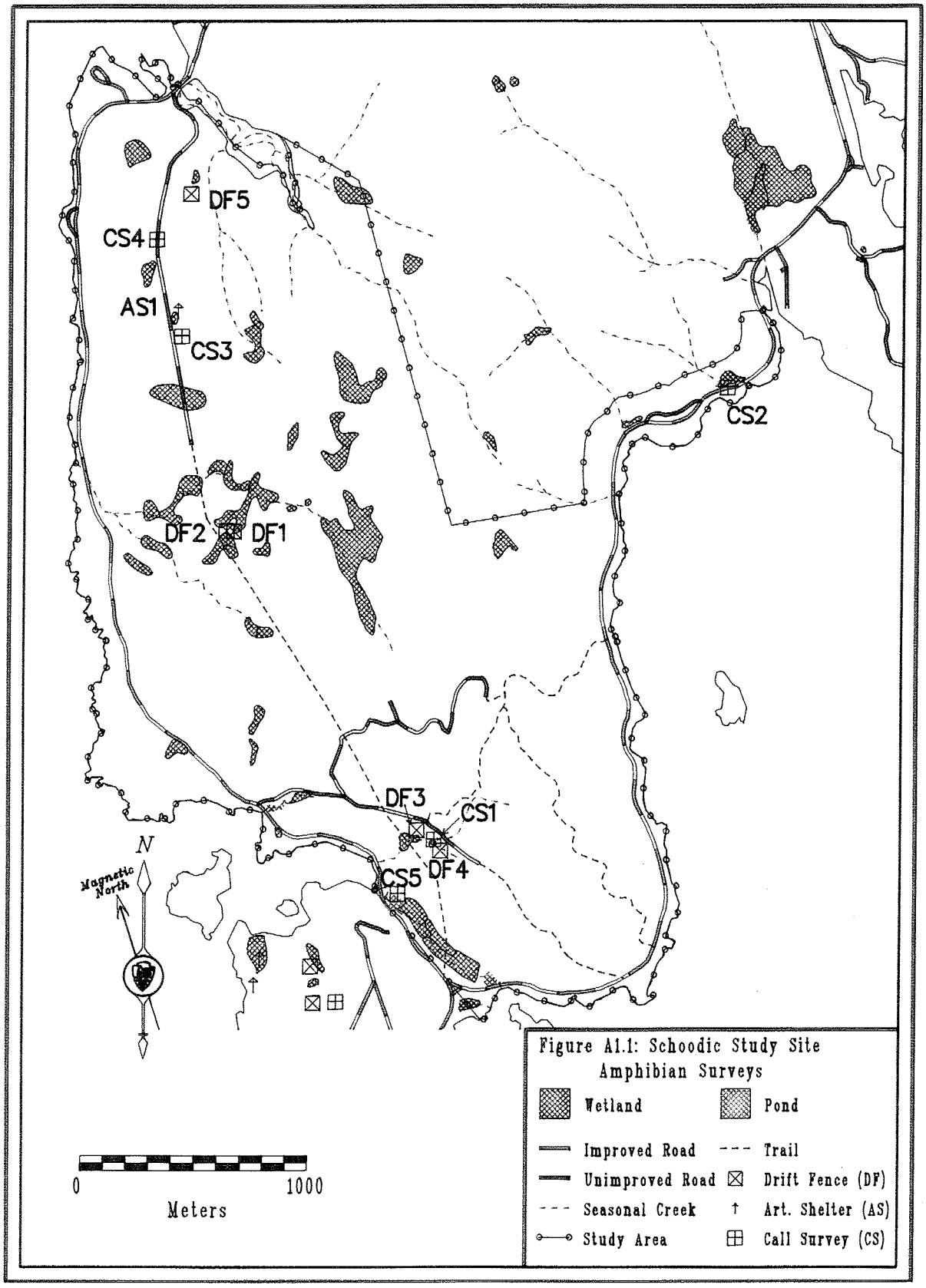
(North Fire Road) (private road located on the northern boundary of Navy lands): begin at the junction of Route 195 and the private road and head west to the house at the end of the road.

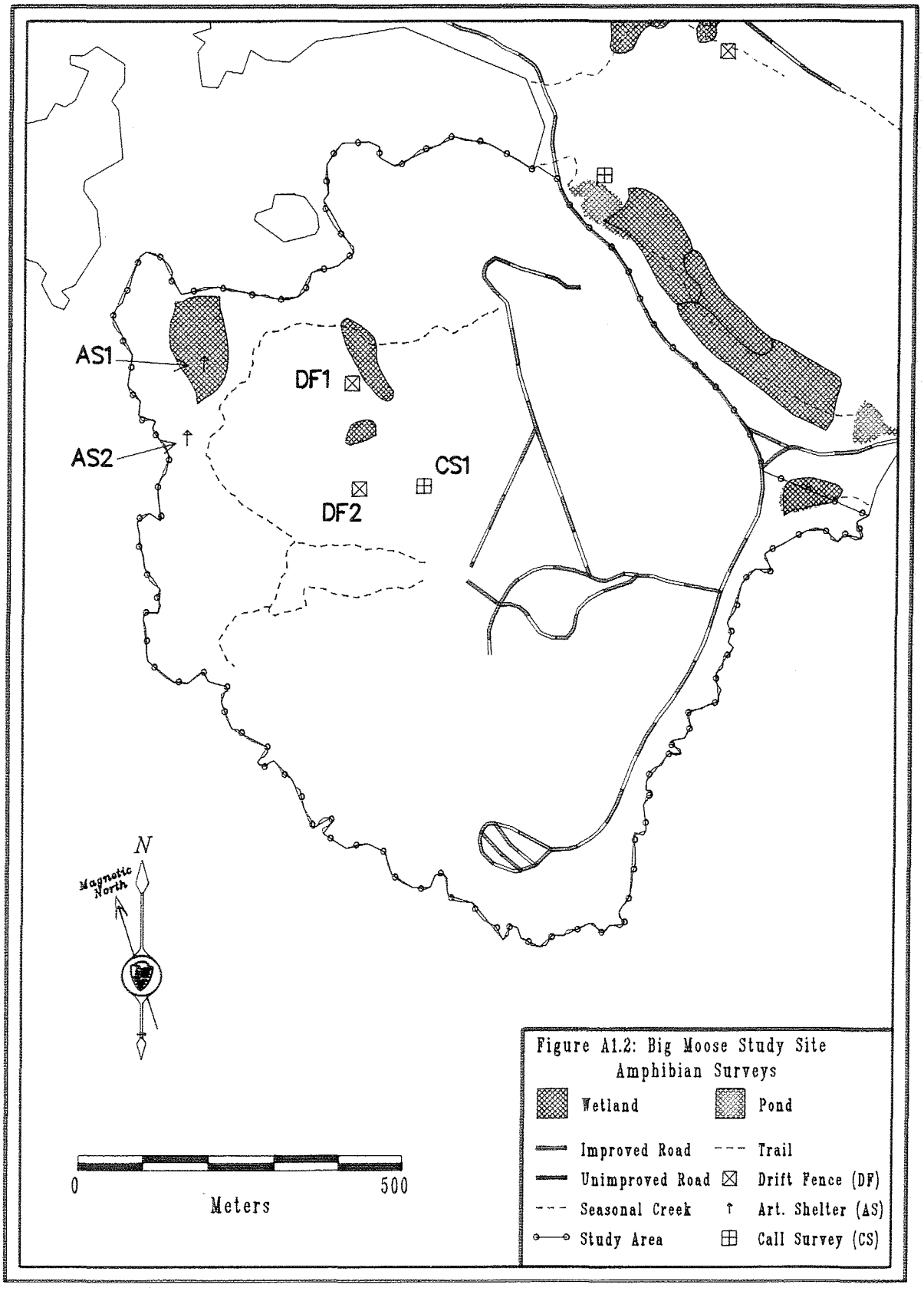
Night Drive Leg 9

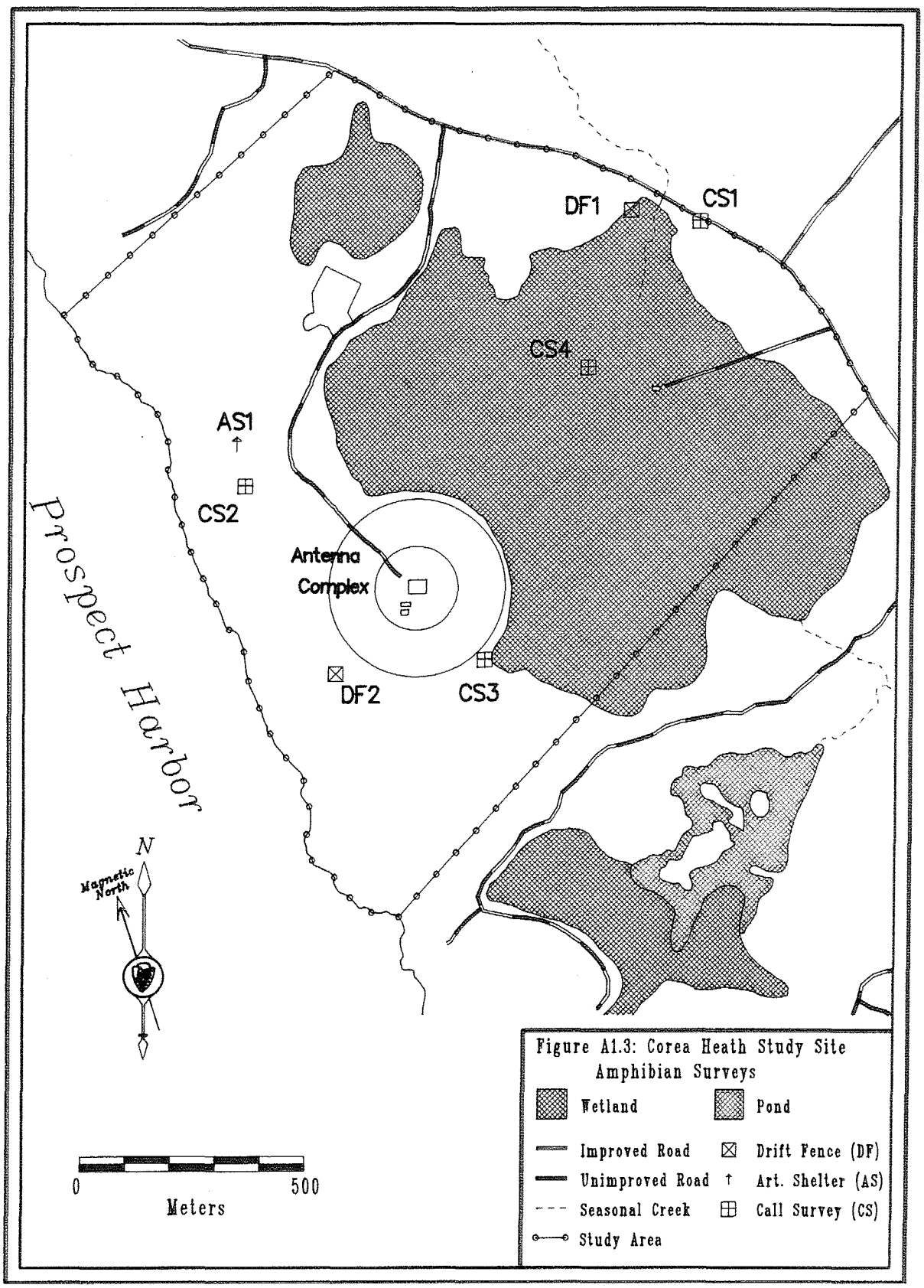
(South Fire Road) (private road located on the southern boundary of Navy lands): begin at the junction of Route 195 and the private road and head west to the end of the road near the ocean shore.

Night Drive Leg 10

(Corea Navy Base paved access road): Begin at the junction of Route 195 and the Corea Navy Base access road. Leg follows this access road to the large antennae array on the Navy Base. Total distance is 1.4 miles.


DF5
CS4
AS1
CS3
CS2
DF2
DF1
DF3
CS1
CS5
DF4
N
Magnetic North
0
1000
Meters
Figure A1.1: Schoodic Study Site
Amphibian Surveys
Wetland
Pond
Improved Road
Trail
Unimproved Road
Drift Fence (DF)
Seasonal Creek
Art. Shelter (AS)
Study Area
Call Survey (CS)


AS1
DF1
AS2
CS1
DF2
N
Magnetic North
0
500
Meters
Figure A1.2: Big Moose Study Site
Amphibian Surveys
Wetland
Pond
Improved Road
Trail
Unimproved Road
Drift Fence (DF)
Seasonal Creek
Art. Shelter (AS)
Study Area
Call Survey (CS)


DF1
CS1
CS4
AS1
CS2
Antenna
Complex
DF2
CS3
Prospect Harbor
N
Magnetic
North
0
500
Meters
Figure A1.3: Corea Heath Study Site
Amphibian Surveys
Wetland
Pond
Improved Road
Unimproved Road
Seasonal Creek
Study Area
Drift Fence (DF)
Art. Shelter (AS)
Call Survey (CS)

Appendix 2. Amphibian species collected in the Schoodic Peninsula Study Areas, 1996.

SPECIES	STUDY SITE	COLLECTION DATE	SPECIMEN #	PRESERVATIVE
wood frog	Big Moose Island	5/10/96	BM2 051096-1-Rd	50% alcohol, 50% water
wood frog	Corea Heath	05/08/96	CR2 050896-1-DF	50% alcohol, 50% water
red-spotted newt	Schoodic Head	5/10/96	SCH 051096-1-Rd	50% alcohol, 50% water
redback salamander	Corea Heath	6/10/96	CR2 61096-4-DF (lead)	50% alcohol, 50% water
redback salamander	Corea Heath	6/08/94	CR2 61096-8-DF	50% alcohol, 50% water
redback salamander	Corea Heath	6/10/94	CR2 61096-9-DF	50% alcohol, 50% water
redback salamander	Corea Heath	04/26/96	CR2 042696-1-DF	50% alcohol, 50% water
redback salamander	Corea Heath	04/26/96	CR2 042696-1-DF	50% alcohol, 50% water
redback salamander	Corea Heath	04/26/96	CR2 042696-1-DF	50% alcohol, 50% water
redback salamander	Corea Heath	04/26/96	CR2 042696-1-DF	Buffered Formalin Phosphate
redback salamander	Corea Heath	04/26/96	CR2 042696-1-DF	Buffered Formalin Phosphate
redback salamander	Corea Heath	04/26/96	CR2 042696-1-DF	Buffered Formalin Phosphate
redback salamander	Corea Heath	04/26/96	CR2 042696-1-DF	Buffered Formalin Phosphate
redback salamander	Corea Heath	04/26/96	CR2 042696-1-DF	Buffered Formalin Phosphate
redback salamander	Corea Heath	04/26/96	CR2 042696-1-DF	Buffered Formalin Phosphate
redback salamander	Corea Heath	04/26/96	CR2 042696-1-DF	Buffered Formalin Phosphate

SPECIES	STUDY SITE	COLLECTION DATE	SPECIMEN #	PRESERVATIVE
redback salamander	Corea Heath	04/26/96	CR2 042696-1-DF	Buffered Formalin Phosphate
redback salamander	Corea Heath	06/18/96	CR1 0618/96-1-DF	Water & Isopropyl (2:1)
redback salamander	Corea Heath	06/28/96	CR1 062896-2-DF	Water & Isopropyl (2:1)
redback salamander	Schoodic Head	06/28/96	SH1 062896-1-DF	Water & Isopropyl (2:1)
green frog	Corea Heath	05/21/96	CR 052196-Rd	
green frog	Corea Heath	05/23/96	CR 052396-??	
redback salamander	Corea Heath	04/26/96	CR2 042696-1-DF	50% alcohol, 50% water
redback salamander	Corea Heath	04/26/96	CR2 042696-1-DF	50% alcohol, 50% water

Appendix 3. Maps and Locations of Bat Sampling Localities

UTM COORDINATES OF BAT SURVEY POINTS BY STUDY SITE, 1996

The coordinates for survey points were collected with a Trimble (Professional model) global position unit and are presented in the following format with the following GPS critical settings:
Datum : NAD-27 CONUS
Coordinate System : Universal Transverse Mercator [19T]
PDOP mask : set at 6 unless noted
SNR mask : set at 6 unless noted

