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Canada Goose Studies in the Maritime Provinces 1950-1992

Anthony J. Erskine

Environment Canada - Atlantic Region
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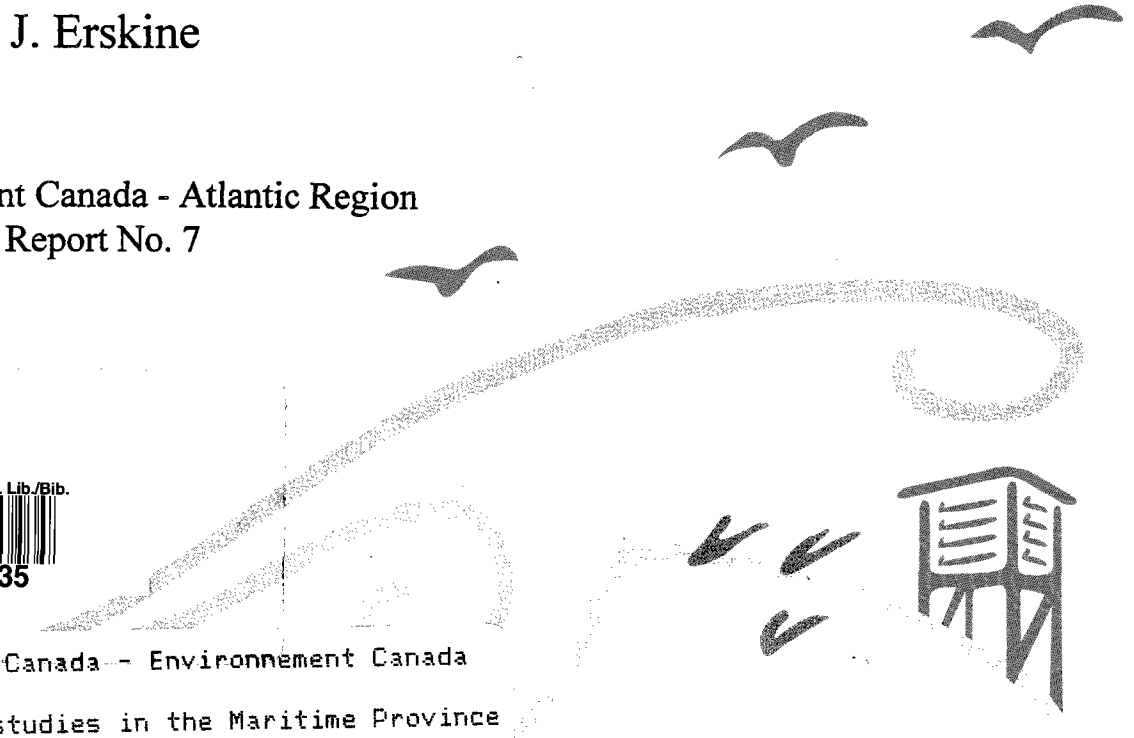

CANADA GOOSE STUDIES IN THE MARITIME PROVINCES 1950–1992

compiled, edited, and interpreted for

Environment Canada
Atlantic Region

by

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In remembrance of

Dr. Harrison Flint Lewis,

first Chief of the Canadian Wildlife Service,
who lived his last twenty years by the Sable River (N.S.)
Canada Goose sanctuary,

and

Dr. David Aird Munro,
first Chief Ornithologist of the Canadian Wildlife Service,
who in 1960 directed me to study Canada Geese in the Port Joli area
and thus provided the initial stimulus that led to the compiling of this compendium.

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Preamble

Canada Geese are the largest waterfowl that occur regularly in the Maritime Provinces of Canada. They are admired by almost everyone as a symbol of wild life, and they are pursued ardently by hunters throughout this region. Although small numbers breed in each province as a result of planned introductions or derived from free-flying birds out of captive flocks, Canada Geese occur here mainly as migrants in spring and fall. A few thousand geese wintered here as far back as records extend, and with milder winters the numbers remaining may have increased somewhat in recent decades. Wintering geese still comprise only a small proportion (10–20%) of the numbers that pass through in spring or fall.