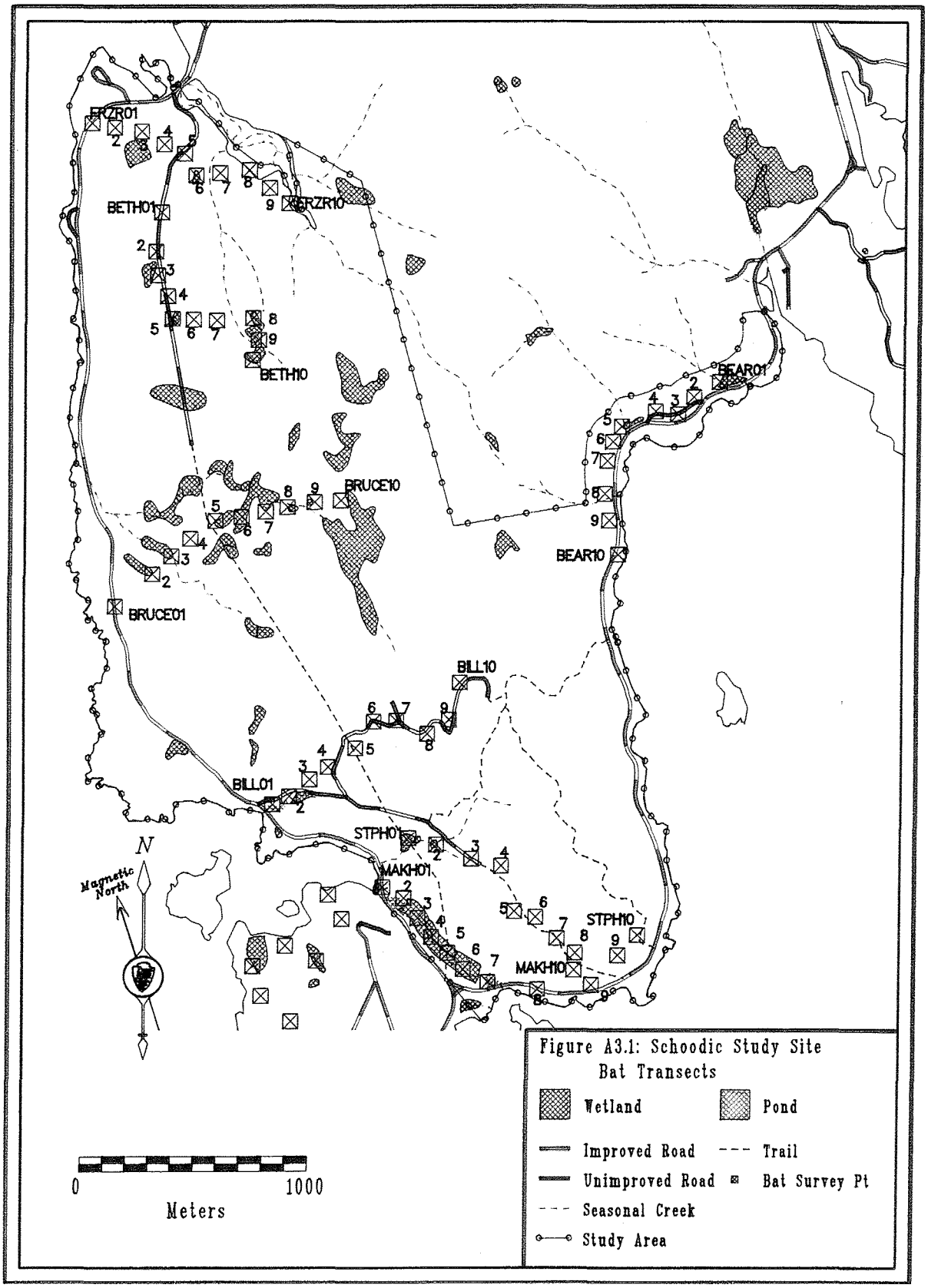
Key to superscripts:

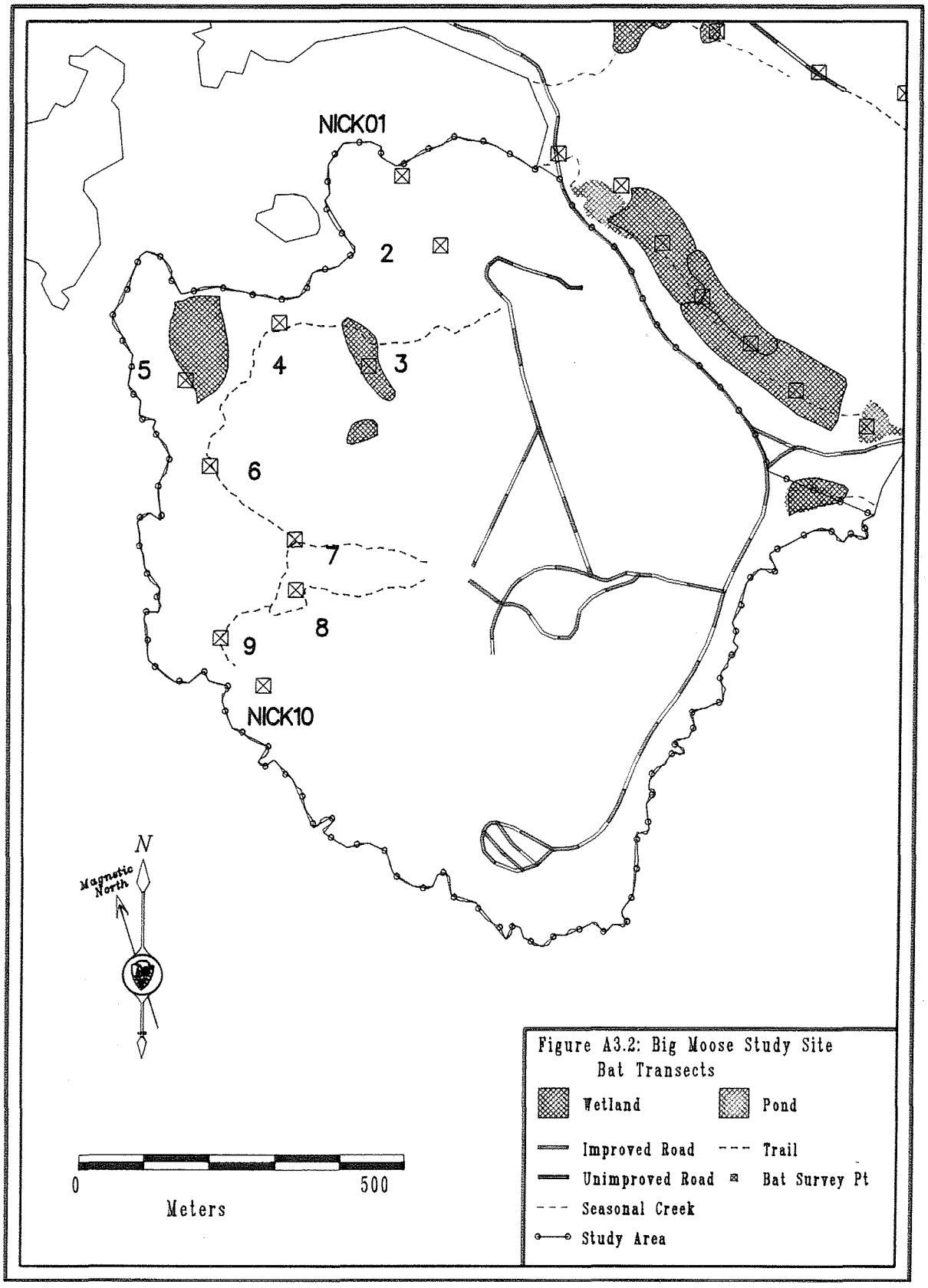
* : GPS position was collected near the actual survey point location. Survey point location was calculated by recording angle and distance to actual survey point location with a staff compass and fiberglass tape and solving geometrically.
** : SNR mask set at 4, PDOP mask set at 6
*** : SNR mask set at 6, PDOP mask set at 8

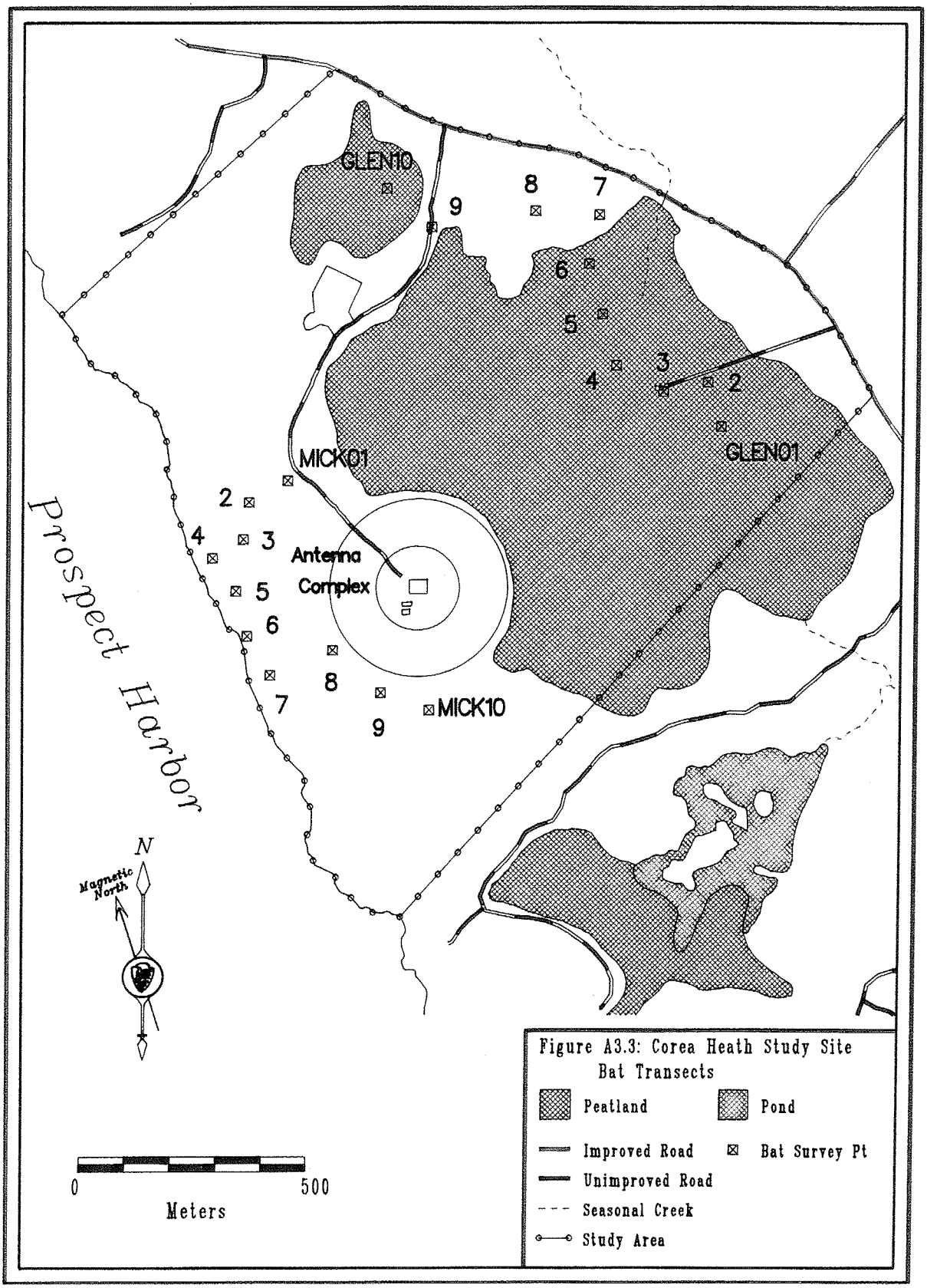
Location	Roverfile	Points	Easting (STD)	Northing (STD)
SCHOODIC PENINSULA:				
BEAR01	R071817a	183 pts	576358.74 (.80)	4912382.54 (1.07)
BEAR02	R071818a	183 pts	576245.50 (1.09)	4912317.11 (2.03)
BEAR03	D092812b*	186 pts**	576177.23 (.63)	4912238.60 (1.58)
BEAR04	D092813a*	188 pts**	576078.25 (.97)	4912251.60 (1.47)
BEAR05	R071818b	182 pts	575932.33 (.83)	4912184.81 (2.06)
BEAR06	D092813b	185 pts	575893.60 (1.40)	4912118.27 (1.10)
BEAR07	R071820a	183 pts	575869.82 (1.67)	4912032.77 (.67)
BEAR08	D092814a*	180 pts***	575859.91 (1.07)	4911885.74 (.88)
BEAR09	R071819a	182 pts	575879.22 (.68)	4911768.19 (.74)
BEAR10	R071819b	182 pts	575917.95 (.51)	4911614.75 (.52)
BETH01	D092711a	184 pts	573903.16 (.49)	4913134.45 (.35)
BETH02	D092712a*	180 pts	573877.70 (.57)	4912960.45 (.89)
BETH03	D092713a*	180 pts**	573885.98 (.68)	4912854.64 (.71)
BETH04	D092713b	223 pts**	573930.71 (.48)	4912763.46 (.92)
BETH05	D092713c	182 pts	573951.29 (.46)	4912662.14 (1.41)
BETH06	D092713d	181 pts	574045.45 (1.03)	4912657.92 (.80)
BETH07	D092714a	181 pts**	574145.82 (.85)	4912655.44 (1.04)
BETH08	D092714b	184 pts**	574304.43 (.29)	4912665.83 (.34)
BETH09	D092714c	187 pts**	574328.04 (.51)	4912568.39 (.43)
BETH10	D092714d	188 pts	574302.05 (.62)	4912479.38 (1.04)
BILL01	R071522a	182 pts	574399.15 (.49)	4910505.54 (.47)
BILL02	R071522b	182 pts	574472.03 (.68)	4910542.08 (.82)
BILL03	D092812a*	183 pts	574560.83 (.34)	4910616.69 (.39)

BILL04	D092811c*	131 pts**	574642.03 (.82)	4910672.29 (.91)
BILL05	R071523a	182 pts	574762.20 (.39)	4910755.69 (.49)
BILL06	D092811b	184 pts***	574841.86 (.49)	4910874.13 (.57)
BILL07	D092811a*	185 pts***	574943.72 (.43)	4910879.27 (.48)
BILL08	D092810a*	189 pts**	575082.41 (.37)	4910818.79 (.68)
BILL09	D092809b*	184 pts**	575178.96 (.61)	4910882.82 (1.18)
BILL10	D092809a	183 pts	575226.92 (.28)	4911047.28 (.52)
BRUCE01	D100315a	182 pts	573706.26 (.38)	4911385.15 (.33)
BRUCE02	D100314h	183 pts	573867.51 (.33)	4911529.09 (.40)
BRUCE03	D100314g	181 pts	573952.06 (.19)	4911609.02 (.32)
BRUCE04	D100314f	183 pts	574035.46 (.72)	4911686.13 (.68)
BRUCE05	D100314e	183 pts	574143.88 (.42)	4911766.04 (.59)
BRUCE06	D100314d	181 pts	574258.35 (.29)	4911784.38 (.30)
BRUCE07	D100314c	181 pts	574361.81 (.72)	4911807.12 (.89)
BRUCE08	D100314b	181 pts	574457.09 (.79)	4911827.90 (2.19)
BRUCE09	D100314a	182 pts	574575.07 (.84)	4911850.06 (.56)
BRUCE10	D100313a	184 pts	574689.56 (4.24)	4911856.72 (3.78)
FRZR01	D100315b	181 pts	573593.66 (.79)	4913528.09 (1.23)
FRZR02	D100315c	186 pts	573693.46 (1.51)	4913508.90 (3.65)
FRZR03	D100315d	182 pts	573813.16 (.61)	4913491.44 (1.54)
FRZR04	D100316a	180 pts	573913.55 (.80)	4913434.90 (1.14)
FRZR05	D100316b	180 pts	574002.31 (.51)	4913393.74 (.80)
FRZR06	R071521a	182 pts	574050.50 (1.03)	4913296.79 (1.16)
FRZR07	D100316c	180 pts	574155.10 (.62)	4913307.25 (2.24)
FRZR08	R071520c	182 pts	574283.05 (.67)	4913320.65 (.96)
FRZR09	D100316d	181 pts	574371.47 (.41)	4913241.73 (.92)
FRZR10	R071520a	186 pts	574457.09 (.62)	4913172.99 (1.07)
MAKH01	R061900a	184 pts	574887.64 (.48)	4910141.20 (.40)
MAKH02	R061901e	183 pts	574982.51 (.53)	4910090.55 (.97)
MAKH03	R061900b	184 pts	575045.85 (.39)	4910003.14 (.43)
MAKH04	R061900c	187 pts	575107.93 (.84)	4909919.88 (.57)
MAKH05	R061900d	182 pts	575181.58 (.26)	4909848.00 (.60)
MAKH06	R061900e	182 pts	575251.77 (.49)	4909776.28 (.87)
MAKH07	R061901a	186 pts	575361.99 (.37)	4909719.84 (.41)
MAKH08	R061901d	182 pts	75583.68 (.72)	4909687.59 (.98)
MAKH09	R061901b	185 pts	575817.71 (.25)	4909706.69 (.68)
MAKH10	R061901c	180 pts	575742.48 (.27)	4909772.99 (.37)
STPH01	R062708a	186 pts	575003.82 (.26)	4910356.64 (.33)
STPH02	R062709a	185 pts	575126.07 (.68)	4910328.71 (.70)
STPH03	R062709b	182 pts	575282.70 (.54)	4910265.98 (.48)
STPH04	R062709c	181 pts	575417.03 (.41)	4910234.23 (.61)
STPH05	D092808a	189 pts	575478.47 (.98)	4910031.83 (1.57)
STPH06	R062709d	365 pts	575572.18 (1.11)	4910007.85 (.61)
STPH07	R062710a	182 pts	575666.84 (1.36)	4909913.02 (1.95)
STPH08	R062710b	183 pts	575746.53 (.27)	4909848.72 (.31)