The first investigation of Canada Geese in the Maritimes occurred a few years after the passage in 1917 of legislation putting into effect the Migratory Birds Convention (Lloyd 1923). Few other reports were published for many years, and most results of subsequent work still repose in government files and internal reports. One of my first assignments, after I joined the Canadian Wildlife Service (CWS) in 1960, was to investigate the "Canada Goose problem" around the Migratory Bird Sanctuaries on the South Shore of Nova Scotia. My studies in 1960–61, unpublished until now, are summarized in the second chapter of this compendium. That report provided me with a focus around which to assemble other unpublished materials that subsequently came to my attention, from studies by federal and provincial wildlife personnel and by university students and faculty. I noted the potential and the desirability of gathering together all these Canada Goose studies in the Maritimes as early as 1982, but the time I needed for assembling it was not available until 1992, after my retirement from CWS. The quantity of data available by then far exceeded my original expectations and allowed me to present a picture spanning the Maritimes, though the detail for different areas varied greatly (Figs. 1, 2).

This compilation used data collected, for other purposes, by many different people and agencies. I accepted most reports at face value, on the assumption that Canada Geese were a species unlikely to be misidentified by anyone who would make the effort to record the information on sightings. In some chapters, I commented critically on some reported estimates of numbers, and I discarded a few that seemed impossibly high. One (perhaps self-evident) caveat that applied in many chapters was that most surveys were focussed on areas where geese were known to concentrate, and coverage of other areas—especially inland areas—was incomplete or lacking in most periods. Undoubtedly, substantial numbers of geese were missed by most surveys, but comparisons between such surveys should be valid as long as their limitations are recognized.

Preliminary estimates of Canada Goose breeding populations and fall flight numbers in Newfoundland and Labrador were included in an earlier compendium (Erskine 1987). Those order-of-magnitude figures provided perspective for interpretation of the studies of migrating and wintering geese in the Maritimes that deal with the same stocks much more intensively than has been possible in the far-flung breeding areas.

Purposes and scope of this compendium

Two main goals provided the basis for this compilation. One was to assemble a resource document summarizing 40 years of unpublished Canada Goose data, mostly almost unknown outside the agencies that commissioned those surveys or studies. The other goal was to interpret the assembled information, not available to previous workers, in the context of flyway and nation, for which earlier compilations (based elsewhere; e.g. Hindman and Ferrigno 1990; Wendt and Boyd 1990) usually ignored this region or dismissed it as insignificant in the wider Canada Goose picture. Fifteen chapters present and discuss information from the individual goose staging and wintering areas in the Maritimes. These are followed by chapters on the few Canada Geese that breed here, on the habitats and foods used by staging and wintering geese, on the longer movements of geese shown by band recoveries and neck-collar sightings, and on the annual kill of Canada Geese by hunters and subsistence users in eastern Canada. A final chapter then discusses the place of these goose stocks in the wider Atlantic Flyway Canada Goose populations.

Literature cited

Erskine, A.J. ed. 1987. Waterfowl breeding population surveys, Atlantic Provinces. Can. Wildl. Serv. Occas. Paper no. 60. 80 pp.

Hindman, L.J., Ferrigno, F. 1990. Atlantic Flyway goose populations: status and management. Trans. N.Am. Wildl. Nat. Res. Conf., 55: 293–311.

Lloyd, H. 1923. Observations on the wintering flocks of Canada Geese in Nova Scotia. Can. Field-Nat. 37(2): 16–28.

Wendt, J.S., Boyd, H. 1990. Goose management in Canada. Trans. N.Am. Wildl. Nat. Res. Conf., 55: 333–337.