STPH09	R061620c	366 pts	575933.42 (.84)	4909838.44 (.53)
STPH10	R062710c	182 pts	576017.60 (1.31)	4909927.84 (1.90)
BIG MOOSE ISLAND:				
NICK01	R062618a	185 pts	574648.48 (.29)	4910106.23 (2.13)
NICK02	R062619a	182 pts	574708.41 (.51)	4909999.21 (.85)
NICK03	R062618b	190 pts	574598.44 (.23)	4909813.22 (.68)
NICK04	R062622a	187 pts	574461.32 (1.22)	4909879.68 (.54)
NICK05	R062620a	209 pts	574320.42 (.34)	4909790.58 (.53)
NICK06	R062621a	184 pts	574357.44 (.61)	4909659.21 (.29)
NICK07	R062621b	187 pts	574486.58 (.35)	4909546.34 (.30)
NICK08	R062621c	185 pts	574489.27 (.99)	4909467.86 (.63)
NICK09	R062621d	186 pts	574374.76 (.56)	4909392.92 (.46)
NICK10	R062623a	185 pts	574440.18 (.97)	4909320.45 (1.78)
COREA HEATH:				
GLEN01	V093018a	181 pts	580957.42 (.27)	4917090.90 (.24)
GLEN02	V093019a	303 pts**	580927.12 (1.72)	4917190.28 (2.66)
GLEN03	V093019b	192 pts	580827.65 (.36)	4917168.53 (.32)
GLEN04	V093019c	184 pts	580722.26 (.17)	4917227.38 (.30)
GLEN05	V093020a	392 pts	580692.40 (.52)	4917340.54 (.36)
GLEN06	V093020b	188 pts	580660.99 (.29)	4917453.25 (.36)
GLEN07	V093021a	188 pts	80682.94 (.76)	4917563.04 (.63)
GLEN08	V093021b	181 pts	580544.40 (.43)	4917571.29 (1.49)
GLEN09	V093022a	181 pts***	580315.70 (2.01)	4917534.79 (1.00)
GLEN10	V093022b	186 pts***	580214.86 (1.63)	4917621.39 (1.02)
MICK01	V100104a	185 pts	579996.91 (.43)	4916970.45 (.61)
MICK02	V100103c	229 pts	579911.56 (.68)	4916922.30 (.96)
MICK03	V100103b	184 pts	579900.26 (.85)	4916839.90 (.90)
MICK04	V100103a	183 pts	579832.90 (.50)	4916797.48 (.66)
MICK05	V100102b	182 pts***	579883.91 (.47)	4916723.17 (.55)
MICK06	V100102a	197 pts	579908.51 (.14)	4916622.92 (.19)
MICK07	V100101c	184 pts**	579959.63 (.31)	4916535.75 (.18)
MICK08	V100101b	188 pts**	580098.93 (.21)	4916590.71 (.45)
MICK09	V100101a	183 pts**	580207.09 (.65)	4916496.38 (.63)
MICK10	V100100a	188 pts	580316.10 (.22)	4916457.65 (.54)


BRZR01
BRZR10
BETH01
BETH10
BEAR01
BEAR10
BRUCE10
BRUCE01
BILL10
BILL01
STPH01
STPH10
MAKH01
MAKH10
N
Magnetic North
0
1000
Meters
Figure A3.1: Schoodic Study Site
Bat Transects
Wetland
Pond
Improved Road
Trail
Unimproved Road
Bat Survey Pt
Seasonal Creek
Study Area


NICK01
2
3
4
5
6
7
8
9
NICK10
N
Magnetic North
0
500
Meters
Figure A3.2: Big Moose Study Site
Bat Transects
Wetland
Pond
Improved Road
Trail
Unimproved Road
Bat Survey Pt
Seasonal Creek
Study Area


GLEN10
9
8
7
6
5
4
3
2
GLEN01
MICK01
2
4
3
Antenna
Complex
5
6
8
7
9
MICK10
Prospect Harbor
N
Magnetic
North
0
500
Meters
Figure A3.3: Corea Heath Study Site
Bat Transects
Peatland
Pond
Improved Road
Bat Survey Pt
Unimproved Road
Seasonal Creek
Study Area

Appendix 4. Maps and UTM Locations of Mammal Sampling Localities in the Schoodic Region .

UTM COORDINATES OF END POINTS OF MAMMAL TRAPLINES BY STUDY SITE, 1996:

The coordinates for survey points were collected with a Trimble (Professional model) global position unit and are presented in the following format with the following GPS critical settings:
Datum : NAD-27 CONUS
Coordinate System : Universal Transverse Mercator [19T]
PDOP mask : set at 6 unless noted
SNR mask : set at 6 unless noted

Key to superscripts:

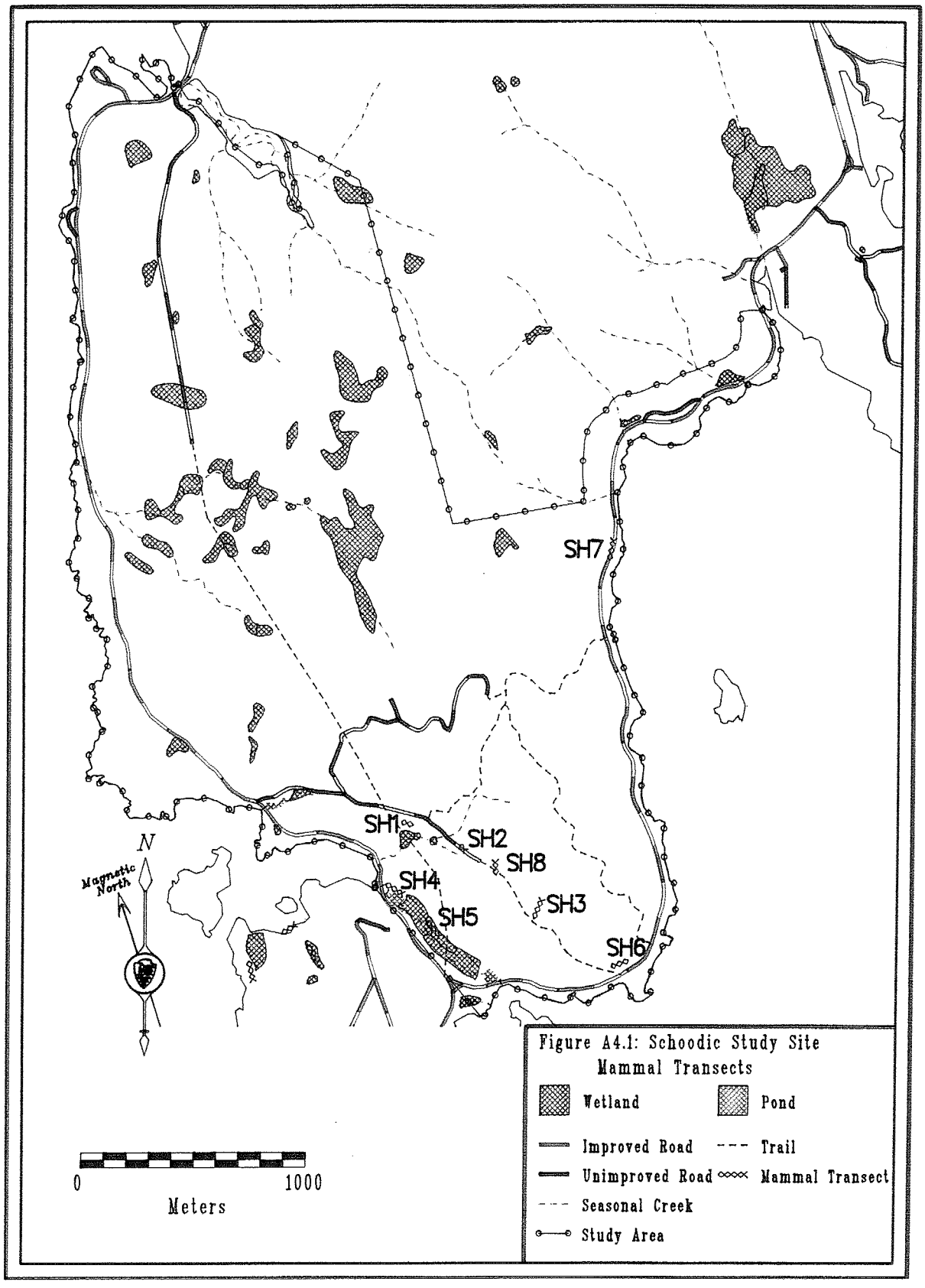
* : GPS position was collected near the actual survey point location. Survey point location was calculated by recording angle and distance to actual survey point location with a staff compass and fiberglass tape and solving geometrically.

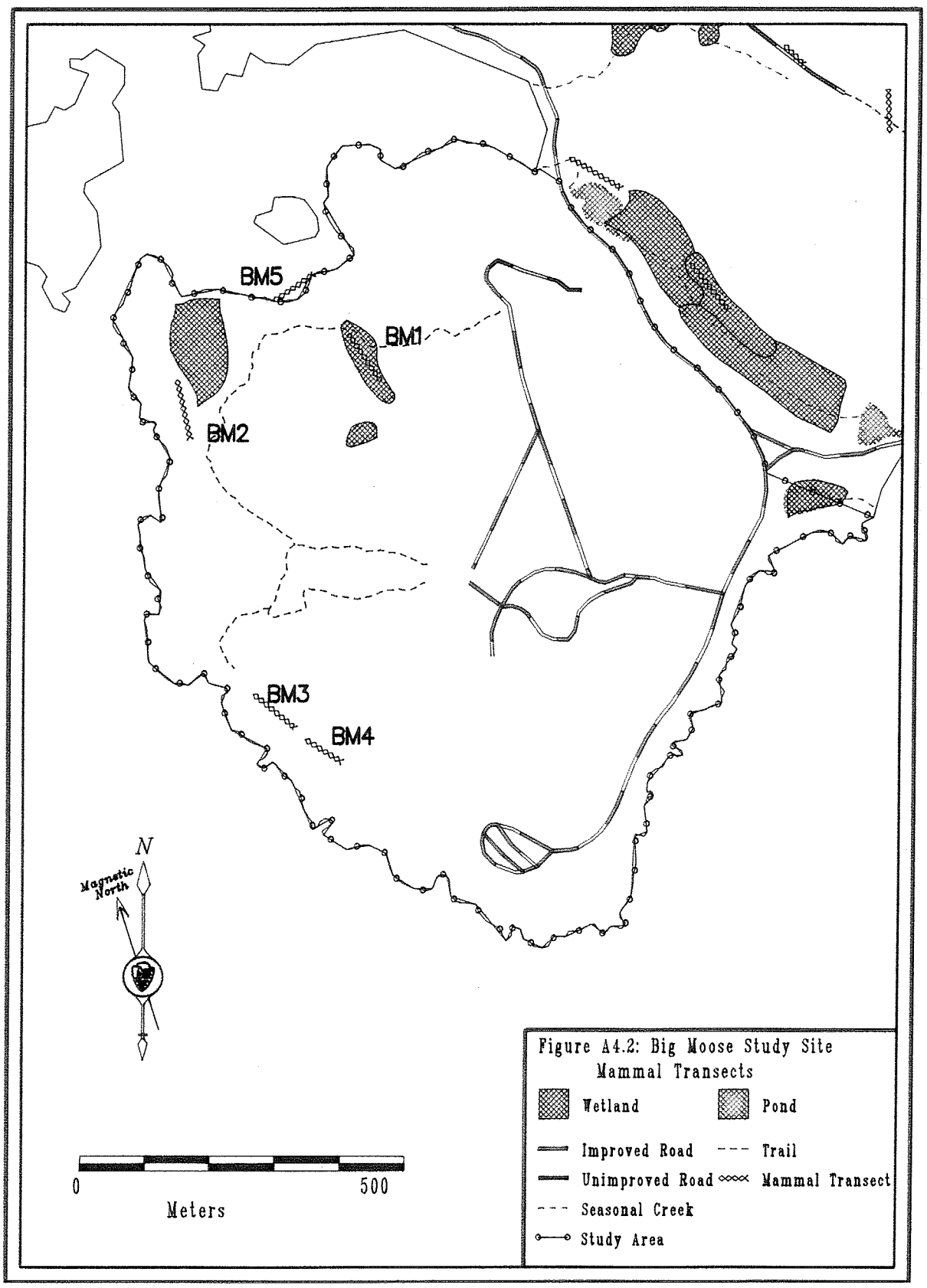
LOCATION	ROVERFILE	POINTS	EASTING (STD)	NORTHING (STD)
SCHOODIC PENINSULA:				
SH1PT1	R082711a	180 pts	575026.42 (.70)	4910397.91 (.61)
SH1PT11	R082711b	181 pts	574972.93 (.93)	4910411.96 (.52)
SH2PT1	R082709a	183 pts	575231.17 (.67)	4910310.51 (.90)
SH2PT11	R082709a	181 pts	575260.72 (1.19)	4910281.22 (1.05)
SH3PT1	R082710b	181 pts	575567.46 (.98)	4909980.95 (.67)
SH3PT11	R082710c	198 pts	575603.45 (2.31)	4910068.87 (2.37)
SH4PT1	R082711c	185 pts	574905.71 (.33)	4910137.36 (.60)
SH4PT11	R082711d	181 pts	574985.74 (1.95)	4910089.87 (.49)
SH5PT1	R082711e	181 pts	575091.99 (.61)	4909973.64 (.98)
SH5PT11	R082711f	183 pts	575150.17 (1.77)	4909900.50 (.94)
SH6PT1	R082719a	181 pts	575993.71 (.41)	4909794.56 (.68)
SH6PT11	R082719b*	181 pts	575916.97 (.25)	4909767.21 (.43)
SH7PT1	R082719c	181 pts	575892.84 (.59)	4911578.19 (1.35)
SH7PT11	R082719d*	139 pts	575911.43 (.25)	4911676.22 (.43)
SH8PT1	R082718a*	181 pts	575394.64 (.40)	4910176.04 (.53)
SH8PT11	R082718b*	183 pts	575391.69 (.87)	4910242.79 (.77)
BIG MOOSE ISLAND:				
BM1PT1	R082712a	180 pts	574618.25 (.85)	4909791.88 (.85)
BM1PT11	R082712b	180 pts	574567.90 (.68)	4909864.76 (.74)
BM2PT1	R082712e	180 pts	574306.40 (.26)	4909796.44 (.57)
BM2PT11	R082714b	180 pts	574327.42 (1.19)	4909702.69 (.75)

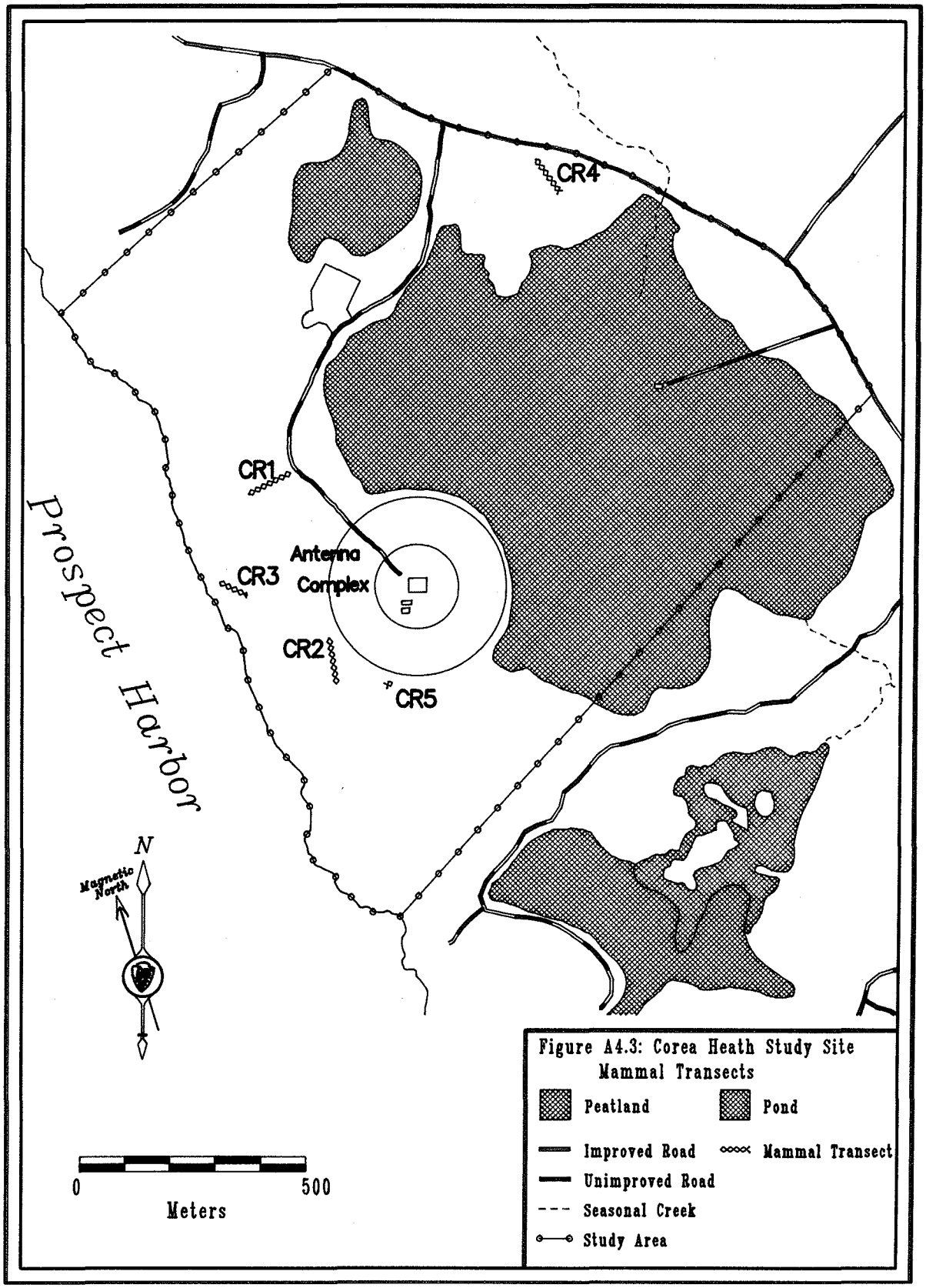
BM3PT1	R082713b	182 pts	574426.63 (1.39)	4909307.64 (.65)
BM3PT11	R082713c	181 pts	574491.39 (.27)	4909255.83 (.41)
BM4PT1	R082713d	181 pts	574506.65 (.92)	4909238.49 (.87)
BM4PT11	R082714a	181 pts	574562.57 (.43)	4909202.52 (.46)
BM5PT1	R082712c	183 pts	574452.63 (1.03)	4909915.81 (.58)
BM5PT11	R082712d	180 pts	574514.03 (1.69)	4909957.92 (1.43)

COREA HEATH:

CR1PT1	R082716c	182 pts	580005.10 (.38)	4916983.67 (.38)
CR1PT11	R082716b	181 pts	579913.75 (.95)	4916935.60 (.97)
CR2PT1	R082716d	181 pts	580092.82 (.32)	4916614.79 (.48)
CR2PT11	R082716e	181 pts	580109.53 (.48)	4916512.61 (.48)
CR3PT1	R082717a	181 pts	579851.11 (.33)	4916739.38 (.46)
CR3PT11	R082717a	180 pts	579910.94 (10.26)	4916710.10 (1.51)
CR4PT1	R082715a	180 pts	580547.62 (.20)	4917680.06 (.71)
CR4PT11	R082715b	180 pts	580600.91 (.52)	4917606.84 (1.03)
CR5PT1	R082717c	181 pts	580234.82 (.31)	4916516.44 (.48)
CR5PT11	R082717d	181 pts	580219.52 (1.40)	4916507.93 (.90)


SH7
SH1
SH2
SH8
SH4
SH3
SH5
SH6
N
Magnetic North
0
1000
Meters
Figure A4.1: Schoodic Study Site
Mammal Transects
Wetland
Pond
Improved Road
Trail
Unimproved Road
Mammal Transect
Seasonal Creek
Study Area


BM5
BM1
BM2
BM3
BM4
N
Magnetic North
0
500
Meters
Figure A4.2: Big Moose Study Site
Mammal Transects
Wetland
Pond
Improved Road
Trail
Unimproved Road
Mammal Transect
Seasonal Creek
Study Area


CR4
CR1
Antenna
Complex
CR3
CR2
CR5
Prospect Harbor
N
Magnetic
North
0
500
Meters
Figure A4.3: Corea Heath Study Site
Mammal Transects
Peatland
Pond
Improved Road
Mammal Transect
Unimproved Road
Seasonal Creek
Study Area

Appendix 5. Mammal specimens obtained in the Schoodic Biological Inventory, 1996. Species arranged by mammalian order. Capture techniques: DF=drift fence pitfall traps; LT= Sherman live-trap.

Species	Date	Site	Collection Number	Weight in grams	Total Length (mm)	Tail Length (mm)	Capture Technique & Remarks
Insectivora:							
Condylura cristata	6/28/96	Schoodic	SH5-0628-1	30.5	169	7	DF, wet
Blarina brevicauda	8/12/96	Schoodic	MM6-9-0812	18.5	110	30	LT, wet weight
Blarina brevicauda	7/19/96	Schoodic	MM6-1-0719	19.3	113	29	LT, wet
Blarina brevicauda	8/12/96	Schoodic	MM7-3-0812	20.8	132	39	LT, dry
Blarina brevicauda	7/16/96	Schoodic	MM6-9-0716	18.5	121	34	LT, wet
Blarina brevicauda	6/10/96	Corea	CR2-0610-2	25.5	128	25	DF, wet
Blarina brevicauda	6/17/96	Big Moose	BM2-0617-1	15	112	34	DF, head damaged
Blarina brevicauda	6/12/96	Schoodic	SH3-0612-1	12.3	102	28	DF, wet wt.
Blarina brevicauda	6/11/96	Schoodic	MM2-8-0611	26	103	13	LT, wet
Blarina brevicauda	5/24/96	Schoodic	SH5-0524-1	24	118	20	DF, wet
Blarina brevicauda	5/24/96	Schoodic	SH4-0524-2	16.5	117	30	DF,wet
Blarina brevicauda	6/20/96	Schoodic	MM4-1-0620	21	119	30	LT, wet
Blarina brevicauda	5/20/96	Schoodic	SH4-0520-2	17	113	26	DF, wet
Blarina brevicauda	4/29/96	Schoodic	SH3-0429--1	12.5	107	28	DF, wet
Blarina brevicauda	4/24/96	Schoodic	SH4-0424-1	20	125	27	DF
Blarina brevicauda	5/20/96	Big Moose	BM2-0520-1	28	128	34	DF
Blarina brevicauda	6/26/96	Schoodic	MM4-1-0626	26.5	120	29	LT
Blarina brevicauda	7/9/96	Schoodic	MM2-3-0709	25.3	116	30	LT, pregnant?
Sorex cinereus	8/6/96	Corea	MM1-3-0806	3.3	93	47	LT, dry
Sorex cinereus	8/15/96	Schoodic	MM4-1-0815	3.25	91	45	LT, dry
Sorex cinereus	8/13/96	Schoodic	MM6-8-0813	4.5	94	40	LT, wet
Sorex cinereus	8/13/96	Schoodic	MM4-1-0813	3	95	47	LT, dry
Sorex cinereus	6/24/96	Corea	CR2-0624-6	4.25	89	43	DF, wet
Sorex cinereus	6/24/96	Corea	CR2-0624-5	4	95	42	DF, wet

Species	Date	Site	Collection Number	Weight in grams	Total Length (mm)	Tail Length (mm)	Capture Technique & Remarks
Sorex cinereus	6/24/96	Corea	CR2-0624-4	4	92	46	DF, wet
Sorex cinereus	6/24/96	Corea	CR2-0624-3	4.5	95	45	DF, wet
Sorex cinereus	6/24/96	Corea	CR2-0624-2	6	100	45	DF, wet
Sorex cinereus	8/12/96	Schoodic	MM6-2-0812	2.75	96	47	LT, dry
Sorex cinereus	6/23/96	Schoodic	SH1-0623-2	5.25	99	42	DF, wet
Sorex cinereus	6/23/96	Schoodic	SH4-0623-3	6	100	47	DF, wet
Sorex cinereus	6/23/96	Schoodic	SH4-0623-4	6.75	106	48	DF, wet
Sorex cinereus	6/23/96	Schoodic	SH4-0623-5	3.25	94	43	DF, wet
Sorex cinereus	6/23/96	Schoodic	SH4-0623-1	3.5	96	46	DF, wet
Sorex cinereus	6/24/96	Corea	CR1-0624-6	5.5	99	45	DF, wet
Sorex cinereus	6/23/96	Schoodic	SH3-0623-2	3	90	42	DF, wet
Sorex cinereus	6/23/96	Schoodic	SH3-0623-3	3.5	96	48	DF, wet
Sorex cinereus	6/26/96	Schoodic	SH4-0626-2	4.75	98	47	DF, wet
Sorex cinereus	7/12/96	Schoodic	MM3-9-0712	4	92	44	LT, dry
Sorex cinereus	7/12/96	Schoodic	MM3-7-0712	4	92	41	LT, dry
Sorex cinereus	7/10/96	Schoodic	MM3-7-0710	4	90	41	LT, dry
Sorex cinereus	6/23/96	Big Moose	BM2-0623-2	4	97	47	DF, wet
Sorex cinereus	6/23/96	Big Moose	BM1-0623-8	5.25	108	48	DF, wet
Sorex cinereus	6/23/96	Big Moose	BM2-0623-3	3.25	96	47	DF, wet
Sorex cinereus	6/23/96	Big Moose	BM1-0623-10	3.5	93	46	DF, wet
Sorex cinereus	6/23/96	Big Moose	BM1-0623-12	5.75	105	48	DF, wet
Sorex cinereus	6/26/96	Big Moose	BM1-0626-2	3.25	93	43	DF, wet
Sorex cinereus	6/24/96	Corea	CR2-0624-8	4	96	44	DF, wet
Sorex cinereus	7/9/96	Schoodic	MM3-8-0709	4	90	41	LT, dry
Sorex cinereus	8/12/96	Schoodic	MM4-8-0812	2.75	94	46	LT, dry
Sorex cinereus	8/16/96	Schoodic	MM4-1-0816	3	85	44	LT, dry
Sorex cinereus	6/24/96	Corea	CR1-0624-1	4.5	92	42	DF, wet
Sorex cinereus	6/24/96	Corea	CR1-0624-2	3.5	92	47	DF,wet
Sorex cinereus	6/24/96	Corea	CR1-0624-3	4.5	100	44	DF, wet

Species	Date	Site	Collection Number	Weight in grams	Total Length (mm)	Tail Length (mm)	Capture Technique & Remarks
Sorex cinereus	6/24/96	Corea	CR1-0624-4	5	100	47	DF, wet
Sorex cinereus	6/14/96	Schoodic	SH2-0614-1	3.25	91	45	DF, wet
Sorex cinereus	6/14/96	Schoodic	SH1-0614-5	3.25	95	43	DF, wet
Sorex cinereus	6/14/96	Schoodic	SH1-0614-6	5	100	44	DF, wet
Sorex cinereus	6/14/96	Schoodic	SH5-0614-1	3.75	100	49	DF, wet
Sorex cinereus	6/14/96	Schoodic	SH5-0614-2	5.25	95	40	DF, wet
Sorex cinereus	6/23/96	Big Moose	BM1-0623-2	3	95	45	DF, wet
Sorex cinereus	6/23/96	Big Moose	BM1-0623-5	3.5	100	46	DF, wet
Sorex cinereus	6/26/96	Big Moose	BM1-0626-1	4	95	49	DF, wet
Sorex cinereus	6/26/96	Schoodic	SH1-0626-1	5	94	41	DF, wet
Sorex cinereus	6/26/96	Schoodic	SH4-0626-1	4.25	91	46	DF, wet
Sorex cinereus	6/26/96	Corea	CR2-0626-1	4.25	92	45	DF, wet
Sorex cinereus	6/24/96	Corea	CR1-0624-5	3.25	97	49	DF, wet
Sorex cinereus	6/23/96	Big Moose	BM1-0623-11	3.25	95	45	DF, wet
Sorex cinereus	6/23/96	Big Moose	BM1-0623-1	3.75	94	47	DF, wet
Sorex cinereus	6/23/96	Big Moose	BM1-0623-6	3.25	100	47	DF, wet
Sorex cinereus	6/23/96	Big Moose	BM2-0623-1	3.75	96	48	DF, wet
Sorex cinereus	6/23/96	Big Moose	BM2-0623-4	3.5	97	47	DF, wet
Sorex cinereus	6/24/96	Corea	CR1-0624-5	3.25	97	49	DF, wet
Sorex cinereus	6/26/96	Schoodic	SH3-0626-1	4.25	96	49	DF, wet
Sorex cinereus	6/10/96	Corea	CR2-0610-1	5.5	98	46	DF, wet
Sorex cinereus	6/10/96	Schoodic	SH1-0610-1	5.5	101	45	DF, wet
Sorex cinereus	6/14/96	Big Moose	BM2-0614-7	3.5+	80+	41+	DF, head missing
Sorex cinereus	6/14/96	Big Moose	BM2-0614-6	3.25	95	47	DF, wet
Sorex cinereus	6/14/96	Big Moose	BM2-0614-5	3	94	46	DF, wet
Sorex cinereus	6/14/96	Big Moose	BM2-0614-4	5.5	106	46	DF, wet
Sorex cinereus	6/14/96	Big Moose	BM2-0614-3	4.5	98	41	DF, wet
Sorex cinereus	6/14/96	Big Moose	BM2-0614-2	3.25	92	44	DF, wet
Sorex cinereus	6/14/96	Big Moose	BM2-0614-1	5	102	48	DF, wet

Species	Date	Site	Collection Number	Weight in grams	Total Length (mm)	Tail Length (mm)	Capture Technique & Remarks
Sorex cinereus	6/14/96	Big Moose	BM1-0614-4	5.5	102	46	DF, wet
Sorex cinereus	6/14/96	Big Moose	BM1-0614-3	3	89	43	DF, wet
Sorex cinereus	6/14/96	Big Moose	BM1-0614-2	5.25	98	41	DF, wet
Sorex cinereus	6/14/96	Big Moose	BM1-0614-1	3	96	46	DF, wet
Sorex cinereus	6/14/96	Schoodic	SH1-0614-1	3	91	44	DF, wet
Sorex cinereus	6/14/96	Schoodic	SH3-0614-1	3	90	48	DF, wet
Sorex cinereus	6/14/96	Schoodic	SH3-0614-2	5	94	41	DF, wet
Sorex cinereus	6/14/96	Schoodic	SH4-0614-1	9	97	45	DF, wet
Sorex cinereus	6/14/96	Schoodic	SH5-0614-3	3.25	97	46	DF, wet
Sorex cinereus	6/14/96	Schoodic	SH1-0614-2	4.5	99	46	DF, wet
Sorex cinereus	6/14/96	Schoodic	SH1-0614-3	4.5	98	47	DF, wet
Sorex cinereus	6/14/96	Schoodic	SH1-0614-4	3	87	44	DF, wet
Sorex cinereus	6/14/96	Corea	CR2-0614-1	6	101	45	DF, wet
Sorex cinereus	6/14/96	Corea	CR2-0614-2	5.5	98	42	DF, wet
Sorex cinereus	6/14/96	Corea	CR2-0614-3	5.5	100	44	DF, wet
Sorex cinereus	6/10/96	Big Moose	BM2-0610-1	5.5	97	41	DF, wet
Sorex cinereus	6/10/96	Big Moose	BM2-0610-2	4	99	42	DF, wet
Sorex cinereus	6/10/96	Big Moose	BM2-0610-3	6.5	99	44	DF, wet
Sorex cinereus	6/10/96	Big Moose	BM2-0610-4	3.5	99	49	DF, wet
Sorex cinereus	6/10/96	Big Moose	BM2-0610-5	5	94	42	DF, wet
Sorex cinereus	6/10/96	Big Moose	BM2-0610-6	5.5	103	45	DF, wet
Sorex cinereus	6/10/96	Corea	CR1-0610-3	3.5	104	49	DF, wet
Sorex cinereus	6/10/96	Corea	CR1-0610-2	5.5	102	45	DF, wet
Sorex cinereus	6/10/96	Corea	CR1-0610-1	5.5	105	46	DF, wet
Sorex cinereus	6/10/96	Corea	CR2-0610-3	5.75	99	42	DF, wet
Sorex cinereus	6/10/96	Corea	CR2-0610-6	6.5	93	37	DF, wet
Sorex cinereus	6/10/96	Corea	CR2-0610-7	5.75	98	42	DF, wet
Sorex cinereus	6/10/96	Schoodic	SH1-0610-2	3	96	43	DF, wet
Sorex cinereus	6/10/96	Schoodic	SH1-0610-3	5	102	40	DF, wet

Species	Date	Site	Collection Number	Weight in grams	Total Length (mm)	Tail Length (mm)	Capture Technique & Remarks
Sorex cinereus	6/10/96	Schoodic	SH1-0610-4	5.5	106	44	DF, wet
Sorex cinereus	6/10/96	Schoodic	SH1-0610-5	5.5	101	43	DF, wet
Sorex cinereus	6/10/96	Schoodic	SH4-0610-1	5.75	111	46	DF, wet
Sorex cinereus	6/3/96	Schoodic	SH3-0603-1	7.5	102	47	DF, wet, pregnant
Sorex cinereus	6/12/96	Corea	CR2-0612-6	6.5	9.3	37	DF, wet
Sorex cinereus	6/12/96	Corea	CR2-0612-5	5.75	101	45	DF, wet
Sorex cinereus	6/12/96	Corea	CR2-0612-4	6	100	43	DF, wet
Sorex cinereus	6/12/96	Corea	CR2-0612-2	4.25	98	45	DF, wet
Sorex cinereus	6/12/96	Corea	CR1-0612-1	5	96	41	DF, wet
Sorex cinereus	6/12/96	Corea	CR1-0612-2	5.75	100	42	DF, wet
Sorex cinereus	6/12/96	Big Moose	BM1-0612-1	5	101	48	DF, wet
Sorex cinereus	6/10/96	Big Moose	BM1-0610-1	5.5	105	48	DF, wet
Sorex cinereus	6/10/96	Big Moose	BM1-0610-2	5.75	106	50	DF, wet
Sorex cinereus	6/12/96	Schoodic	SH4-0612-1	6.25	108	45	DF, wet
Sorex cinereus	6/12/96	Schoodic	SH4-0612-2	5	99	45	DF, wet
Sorex cinereus	6/7/96	Schoodic	SH5-0607-1	4.75	93	41	DF, wet
Sorex cinereus	6/7/96	Schoodic	SH5-0607-2	6	96	43	DF, wet
Sorex cinereus	6/7/96	Schoodic	SH5-0607-3	6.25	99	43	DF, wet
Sorex cinereus	6/5/96	Schoodic	SH1-0605-1	4.5	104	49	DF, wet
Sorex cinereus	6/5/96	Schoodic	SH5-0605-1	5.25	102	44	DF, wet
Sorex cinereus	6/5/96	Big Moose	BM2-0605-1	5.75	105	49	DF, wet
Sorex cinereus	6/5/96	Big Moose	BM2-0605-3	7.5	103	43	DF, wet, pregnant
Sorex cinereus	6/10/96	Corea	CR2-0610-4	3.5	98	45	DF, wet
Sorex cinereus	6/17/96	Schoodic	SH1-0617-1	3.5	96	47	DF, wet
Sorex cinereus	6/17/96	Schoodic	SH1-0617-2	3.5	89	42	DF, wet
Sorex cinereus	6/17/96	Schoodic	SH1-0617-3	4.75	96	41	DF, wet
Sorex cinereus	6/17/96	Corea	CR1-0617-1	4.5	95	45	DF, wet
Sorex cinereus	6/17/96	Corea	CR1-0617-2	5.5	104	47	DF, wet