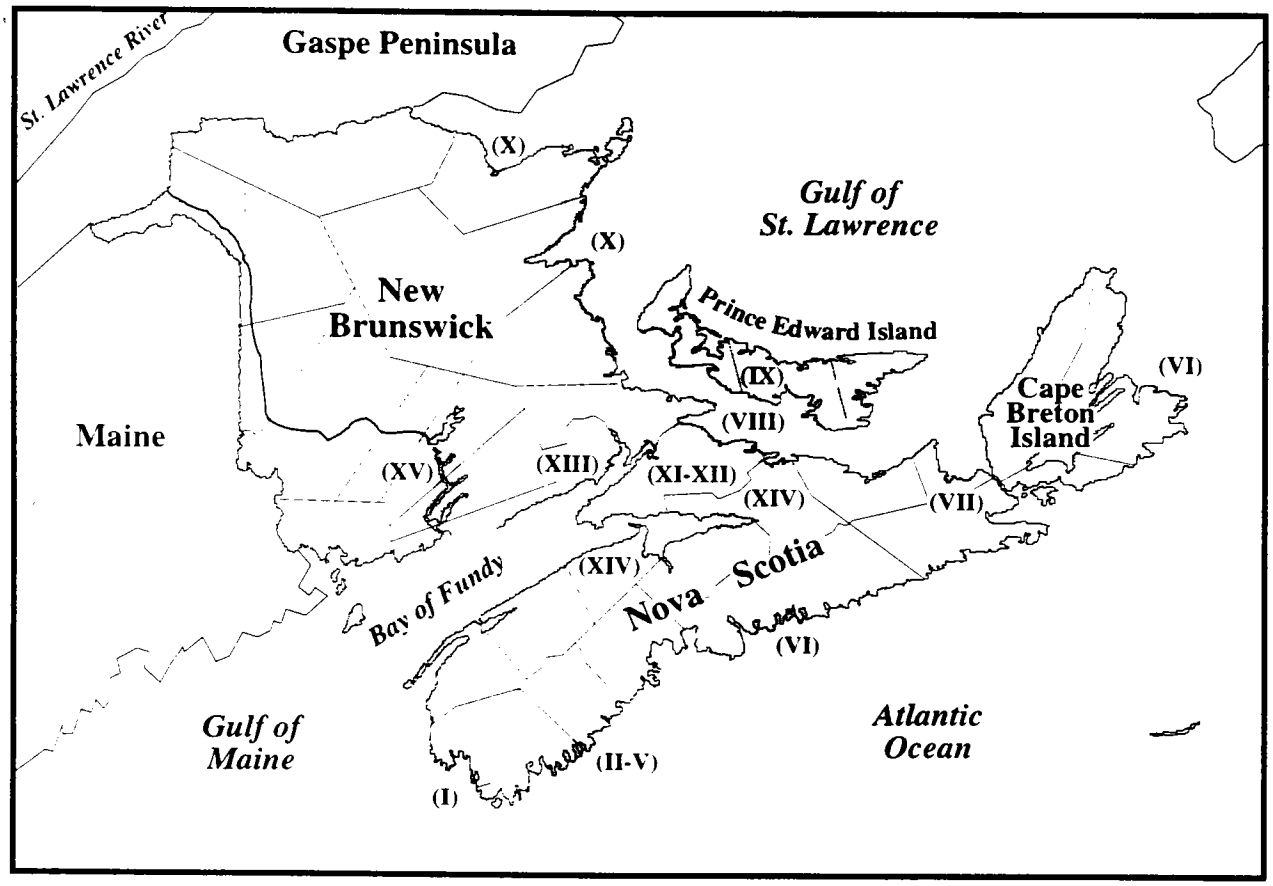

Figure 1 The Maritime Provinces of Canada: New Brunswick, Nova Scotia, Prince Edward Island. Shading shows the areas where Canada Geese stage or winter in this region, with Roman numerals indicating the chapters treating each area.

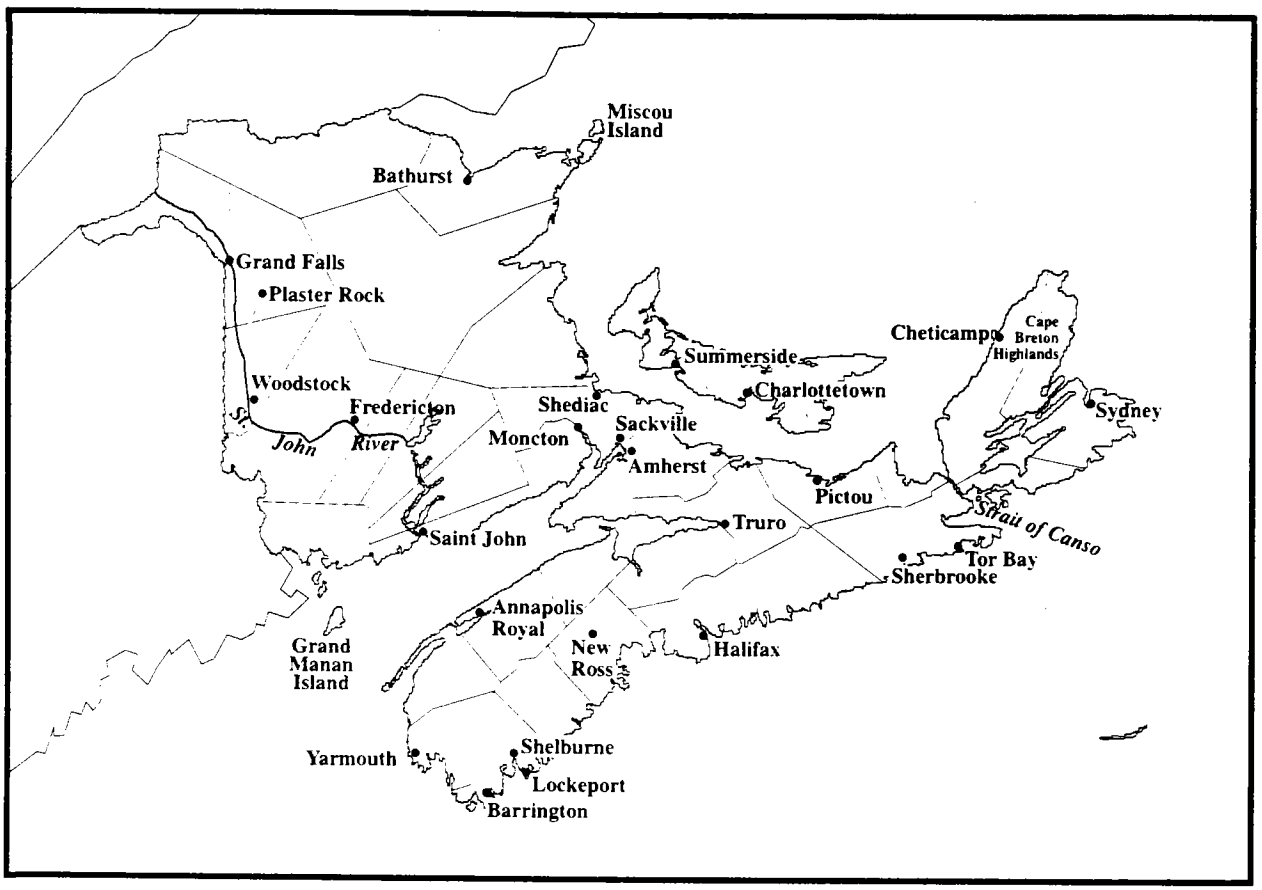

Figure 2 The Maritime Provinces of Canada, showing place-names cited in the text that do not appear on other maps in this volume.

A. ATLANTIC COASTS OF NOVA SCOTIA (SOUTH SHORE AND EASTERN SHORE IN LOCAL USAGE).

The general introduction is to Chapters II-V, on Canada Goose studies in and near Port Joli, including a historical summary of boundary changes affecting the Port Joli area sanctuary system, 1915-1933 (from unpublished report by C. MacKinnon, D. Amirault, and R. Hicks, CWS-AR, 1993); introductory matter on other goose areas is presented within Chapters I and VI.