Species	Date	Site	Collection Number	Weight in grams	Total Length (mm)	Tail Length (mm)	Capture Technique & Remarks
Sorex cinereus	6/12/96	Schoodic	SH5-0612-6	5	100	45	DF, wet
Sorex cinereus	6/12/96	Big Moose	BM2-0612–1	4.5	94	44	DF, wet
Sorex cinereus	6/12/96	Corea	CR1-0612-3	4	92	45	DF, wet
Sorex cinereus	6/17/96	Schoodic	SH5-0617-1	3	94	44	DF, wet
Sorex cinereus	6/17/96	Schoodic	SH5-0617-3	4.5	95	42	DF, wet
Sorex cinereus	6/17/96	Schoodic	SH5-0617-4	3.25	94	44	DF, wet
Sorex cinereus	6/17/96	Schoodic	SH2-0617-1	3.5	98	44	DF, wet
Sorex cinereus	6/17/96	Big Moose	BM1-0617-1	5.25	99	42	DF, wet
Sorex cinereus	6/17/96	Corea	CR1-0617-4	3.5	94	47	DF, wet
Sorex cinereus	6/12/96	Corea	CR2-0612-1	5.5	95	40	DF, wet
Sorex cinereus	5/31/96	Big Moose	MM1-7-0531	5.5	90	41	LT, wet
Sorex cinereus	5/29/96	Big Moose	MM3-2-0529	5.25	90	40	LT, dry
Sorex cinereus	6/14/96	Schoodic	MM3-5-0530	2?	82	42	LT, dry
Sorex cinereus	6/19/96	Schoodic	SH5-0619-3	3.5	105	48	DF, wet
Sorex cinereus	6/19/96	Schoodic	SH5-0619-4	3.5	95	45	DF, wet
Sorex cinereus	5/31/96	Schoodic	SH2-0531-1	6	93	41	DF, wet
Sorex cinereus	5/27/96	Schoodic	SH1-0527-1	6	99	41	DF, wet
Sorex cinereus	5/22/96	Schoodic	SH4-0522-1	5	97	41	DF, wet
Sorex cinereus	6/7/96	Schoodic	SH1-0607-1	5	93	40	DF, wet
Sorex cinereus	6/12/96	Schoodic	SH5-0612-2	3.75	94	45	DF, wet
Sorex cinereus	6/12/96	Schoodic	SH5-0612-4	3.5	97	45	DF, wet
Sorex cinereus	6/12/96	Schoodic	SH5-0612-5	5.25	100	45	DF, wet
Sorex cinereus	6/12/96	Big Moose	BM2-0612-2	5.5	99	49	DF, wet
Sorex cinereus	6/17/96	Corea	CR1-0617-3	4	94	44	DF, wet
Sorex cinereus	6/17/96	Corea	CR1-0617-5	4.75	101	46	DF, wet
Sorex cinereus	6/17/96	Corea	CR1-0617-6	5	99	44	DF, wet
Sorex cinereus	6/17/96	Corea	CR2-0617-1	5	90	40	DF, wet
Sorex cinereus	6/17/96	Schoodic	SH4-0617-1	3.5	93	45	DF, wet
Sorex cinereus	6/17/96	Schoodic	SH5-0617-2	3.25	92	46	DF, wet

Species	Date	Site	Collection Number	Weight in grams	Total Length (mm)	Tail Length (mm)	Capture Technique & Remarks
Sorex cinereus	6/12/96	Schoodic	SH5-0612-1	5.75	102	47	DF, wet
Sorex cinereus	6/12/96	Schoodic	SH4-0612-4	4.5	93	44	DF, wet
Sorex cinereus	6/12/96	Schoodic	SH3-0612-3	3.5	101	47	DF, wet
Sorex cinereus	6/21/96	Schoodic	SH4-0621-3	3.5	91	45	DF, wet
Sorex cinereus	6/21/96	Schoodic	SH3-0621-1a	3.5	93	45	DF, wet
Sorex cinereus	6/21/96	Schoodic	SH3-0621-1b	3.5	94	44	DF, wet
Sorex cinereus	6/21/96	Big Moose	BM1-0621-1	3.25	95	45	DF, wet
Sorex cinereus	6/19/96	Corea	CR1-0619-1	5	95	41	DF, wet, part eaten
Sorex cinereus	6/19/96	Big Moose	BM1-0619-1	5.5	104	46	DF, wet
Sorex cinereus	6/19/96	Big Moose	BM1-0619-2	3.5	96	44	DF, wet
Sorex cinereus	6/19/96	Big Moose	BM1-0619-3	3.5	100	45	DF, wet
Sorex cinereus	6/19/96	Big Moose	BM2-0619-1	5.25	99	42	DF, wet, part eaten
Sorex cinereus	6/19/96	Schoodic	SH1-0619-1	3.5	98	46	DF, wet
Sorex cinereus	6/19/96	Schoodic	SH1-0619-2	4.5	99	40	DF, wet
Sorex cinereus	6/19/96	Schoodic	SH2-0619-1	3.5	95	43	DF, wet
Sorex cinereus	6/19/96	Schoodic	SH3-0619-1	5.5	95	40	DF, wet
Sorex cinereus	6/19/96	Schoodic	SH3-0619-2	3.25	96	48	DF, wet
Sorex cinereus	6/19/96	Schoodic	SH3-0619-3	4	97	47	DF, wet
Sorex cinereus	6/19/96	Schoodic	SH3-0619-4	3.5	91	45	DF, wet
Sorex cinereus	6/19/96	Schoodic	SH4-0619-1	4	96	46	DF, wet
Sorex cinereus	6/19/96	Schoodic	SH5-0619-1	4.5	93	37	DF, wet
Sorex cinereus	6/19/96	Schoodic	SH5-0619-2	3.75	98	46	DF, wet
Sorex cinereus	6/21/96	Corea	CR1-0621-1	2.75	87	39	DF, wet
Sorex cinereus	6/21/96	Corea	CR1-0621-2	3.25	94	45	DF, wet
Sorex cinereus	6/21/96	Corea	CR1-0621-3	5	94	42	DF, wet
Sorex cinereus	6/21/96	Big Moose	BM2-0621-1	3	91	45	DF, wet
Sorex cinereus	6/21/96	Big Moose	BM1-0621-4	3.5	98	49	DF, wet
Sorex cinereus	6/21/96	Schoodic	SH5-0621-1	3.5	96	42	DF, wet

Species	Date	Site	Collection Number	Weight in grams	Total Length (mm)	Tail Length (mm)	Capture Technique & Remarks
Sorex cinereus	6/21/96	Schoodic	SH5-0621-2	3.5	92	44	DF, wet
Sorex cinereus	6/21/96	Schoodic	SH5-0621-3	3.5	100	45	DF, wet
Sorex cinereus	6/21/96	Schoodic	SH4-0621-2	3.25	92	41	DF, wet
Sorex cinereus	6/21/96	Schoodic	SH4-0621-5	3	92	44	DF, wet
Sorex cinereus	6/21/96	Schoodic	SH3-0621-1	3.5	93	46	DF, wet
Sorex cinereus	4/24/96	Big Moose	BM2-0424-1	4.5	104	43	DF, wet
Sorex cinereus	4/24/96	Big Moose	BM2-0424-2	4	97	43	DF, wet
Sorex cinereus	4/24/96	Big Moose	BM2-0424-3	3.5	85	43	DF, wet
Sorex cinereus	4/24/96	Big Moose	BM2-0424-4	4.5	97	41	DF, wet
Sorex cinereus	4/24/96	Big Moose	BM1-0424-1	5	99	43	DF, wet
Sorex cinereus	4/24/96	Big Moose	BM1-0424-2	4.5	98	43	DF, wet
Sorex cinereus	4/26/96	Big Moose	BM1-0426-1	4.5	98	42	DF, wet
Sorex cinereus	5/1/96	Big Moose	BM1-0501-1	5.75	97	40	DF, wet
Sorex cinereus	5/1/96	Big Moose	BM2-0501-1	5	96	43	DF, wet
Sorex cinereus	5/13/96	Big Moose	BM2-0513-2	4.5	91	42	DF, wet
Sorex cinereus	5/20/96	Corea	CR2-0520-1	6.5	107	44	DF, wet
Sorex cinereus	4/6/96	Schoodic	SH2-0406	1	3.5	88	43DF, wet
Sorex cinereus	4/12/96	Schoodic	SH1-0412-4	5	96	42	DF, wet
Sorex cinereus	4/12/96	Schoodic	SH1-0412-5	4	92	45	DF, wet
Sorex cinereus	4/12/96	Schoodic	SH4-0412-2	4.5	93	40	DF, wet
Sorex cinereus	4/12/96	Schoodic	SH4-0412-3	4.5	90	46	DF, wet
Sorex cinereus	4/12/96	Big Moose	BM2-0412-1	4.25	91	41	DF, wet
Sorex cinereus	4/16/96	Big Moose	BM2-0416-1	5	98	47	DF, wet
Sorex cinereus	4/16/96	Schoodic	SH2-0416-1	4	90	41	DF, wet
Sorex cinereus	4/16/96	Schoodic	SH3-0416-1	6	103	45	DF, wet
Sorex cinereus	4/19/96	Schoodic	SH2-0419-1	5.5	95	44	DF, wet
Sorex cinereus	4/19/96	Big Moose	BM2-0419-1	4	101	45	DF, wet
Sorex cinereus	4/19/96	Big Moose	BM2-0419-2	4.4	99	43	DF, wet
Sorex cinereus	4/20/96	Schoodic	SH3-0420-1	4.5	100	45	DF, wet

Species	Date	Site	Collection Number	Weight in grams	Total Length (mm)	Tail Length (mm)	Capture Technique & Remarks
Sorex cinereus	4/24/96	Schoodic	SH3-0424-1	4	103	45	DF, wet
Sorex cinereus	4/24/96	Schoodic	SH3-0424-2	5.5	102	46	DF, wet
Sorex cinereus	4/24/96	Schoodic	SH2-0424-1	4.25	97	42	DF, wet
Sorex cinereus	4/24/96	Schoodic	SH2-0424-2	4.5	99	44	DF, wet
Sorex cinereus	4/24/96	Schoodic	SH2-0424-3	4.75	93	41	DF, wet
Sorex cinereus	4/24/96	Corea	CR1-0424-1	4	95	38	DF, wet
Sorex cinereus	4/24/96	Corea	CR1-0424-2	5	101	45	DF, wet
Sorex cinereus	5/1/96	Big Moose	BM1-0501-3	5.25	99	46	DF, wet
Sorex cinereus	5/1/96	Big Moose	BM1-0501-2	5	97	39	DF, wet
Sorex cinereus	5/1/96	Corea	CR1-0501-1	5	93	43	DF, wet
Sorex cinereus	5/10/96	Schoodic	SH3-0510-1	5.5	95	46	DF, wet
Sorex cinereus	5/13/96	Schoodic	SH3-513-1	5.5	100	45	DF, wet
Sorex cinereus	5/13/96	Big Moose	BM1-0513-1	5	99	41	DF, wet
Sorex cinereus	5/17/96	Corea	CR1-0517-1	5.25	99	4.5	DF, wet
Sorex cinereus	5/17/96	Schoodic	SH3-0517-2	5	94	42	DF, wet
Sorex cinereus	6/23/96	Schoodic	SH1-0623-1	4	94	40	DF, wet
Sorex cinereus	6/23/96	Schoodic	SH1-0623-3	6	105	46	DF, wet
Sorex cinereus	6/23/96	Schoodic	SH1-0623-4	5	96	40	DF, wet
Sorex cinereus	6/23/96	Schoodic	SH1-0623-5	4	95	46	DF, wet
Sorex cinereus	6/23/96	Schoodic	SH1-0623-6	5.5	104	43	DF, wet
Sorex cinereus	6/23/96	Schoodic	SH1-0623-7	5.25	61 (Body)	none	DF, wet, no tail
Sorex cinereus	6/23/96	Schoodic	SH1-0623-8	5.75	109	45	DF, wet
Sorex cinereus	6/23/96	Schoodic	SH2-0623-1	4	97	47	DF, wet
Sorex cinereus	6/23/96	Schoodic	SH2-0623-2	4	101	50	DF, wet
Sorex cinereus	6/23/96	Schoodic	SH3-0623-4	3.25	90	43	DF, wet
Sorex cinereus	6/23/96	Schoodic	SH5-0623-1	3.5	97	47	DF, wet
Sorex cinereus	6/23/96	Schoodic	SH5-0623-2	3.5	94	45	DF, wet
Sorex cinereus	6/23/96	Schoodic	SH5-0623-3	3.75	97	44	DF, wet
Sorex cinereus	6/23/96	Schoodic	SH5-0623-4	5.25	98	46	DF, wet

Species	Date	Site	Collection Number	Weight in grams	Total Length (mm)	Tail Length (mm)	Capture Technique & Remarks
Sorex cinereus	6/23/96	Schoodic	SH5-0623-5	3.5	96	46	DF, wet
Sorex cinereus	6/23/96	Schoodic	SH5-0623-6	4.25	99	49	DF, wet
Sorex cinereus	6/23/96	Schoodic	SH5-0623-7	3.5	95	46	DF, wet
Sorex cinereus	6/24/96	Corea	CR2-0624-1	3.75	89	46	DF, wet
Sorex cinereus	6/28/96	Corea	CR1-0628-1	3.25	95	45	DF, wet
Sorex cinereus	6/28/96	Schoodic	SH1-0628-2	3.25	90	48	DF, dry
Sorex cinereus	6/28/96	Schoodic	SH5-0628-2	3.75	100	48	DF, wet
Sorex cinereus	7/12/96	Schoodic	MM?-0712	2.5	85	41	LT, dry, no transect data
Sorex fumeus	6/28/96	Big Moose	BM2-0628-1	10.8	110	42	DF, pregnant
Sorex fumeus	6/25/96	Big Moose	MM3-3-0625	8	105	44	LT, wet
Sorex fumeus	6/24/96	Corea	CR2-0624-1	7	107	45	DF, wet wt.
Sorex fumeus	7/23/96	Big Moose	MM3-4-0723	5.8	111	49	LT, dry
Sorex fumeus	6/23/96	Big Moose	BM1-0623-3	9.3	115	45	DF, wet wt
Sorex fumeus	6/23/96	Big Moose	BM1-0623-4	6.5	109	49	DF, wet wt
Sorex fumeus	6/23/96	Big Moose	BM2-0623-5	7.5	108	50	DF, wet wt
Sorex fumeus	6/23/96	Big Moose	BM1-0623-7	6	111	49	DF, wet wt
Sorex fumeus	6/23/96	Big Moose	BM1-0623-9	8.8	111	44	DF, wet wt.
Sorex fumeus	6/5/96	Schoodic	SH4-0605-2	8.3	111	44	DF, wet wt.
Sorex fumeus	6/5/96	Big Moose	BM2-0605-1	6.5	110	50	DF, wet wt.
Sorex fumeus	6/5/96	Corea	CR2-0605-3	7.3	105	40	DF, wet wt, dark coat
Sorex fumeus	6/7/96	Corea	CR1-0607-1	6.3	111	52	DF, wet wt.
Sorex fumeus	5/30/96	Big Moose	MM3-5-0530	8.3	102	42	LT, dry, tail damage
Sorex fumeus	6/12/96	Schoodic	SH5-0612-3	6	106	45	DF, wet wt.
Sorex fumeus	6/12/96	Big Moose	BM1-0612-3	5.5	105	50	DF, wet wt. dark pelage
Sorex fumeus	6/21/96	Big Moose	BM1-0621-2	10	114	46	DF, wet wt.
Sorex fumeus	6/19/96	Big Moose	BM1-0619-4	5.5	112	46	DF, wet

Species	Date	Site	Collection Number	Weight in grams	Total Length (mm)	Tail Length (mm)	Capture Technique & Remarks
Sorex fumeus	4/24/96	Schoodic	SH4-0424-3	8.2	112	46	DF, wet
Sorex fumeus	4/24/96	Big Moose	BM1-0424-3	10.3	125	48	DF, wet
Sorex fumeus	5/20/96	Schoodic	SH5-0520-1	6	110	45	DF, wet
Sorex fumeus	6/12/96	Schoodic	SH3-0612-4	10.2	113	43	DF, wet
Sorex fumeus	4/9/96	Schoodic	SH4-0409-1	8	110	39	DF, wet
Sorex fumeus	5/20/96	Schoodic	SH4-0520-1	8.3	104	49	DF, wet
Sorex fumeus	5/17/96	Schoodic	SH3-0517-1	9.2	107	45	DF, wet
Sorex fumeus	4/24/96	Schoodic	SH4-0424-2	9	115	43	DF, wet
Sorex palustris	6/23/96	Schoodic	SH3-0623-1	11.25	139	65	DF, snout missing, wet
Sorex palustris	6/10/96	Corea	CR2-0610-5	11	139	68	DF, wet
Sorex palustris	6/5/96	Corea	CR1-0605-1	10.75	138	67	DF, dry
Sorex (Microsorex) thompsoni	6/23/96	Schoodic	SH2-0623-2	2.5	77	32	DF, wet
Sorex thompsoni	6/28/96	Big Moose	BM1-0628-1	2.25	75	34	DF, wet
Sorex (Microsorex) thompsoni	6/10/96	Big Moose	BM2-0610-7	4	84	31	DF, wet
S. (Microsorex) thompsoni	6/12/96	Corea	CR1-0612-4	2.75	73	30	DF, wet
S. (Microsorex) thompsoni	5/20/96	Schoodic	SH4-0520-3	4.5	88	32	DF, wet
S. (Microsorex) thompsoni	4/29/96	Big Moose	BM2-0429-1	3.5	81	31	DF, wet
S. (Microsorex) thompsoni	5/10/96	Big Moose	BM2-0510-1	4	86	32	DF, wet
S. (Microsorex) thompsoni	5/10/96	Big Moose	BM2-0510-2	5	86	32	DF, wet
S. (Microsorex) thompsoni	5/13/96	Big Moose	BM2-0513-1	3.5	80	31	DF, wet
S. (Microsorex) thompsoni	5/13/96	Schoodic	SH2-0513-1	4.5	91	33	DF, wet
S. (Microsorex) thompsoni	5/13/96	Schoodic	SH3-0513-2	4	84	30	DF, wet

Species	Date	Site	Collection Number	Weight in grams	Total Length (mm)	Tail Length (mm)	Capture Technique & Remarks
S. (Microsorex) thompsoni	5/15/96	Big Moose	BM2-0515-1	3.5	78	30	DF, wet
Rodentia							
Microtus pennsylvanicus	6/10/96	Schoodic	SH1-0610-3	28.25	144	44	DF, wet
Peromyscus maniculatus	6/12/96	Corea	CR2-0612-3	11.75	125	62	DF, wet
Tamiasciurus hudsonicus	7/2/96	Big Moose	MM4-10-0702				not measured
Zapus hudsonius	5/20/96	Corea	CR2-0520-2	17.5	196	120	DF, wet
Zapus hudsonius	6/5/96	Corea	CR2-0605-2	23	200	124	DF, wet
Zapus hudsonius	6/5/96	Schoodic	SH3-0605-1	24	224	141	DF, wet
Zapus hudsonius	6/10/96	Big Moose	BM2-0610-2	23.75	222	138	DF, wet
Zapus hudsonius	no date	Schoodic	no number	15	167	85	Found on Loop Road

Appendix 6. Land Mammal Species Recorded from the Schoodic Region. Records of a species present at each of the three sites are indicated by an X. An asterisk (*) indicates a species first recorded at that site during this study in 1996.

	Study Site		
Mammal Species	Schoodic	Big Moose Island	Corea
Short-tailed Shrew, *Blarina brevicauda*	X	X	X*
Masked Shrew, *Sorex cinereus*	X	X	X
Smoky Shrew, *Sorex fumeus*	X	X	X
Water Shrew, *Sorex palustris*	X*	X	X*
Pygmy Shrew, *Sorex (Microsorex) hoyi*	X*	X	X
Hairy-tailed Mole, *Parascalops breweri*		X*	
Star-nosed Mole, *Condylura cristata*	X*		X
Little Brown Bat, *Myotis lucifugus*	X*	X*	X*
Northern Long-eared Bat, *Myotis septentrionalis*	X	X*	X*
Small-footed Bat or Small-footed Myotis, *Myotis leibii*	X*		
Big Brown Bat, *Eptesicus fuscus*	X*		X*
Hoary Bat, *Lasiurus cinereus*	X*		
Red Bat, *Lasiurus borealis*	X*		
Coyote, *Canis latrans*	X	X	X
Red Fox, *Vulpes vulpes*	X		X
Black Bear, *Ursus americanus*	X	X	
Raccoon, *Procyon lotor*	X	X	X
Short-tailed Weasel or Ermine, *Mustela erminea*			X*
Long-tailed Weasel, *Mustela frenata*	X		
Mink, *Mustela vison*	X	X	X
Fisher, *Martes pennanti*	X		
River Otter, *Lutra canadensis*	X		

	Study Site		
	Schoodic	Big Moose Island	Corea
Striped Skunk, *Mephitis mephitis*	X		
Bobcat, *Felis (Lynx) rufus*	X		
Snowshoe Hare, *Lepus americanus*	X	X	X
Beaver, *Castor canadensis*	X*		X*
Eastern Chipmunk, *Tamias striatus*	X	X	X
Red Squirrel, *Tamiasciurus hudsonicus*	X	X	X
Gray Squirrel, *Sciurus carolinensis*	X		
Northern Flying Squirrel, *Glaucomys sabrinus*		X	
Deer Mouse, *Peromyscus maniculatus*	X	X	X
White-footed Mouse, *Peromyscus leucopus*	X*	X	
Muskrat, *Ondatra zibethica*	X		X*
Meadow Vole, *Microtus pennsylvanicus*	X*	X*	X*
Boreal Red-backed Vole, *Clethrionomys gapperi*	X	X	X
Southern Bog Lemming, *Synaptomys cooperi*	X	X	X
Meadow Jumping Mouse, *Zapus hudsonius*	X		X
Woodland Jumping Mouse, *Napaeozapus insignis*	X*	X	
Porcupine, *Erethizon dorsatum*	X	X	X
White-tailed Deer, *Odocoileus virginianus*	X	X	X
Moose, *Alces alces*	X	X	X

Appendix 7. Maps and locations of survey points for bird inventories.

UTM COORDINATES OF BIRD SURVEY POINTS BY STUDY SITE, 1996

The coordinates for survey points were estimated off of topographic maps. All coordinates are in the NAD-27 CORNUS datum.

LOCATION	EASTING	NORTHING
SCHOODIC PENINSULA:		
BBS POINT 20	574016	4913732
BBS POINT 21	573585	4913687
BBS POINT 22	573551	4913063
BBS POINT 23	573596	4912507
BBS POINT 24	573619	4911894
BBS POINT 25	573999	4910796
BBS POINT 26	574400	4910532
BBS POINT 27	574583	4910568
BBS POINT 28	574729	4910504
BBS POINT 29	74720	4910787
BBS POINT 30	574939	4910851
BBS POINT 31	575176	4910824
BBS POINT 32	575322	4910942
BBS POINT 33	574892	4910126
BBS POINT 34	575182	4909716
BIG MOOSE ISLAND:		
LOCATION	EASTING	NORTHING
MIST NET 1	574615	4909464
MIST NET 2	574557	4909446
MIST NET 3	574495	4909404
MIST NET 4	574472	4909455
MIST NET 5	574454	4909493
MIST NET 6	574500	4909520
MIST NET 7	574460	4909585
MIST NET 8	574535	4909522
MIST NET 9	574566	4909515
MIST NET 10	574664	4909536
FALL COUNT 1	574691	4909480
FALL COUNT 2	574582	4909555
FALL COUNT 3	574483	4909434
FALL COUNT 4	574372	4909390

FALL COUNT 5	574545	4909284
FALL COUNT 6	574672	4909515
FALL COUNT 7	574525	4909532
FALL COUNT 8	574417	4909591
FALL COUNT 9	574327	4909619
FALL COUNT 10	574355	4909697
FALL COUNT 11	574759	4909920
FALL COUNT 12	574718	4910024
FALL COUNT 13	574680	4910107
FALL COUNT 14	574860	4909882
FALL COUNT 15	574732	4909861
FALL COUNT 16	574677	4909849

BBS PT 35	575170	4909494
BBS PT 36	574664	4909467
BBS PT 37	574596	4909450
BBS PT 38	574375	4909394
BBS PT 39	574524	4909534
BBS PT 40	574415	4909591
BBS PT 41	574374	4909718
BBS PT 42	574687	4909650
BBS PT 43	574758	4909920
BBS PT 44	574717	4910022
BBS PT 45	574677	4910104
BBS PT 46	574867	4909940
BBS PT 47	574737	4909862
BBS PT 48	574677	4909845
BBS PT 49	574932	4909736
BBS PT 50	574901	4909386

COREA HEATH:

FALL COUNT 1	580302	4917588
FALL COUNT 2	580287	4917476
FALL COUNT 3	580275	4917322
FALL COUNT 4	580242	4917208
FALL COUNT 5	580343	4917190
FALL COUNT 6	580445	4917171
FALL COUNT 7	580403	4917062
FALL COUNT 8	580362	4916975
FALL COUNT 9	580069	4916667
FALL COUNT 10	579945	4917054
FALL COUNT 11	579990	4917164
FALL COUNT 12	579956	4917307

FALL COUNT 13	579768	4917261
FALL COUNT 14	580802	4917600
FALL COUNT 15	580952	4917517
FALL COUNT 16	581257	4917164

BBS PT 10	580186	4917823
BBS PT 11	580304	4917582
BBS PT 12	580287	4917466
BBS PT 13	580223	4917384
BBS PT 14	580804	4917593
BBS PT 15	580955	4917512
BBS PT 16	581257	4917158

BIRD SURVEY POINTS AT OTHER LOCATIONS:

BBS POINT 1	578129	4920829
BBS POINT 2	578129	4920473
BBS POINT 3	578189	4920117
BBS POINT 4	577754	4918277
BBS POINT 5	577635	4917961
BBS POINT 6	577595	4917724
BBS POINT 7	578466	4917110
BBS POINT 8	578782	4918139
BBS POINT 9	579237	4917942
BBS POINT 17	574455	4915841
BBS POINT 18	573734	4915633
BBS POINT 19	574138	4914443

LOCATIONS OF BREEDING BIRD SURVEY COUNT STATIONS IN SCHOODIC AND COREA STUDY AREAS AND ADJACENT LANDS, 1996:

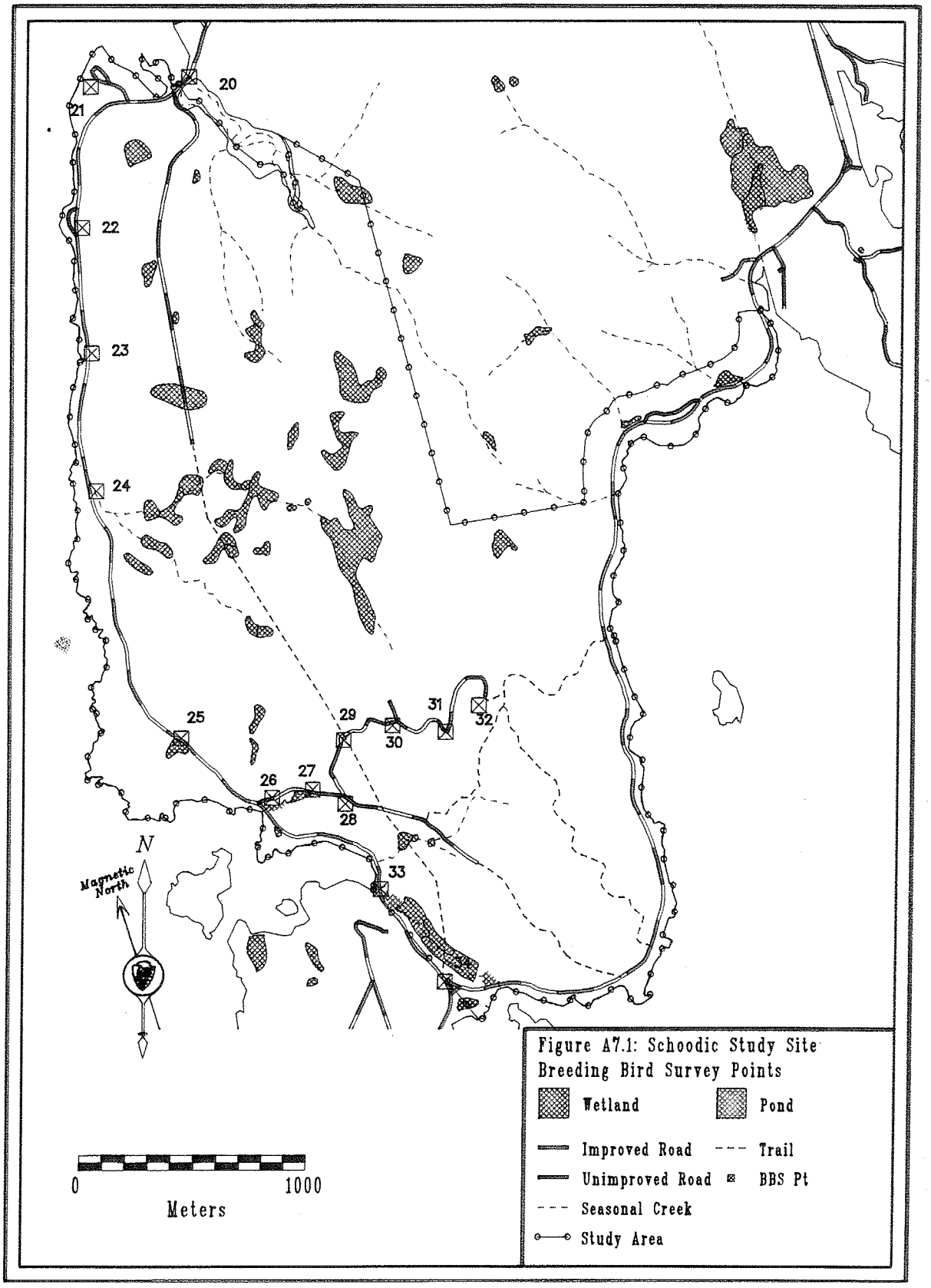
1. Rt. 186 Pole 42 ~75 m beyond Darthia Farm
2. Pole 46 « 2nd pole before house on rt..
3. Pole 103
4. Pole 206
5. Mile 4.8 Pole 195
6. Junct. 195
7. Gate navy Satellite Operation Center.
8. Rt. 195; Corner of Grand Marsh Bay Road.
9. Rt. 195; Power line crossing; Pole 43-1.
10. Rt. 195; Heath by curve sign before turn into base Pole 153/51 1.7 miles from Rt. 186.
11. Access Road to base by Cable crossing.
12. Access Road to base just before road curves right toward gate.
13. Inside gate to Navy facility in small parking area on left overlooking bog. Go to gate

house ask if you can stand ~50m from gate house and count birds for 3 minutes

14. Rt. 195; south of Access road. Pole
15. Rt. 195; south of Access road. Pole on both sides of road (open); forested within 30 m of point center.
16. Rt. 195; Small open blueberry barren on right 0.1 miles past the high security satellite navy area. There is a rock in middle of field. There is also a house 150 m beyond point on left.
17. Rt. 186 1.3 miles beyond Chipman's Irving station. Fen (open) on right.
18. Park Loop Road 0.3 miles from Rt. 195.
19. Park Loop Road (still 2-way road) 0.8 miles beyond bottom of a dip in road.
20. Park Loop Road North end of causeway just before turn to Fraizer Point.
21. Fraizer point picnic area in front of outhouse.
22. Park Loop Road (1-way section) 0.5 miles from turn to Fraizer Point Picnic Area.
23. Park Loop Road 0.5 miles from last stop; 1.0 mile from turn to Fraizer Point.
24. Park Loop Road 1.45-1.50 miles from Fraizer Point and turn There is a 5-stemmed red maple on right next to road.
25. Park Loop Road 2.0 miles. Open fen on right
26. Schoodic head access road 0.1 miles from Park Loop Road.
27. 0.1 miles father down road.
28. Where road divides to Ranger Station and Schoodic Head. Stand by gate to Ranger Station Road.
29. Continue toward Schoodic Head (go left where road divides at stop 28) Drive 0.45 miles to power line crossing.
30. Schoodic Head Road go 0.6 miles farther and stand along a cedar fence over top of a culvert.
31. Schoodic Head Road 0.8 miles, next to hair-pin turn. Small pull off next to (before) hairpin.
32. Top (end) of Schoodic Head Road. Stand facing open cliffs (look out towards ocean) Return to loop road when finished.
33. Park Loop Road Corner of Big Moore Island by lower end of salt marsh. Rocky ledge on your right by head of tide.
34. Park Loop road where it splits toward Schoodic Pt. (right split) and Birch Harbor (left split). Stand on road where split begins and count. Continue to right when finished.
35. Across from entrance to base (Quarter Deck) Park on main road before turning into base. There is a pull off there.
36. Drive to gym area. Walk down shore path about 50 meters.
37. Continue down shore path. There is a double flagging to metal tag on tree.
38. Continue down shore path. Stand 5.0 m from end of path where it reaches shore.
39. Walk back up hill. Bear left where shore path goes right (at ~top of hill). Continue to the Gym-Baseball field path. Turn right and walk 60 m toward gym. Look for tag on tree and double flagging.
40. Reverse direction (walk toward baseball field) Continue straight down long decline. You will see the sea on your left at the bottom of the long decline. Continue another 50 m

and stop next to an ~acre grove of white birches (tall) on your right.

41. Continue down trail towards baseball field.
42. Recreation cabin turn-around stand at lowest point of turn around.
43. Trailer #2; =point count #11
44. Road behind trailer 2 halfway to shore =point count #12
45. Same road near shore =Point count #13
46. Campground site #6
47. Path behind schooner club =Point Count #15 (Point count center is where path turns NW, and it turns again SW about 40m from first sharp turn.)
48. Path behind schooner club =Point Count #16 (50m before wetland on your wetland map.)
49. Trailer #3-5; after first trailer on left side of access road.
50. Near building #1; By turn around in front of building #1. Tennis courts (#17) located about 100m NE of point count center. Center by beginning of closed road.


20
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25
26
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28
29
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31
32
33
N
Magnetic North
0
1000
Meters
Figure A7.1: Schoodic Study Site
Breeding Bird Survey Points
Wetland
Pond
Improved Road
Trail
Unimproved Road
BBS Pt
Seasonal Creek
Study Area

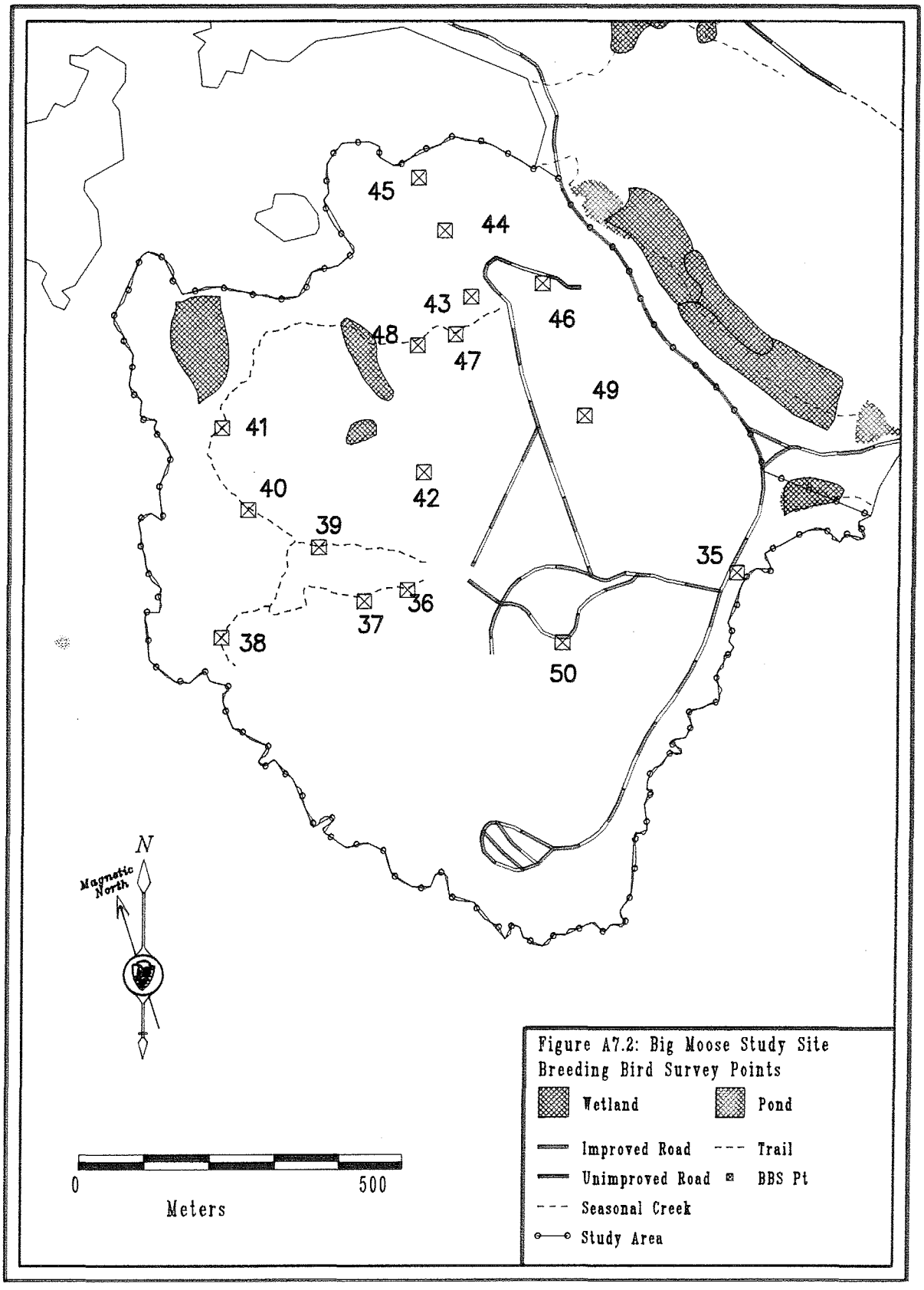
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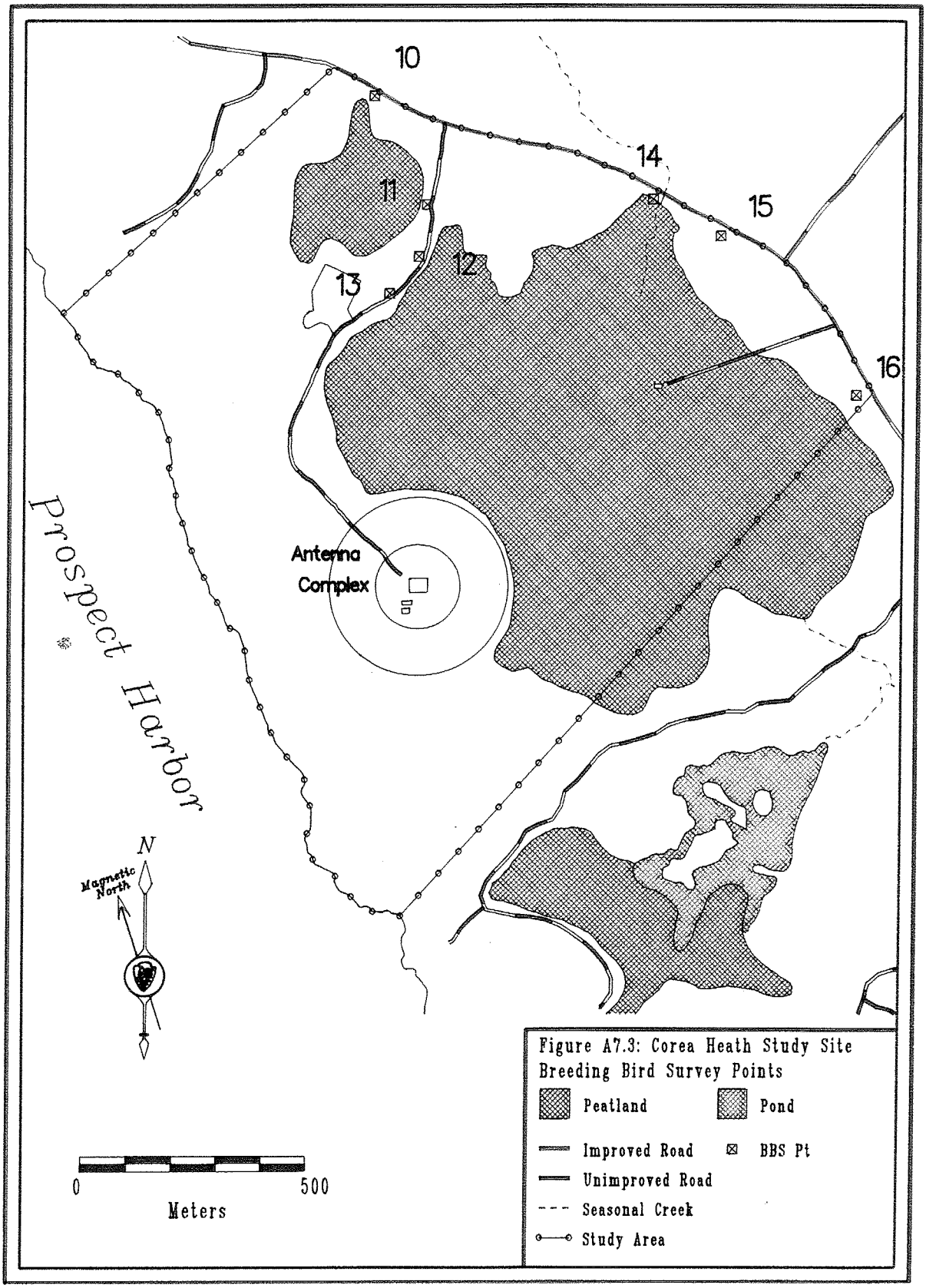
Figure A7.2: Big Moose Study Site
Breeding Bird Survey Points
Wetland
Pond
Improved Road
Trail
Unimproved Road
BBS Pt
Seasonal Creek
Study Area


10
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Antenna Complex
Prospect Harbor
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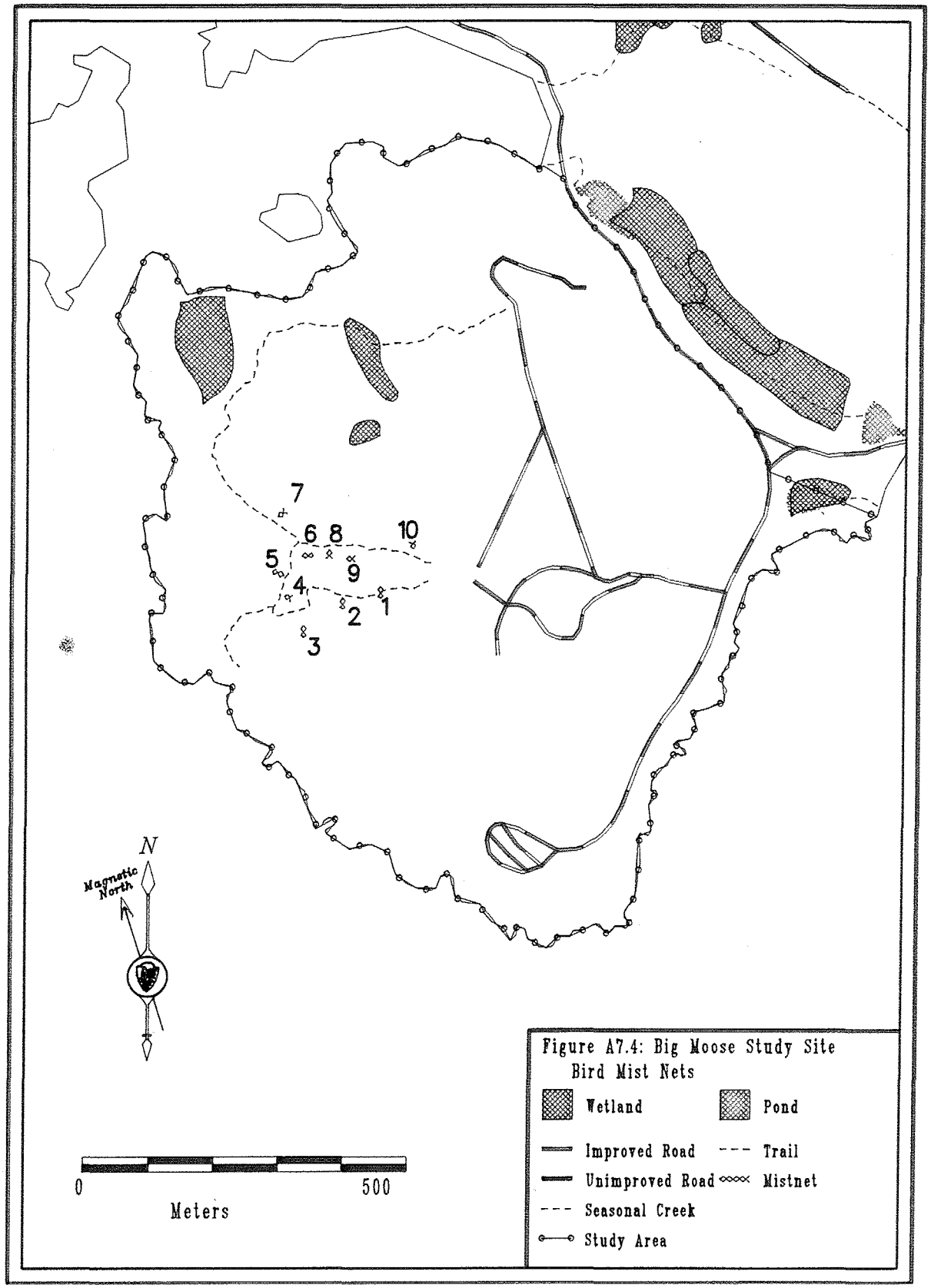
Figure A7.3: Corea Heath Study Site
Breeding Bird Survey Points
Peatland
Pond
Improved Road
BBS Pt
Unimproved Road
Seasonal Creek
Study Area


7
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Magnetic North
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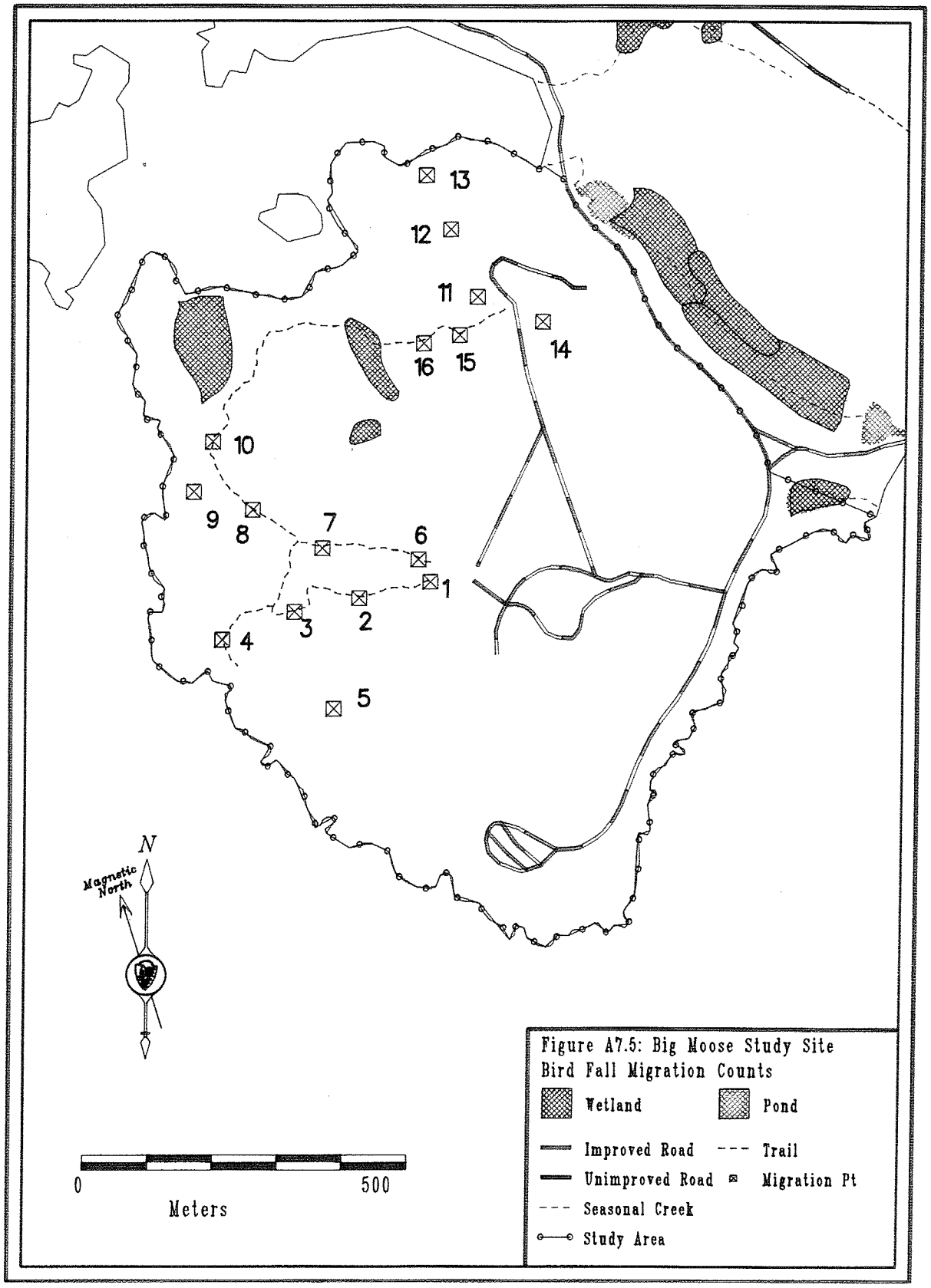
Meters
Figure A7.4: Big Moose Study Site
Bird Mist Nets
Wetland
Pond
Improved Road
Trail
Unimproved Road
Mistnet
Seasonal Creek
Study Area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Magnetic North
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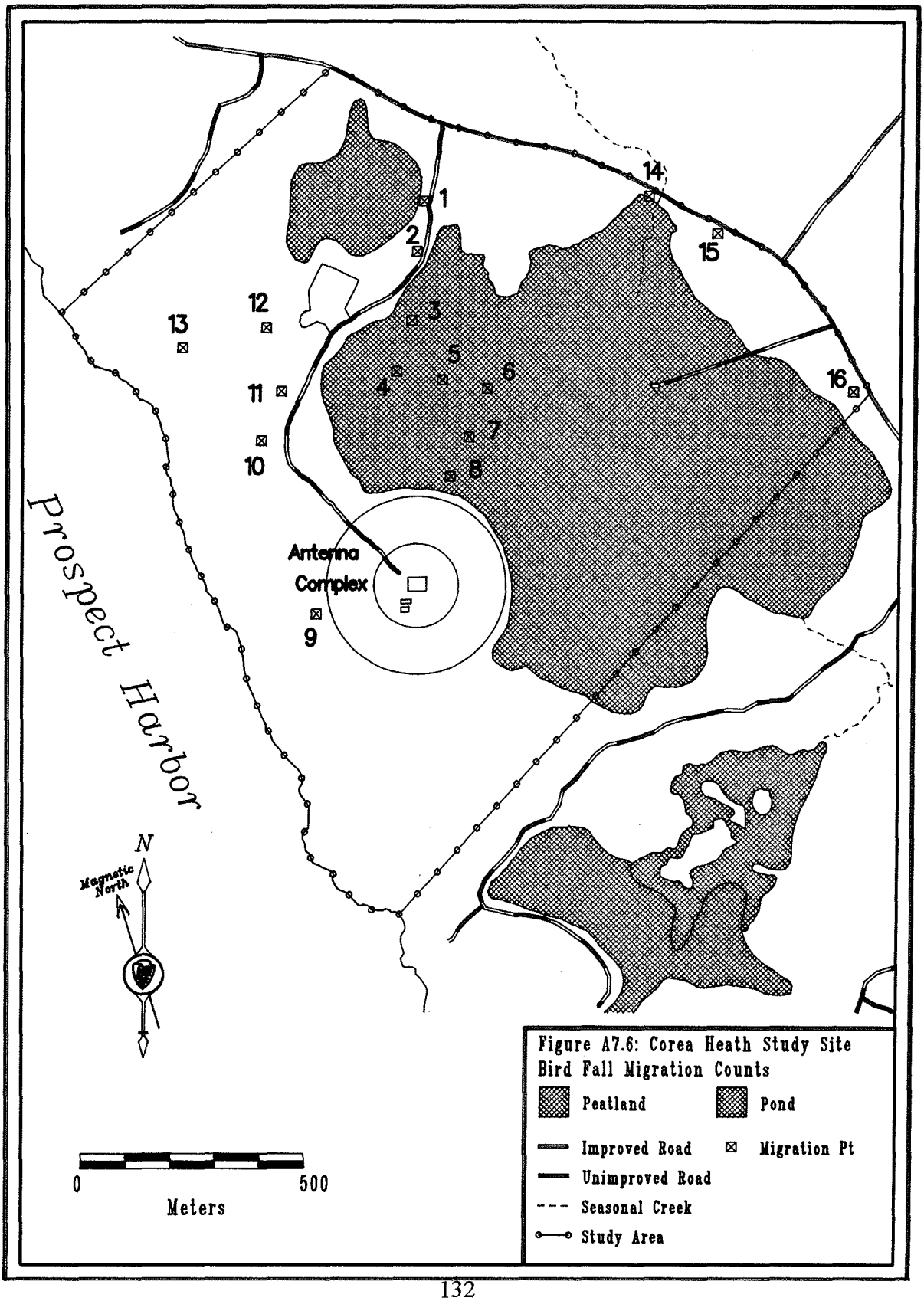
Figure A7.5: Big Moose Study Site
Bird Fall Migration Counts
Wetland
Pond
Improved Road
Trail
Unimproved Road
Migration Pt
Seasonal Creek
Study Area


Prospect Harbor
Antenna Complex
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Magnetic North
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Meters
Figure A7.6: Corea Heath Study Site
Bird Fall Migration Counts
Peatland
Pond
Improved Road
Migration Pt
Unimproved Road
Seasonal Creek
Study Area

Appendix 8. Results of fall migration area searches for birds at Schoodic Point and Corea Heath. In birds per year per area, by species. Total species: 1994=105, 1995=98, 1996=96, All 3 yrs = 134 sp.

	Corea Heath Area			Schoodic Point Area		
Species	1994	1995	1996	1994	1995	1996
Common Loon	2	1	-	-	7	2
Great Cormorant	-	-	-	1	1	-
Double-crested Cormorant	-	153	-	48	310	34
Northern Gannet	-	-	-	-	25	2
Great Blue Heron	-	-	-	8	7	3
Blue-winged Teal	-	-	1	-	-	-
American Black Duck	-	-	-	2	-	-
Mallard	-	-	-	2	-	-
Common Eider	-	-	-	3, 177	10, 089	5000
Surf Scoter	-	-	-	9	1	-
Oldsquaw	-	-	-	1	1	-
Red-breasted Merganser	-	-	-	5	8	65
Sora	-	-	-	1	-	-
Osprey	4	8	4	2	1	1
Northern Harrier	1	-	1	-	-	-
Sharp-shinned Hawk	2	1	1	3	4	2
Cooper's Hawk	-	-	-	-	-	3
American Kestrel	-	1	1	-	-	-
Merlin	-	-	1	2	1	2
Peregrine Falcon	-	-	1	-	-	1
Wild Turkey	-	1	-	-	-	2
Ruffed Grouse	-	-	1	1	3	1
Spruce Grouse	-	-	-	1	1	1
Long-billed Dowitcher	1	1	-	-	-	-
Killdeer	2	-	-	-	-	-
Greater Yellowlegs	-	2	-	-	-	-
Spotted Sandpiper	3	-	-	-	2	1
Willet	-	1	-	-	-	-

	Corea Heath Area			Schoodic Point Area		
Species	1994	1995	1996	1994	1995	1996
Whimbrel	-	2	-	-	-	-
Ruddy Turnstone	-	-	-	-	-	1
Least Sandpiper	-	-	-	2	-	1
Laughing Gull	3	4	2	1	-	-
Ring-billed Gull	-	-	-	1	3	-
Herring Gull	82	31	8	812	237	166
Great Black-backed Gull	4	-	-	57	17	24
Bonaparte's Gull	-	-	-	3	-	1
Black Guillemot	-	-	-	14	44	46
Mourning Dove	6	8	4	-	3	1
Barred Owl	-	-	-	-	1	-
Belted Kingfisher	-	-	1	2	1	3
Yellow-bellied Sapsucker	-	1	1	-	-	-
Downy Woodpecker	4	4	1	2	5	4
Hairy Woodpecker	-	1	1	-	4	1
Black-backed Woodpecker	-	-	-	1	1	-
Northern Flicker	12	24	6	8	7	12
Eastern Wood-pewee	2	-	-	-	-	-
Yellow-bellied Flycatcher	1	-	-	3	2	1
Alder Flycatcher	4	3	3	1	-	-
Least Flycatcher	-	1	-	-	1	1
Barn Swallow	-	1	-	-	-	-
Horned Lark	2	12	1	-	-	-
Gray Jay	1	-	-	-	-	1
Blue Jay	6	11	5	4	13	5
American Crow	294	143	88	156	50	56
Common Raven	10	10	8	8	11	7
Black-capped Chickadee	25	139	76	42	379	58
Boreal Chickadee	-	-	1	19	18	42
Red-breasted Nuthatch	-	2	-	5	25	11

	Corea Heath Area			Schoodic Point Area		
Species	1994	1995	1996	1994	1995	1996
White-breasted Nuthatch	-	-	-	-	1	-
Brown Creeper	-	-	-	-	9	2
Winter Wren	1	2	1	17	11	6
Sedge Wren	-	1	-	-	-	-
Golden-crowned Kinglet	5	37	-	107	247	101
Ruby-crowned Kinglet	3	13	13	17	23	8
Veery	1	-	1	1	1	-
Swainson's Thrush	1	-	3	5	3	15
Hermit Thrush	16	24	18	31	19	26
American Robin	191	60	8	8	15	8
Unidentified Thrush	2	-	-	-	-	2
Gray Catbird	7	17	7	2	2	1
Water Pipit	60	28	13	8	1	-
Bohemian Waxwing	40	-	-	8	-	-
Cedar Waxwing	70	26	72	60	6	40
European Starling	33	1	-	-	-	-
Solitary Vireo	1	4	5	7	17	10
Red-eyed Vireo	1	4	6	5	24	4
Tennessee Warbler	6	5	2	12	5	1
Orange-crowned Warbler	-	-	-	-	1	-
Nashville Warbler	-	1	2	1	2	3
Northern Parula	-	10	4	15	12	15
Yellow Warbler	2	-	-	1	-	-
Chestnut-sided Warbler	-	-	2	-	-	-
Magnolia Warbler	4	3	1	11	3	15
Cape May Warbler	2	-	-	1	-	-
Black-throated Blue Warbler	-	-	-	2	2	1
Yellow-rumped Warbler	230	167	153	199	190	128
Black-throated Green Warbler	14	12	9	28	40	61
Blackburnian Warbler	4	-	-	1	-	-

	Corea Heath Area			Schoodic Point Area		
Species	1994	1995	1996	1994	1995	1996
Pine Warbler	7	-	-	-	-	-
Palm Warbler	60	63	121	10	15	9
Bay-breasted Warbler	1	-	3	2	5	1
Blackpoll Warbler	-	1	3	4	2	8
Bay-breasted/ Blackpoll	-	-	-	3	1	4
Black-and-white Warbler	5	4	11	8	19	9
Connecticut Warbler	-	-	-	-	2	-
Mourning Warbler	-	-	2	-	1	1
Wilson's Warbler	1	8	9	-	1	1
Canada Warbler	2	1	-	2	2	3
American Redstart	7	2	26	4	2	5
Northern Waterthrush	2	3	2	1	1	5
Common Yellowthroat	110	156	305	8	42	36
Yellow-breasted Chat	-	1	-	1	-	-
Unidentified Warbler	74	46	57	69	55	63
Scarlet Tanager	1	-	-	-	-	-
Northern Cardinal	-	1	-	-	-	-
Rose-breasted Grosbeak	1	1	-	-	-	1
Painted Bunting	-	-	-	1	-	-
Dickcissel	-	1	1	-	-	-
Eastern Towhee	-	-	1	-	-	-
Chipping Sparrow	3	-	12	-	-	-
Clay-colored Sparrow	1	-	-	-	-	-
Tree Sparrow	16	-	3	-	-	-
Vesper Sparrow	2	-	-	-	-	-
Savannah Sparrow	12	16	19	7	2	-
Grasshopper Sparrow	-	1	-	-	-	-
Song Sparrow	7	17	60	11	1	26
Lincoln's Sparrow	1	5	18	-	1	-
Swamp Sparrow	16	12	31	-	-	4

	Corea Heath Area			Schoodic Point Area		
Species	1994	1995	1996	1994	1995	1996
White-throated Sparrow	86	211	142	121	192	101
White-crowned Sparrow	12	2	9	2	-	-
Dark-eyed Junco	2	7	3	79	59	56
Dark-eyed Junco Oregon race	-	1	-	-	-	-
Unidentified Sparrow	14	14	47	7	3	8
Lapland Longspur	2	2	-	-	-	-
Snow Bunting	2	-	-	-	-	-
Bobolink	-	1	-	-	-	-
Common Grackle	-	-	-	-	-	2
Pine Grosbeak	-	-	-	-	-	2
Purple Finch	4	6	3	9	8	10
Red Crossbill	-	-	-	3	-	2
White-winged Crossbill	4	-	2	12	-	7
Common Redpoll	4	-	-	-	-	-
Pine Siskin	2	1	1	2	5	2
American Goldfinch	18	35	29	2	7	8
Evening Grosbeak	1	-	-	-	-	-
Total Species by Year (both areas)	105	98	96			
TOTAL BIRD SPECIES (over 3 yrs)	134					
MAMMALS: Red Squirrel	7	39	1	52	104	22
Chipmunk	-	1	-	-	-	-

Appendix 9. Scientific and Common Names of Bird Species Mentioned in this Report. Taxonomy follows Checklist of North American Birds, 7th edition (American Ornithologists' Union, 1998. Recent changes in common names are noted in parentheses.

Gavia immer Common Loon.
Phalacrocorax auritus Double-crested Cormorant.
Phalacrocorax carbo Great Cormorant.
Morus bassanus Northern Gannet.
Ardea herodias Great Blue Heron.
Anas rubripes American Black Duck.
Anas platyrhynchos Mallard.
Anas discors Blue-winged Teal.
Somateria mollissima Common Eider.
Melanitta perspicillata Surf Scoter.
Clangula hyemalis Oldsquaw.
Mergus serrator Red-breasted Merganser.
Porzana carolina Sora.
Pandion haliaetus Osprey.
Haliaeetus leucocephalus Bald Eagle.
Circus cyaneus Northern Harrier.
Accipiter striatus Sharp-shinned Hawk.
Accipiter cooperii Cooper's Hawk.
Falco sparverius American Kestrel.
Falco columbarius Merlin.
Falco peregrinus Peregrine Falcon.
Bonasa umbellus Ruffed Grouse.
Falcipennis canadensis Spruce Grouse.
Meleagris gallopavo Wild Turkey.
Charadrius vociferus Killdeer.
Catoptrophorus semipalmatus Willet.
Tringa melanoleuca Greater Yellowlegs.
Actitis macularia Spotted Sandpiper.
Numenius phaeopus Whimbrel.
Arenaria interpres Ruddy Turnstone.
Calidris minutilla Least Sandpiper.
Limnodromus scolopaceus Long-billed Dowitcher.
Gallinago gallinago Common Snipe.
Larus atricilla Laughing Gull.
Larus philadelphia Bonaparte's Gull.
Larus delawarensis Ring-billed Gull.
Larus argentatus Herring Gull.
Larus marinus Greater Black-backed Gull.
Cepphus grylle Black Guillemot.

Zenaida macroura Mourning Dove.
Strix varia Barred Owl.
Chaetura pelagica Chimney Swift.
Ceryle alcyon Belted Kingfisher.
Sphyrapicus varius Yellow-bellied Sapsucker.
Picoides pubescens Downy Woodpecker.
Picoides villosus Hairy Woodpecker.
Picoides arcticus Black-backed Woodpecker.
Dryocopus pileatus Pileated Woodpecker.
Colaptes auratus Northern Flicker. (Yellow-shafted Flicker)
Contopus virens Eastern Wood-Pewee.
Contopus cooperi Olive-sided Flycatcher.
Empidonax flaviventris Yellow-bellied Flycatcher.
Empidonax alnorum Alder Flycatcher.
Empidonax traillii Willow Flycatcher.
Empidonax minimus Least Flycatcher.
Sayornis phoebe Eastern Phoebe.
Myiarchus crinitus Great Crested Flycatcher.
Tyrannus tyrannus Eastern Kingbird.
Vireo solitarius Solitary Vireo (now Blue-headed Vireo).
Vireo olivaceus Red-eyed Vireo.
Perisoreus canadensis Gray Jay.
Cyanocitta cristata Blue Jay.
Corvus brachyrhynchos American Crow.
Corvus corax Common Raven.
Eremophila alpestris Horned Lark.
Tachycineta bicolor Tree Swallow.
Riparia riparia Bank Swallow.
Petrochelidon pyrrhonota Cliff Swallow.
Hirundo rustica Barn Swallow.
Poecile atricapillus Black-capped Chickadee.
Poecile hudsonicus Boreal Chickadee.
Sitta canadensis Red-breasted Nuthatch.
Sitta carolinensis White-breasted Nuthatch.
Certhia americana Brown Creeper.
Troglodytes aedon House Wren.
Troglodytes troglodytes Winter Wren.
Regulus satrapa Golden-crowned Kinglet.
Regulus calendula Ruby-crowned Kinglet.
Catharus fuscescens Veery.
Catharus bicknelli Bicknell's Thrush.
Catharus ustulatus Swainson's Thrush.
Catharus guttatus Hermit Thrush.

Turdus migratorius American Robin.
Dumetella carolinensis Gray Catbird.
Sturnus vulgaris European Starling. (Introduced)
Anthus rubescens Water Pipit (American Pipit).
Bombycilla garrulus Bohemian Waxwing.
Bombycilla cedrorum Cedar Waxwing.
Vermivora peregrina Tennessee Warbler.
Vermivora celata Orange-crowned Warbler.
Vermivora ruficapilla Nashville Warbler.
Parula americana Northern Parula.
Dendroica petechia Yellow Warbler.
Dendroica pensylvanica Chestnut-sided Warbler.
Dendroica magnolia Magnolia Warbler.
Dendroica tigrina Cape May Warbler.
Dendroica caerulescens Black-throated Blue Warbler.
Dendroica coronata Yellow-rumped Warbler.
Dendroica virens Black-throated Green Warbler.
Dendroica fusca Blackburnian Warbler.
Dendroica pinus Pine Warbler.
Dendroica palmarum Palm Warbler.
Dendroica castanea Bay-breasted Warbler.
Dendroica striata Blackpoll Warbler.
Mniotilta varia Black-and-white Warbler.
Setophaga ruticilla American Redstart.
Seiurus aurocapillus Ovenbird.
Seiurus noveboracensis Northern Waterthrush.
Oporornis agilis Connecticut Warbler.
Oporornis philadelphia Mourning Warbler.
Geothlypis trichas Common Yellowthroat.
Wilsonia pusilla Wilson's Warbler.
Wilsonia canadensis Canada Warbler.
Icteria virens Yellow-breasted Chat.
Piranga olivacea Scarlet Tanager.
Pipilo erythrophthalmus Eastern Towhee.
Spizella arborea Tree Sparrow (now American Tree Sparrow).
Spizella passerina Chipping Sparrow.
Spizella pallida Clay-colored Sparrow.
Pooecetes gramineus Vesper Sparrow.
Passerculus sandwichensis Savannah Sparrow.
Ammodramus savannarum Grasshopper Sparrow.
Melospiza melodia Song Sparrow.
Melospiza lincolnii Lincoln's Sparrow.
Melospiza georgiana Swamp Sparrow.

Zonotrichia albicollis White-throated Sparrow.
Zonotrichia leucophrys White-crowned Sparrow.
Junco hyemalis Dark-eyed Junco.
Calcarius lapponicus Lapland Longspur.
Plectrophenax nivalis Snow Bunting.
Cardinalis cardinalis Northern Cardinal.
Pheucticus ludovicianus Rose-breasted Grosbeak.
Passerina ciris Painted Bunting.
Spiza americana Dickcissel.
Dolichonyx oryzivorus Bobolink.
Agelaius phoeniceus Red-winged Blackbird.
Quiscalus quiscula Common Grackle.
Molothrus ater Brown-headed Cowbird.
Pinicola enucleator Pine Grosbeak.
Carpodacus purpureus Purple Finch.
Loxia curvirostra Red Crossbill.
Loxia leucoptera White-winged Crossbill.
Carduelis flammea Common Redpoll.
Carduelis pinus Pine Siskin.
Carduelis tristis American Goldfinch.
Coccothraustes vespertinus Evening Grosbeak.
Passer domesticus House Sparrow. (Introduced)