by A.J. Erskine

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1. Preamble

Canada Geese have frequented the inlets of Port Joli, Port L'Hebert (pronounced "Labare"), and Sable River on the south shore of Nova Scotia since prehistoric times (Denys 1672; Lloyd 1923; J.S. Erskine 1966). Until climatic amelioration in the 1970s, this was the northernmost area where substantial numbers of geese wintered annually on the Atlantic seaboard (Bellrose 1976). Small flocks that survived some mild winters farther to the northeast were obliged to retreat, to Port Joli or farther, in more usual (cooler) years. Background information general to the next four chapters (II–V) in this compendium, and summarized in this section, includes descriptive material (section 2, section 3) from parallel accounts by A.J. Erskine (unpubl. CWS rpt. 1961) and Martell (1969), and a summary of boundary and regulation changes affecting the sanctuaries and goose hunting in the area (section 4), from a management summary by C.M. MacKinnon and co-workers (unpubl. CWS rpt. 1993).

2. Study area and climate

The Port Joli area (Fig. A-1) comprises the long narrow inlets of Port Joli, Port L'Hebert, and Sable River[1], which indent the southern shore of Nova Scotia near the Queens–Shelburne county line, together with parts of the seaward coastline between Southwest Port Mouton and Allandale. Reference to "the Port Joli area" in this compendium means this larger area covered in these studies, not just the inlet of that name.

From east of Port Joli across to the head of Port L'Hebert, the area is underlain by Devonian granodiorite, with poor thin soils, boulders, ridges, and rocky-shored lakes. In contrast, the outer coasts and Sable River lie on slates, argillite, and schists, or metamorphosed equivalents, of Pre-Cambrian to Ordovician (older) age (Taylor 1967), with clay soils, low hills, and frequent bogs. The region was glaciated by ice moving to the south-southwest, and the retreat of the ice left much glacial till and locally large schist boulders, with some eskers. The sea encroached on and drowned well-established forest growth at several spots along the outer coast, leaving tree-stumps protruding from a peaty layer near the low water mark (Taylor 1967; Martell 1969). The topography is a low (<30 m) coastal plain, with scattered hills rising to 40 to 60 metres. Much of the thin soil, especially in the granitic areas, has been washed from the land after forest fires. Haley Lake, Robertson Lake, Path Lake, and Wilkins Lake traditionally provided geese with fresh water resting areas locally.

The tidal range (1.2–2.4 m; 4–8 ft) exposes extensive mud flats in the upper parts of the inlets, although rocky islets and ledges, some covered at high tide, are frequent. Because of the wide entrance, tidal change in Port Joli is rapid, and in winter this often delays or prevents development of continuous ice-cover. The narrow entrance at Port L'Hebert causes tidal changes to be more gradual, and freezing in winter there is more rapid. In Sable River tidal changes are gradual, but currents from the two small rivers help to delay freezing there. Only brooks empty into the other inlets. The channels from all these streams meander through the flats to permanent (low) tide-water halfway down the inlets. Sand flats occur on the east side of Port Joli and at Louis Head Beach near the mouth of Sable River, and gravel bars emerge at low tide in mid-channel near the mouth of Port L'Hebert. Elsewhere the shores are broken and rocky, with tumbled heaps of boulders. The outer coasts feature rocky outcroppings, shingle spits, and fine sand beaches, with extensive barrier-beach lagoons at Matthews Lake, Johnston Pond, and Joli Basin.

The climate of the Atlantic shores of Nova Scotia is less severe than in the rest of the Maritime Provinces (Putnam 1940). The temperature rarely falls to –20°C (–4°F) even in the coldest winters, and most of the precipitation there falls as rain, with over 150 days per year having measurable precipitation. Climatic data for different coastal areas of the Maritimes are compared in Table A-1. The growing season in the Port Joli area extends from late April to early November, with an average length of 190 days. The frost-free period is about 140 days. Ice conditions in the sanctuaries are affected by the severity of the winter, by tide, and by winds. Most of the water area in the sanctuaries freezes at some time each winter, for varying periods.

[1] In this publication, the names Port Joli, Port L'Hebert, and Sable River mean the inlets, rather than any of the hamlets with those names, thus avoiding the anomalous and cumbersome names, such as "Port Joli Harbour", used in some earlier reports.

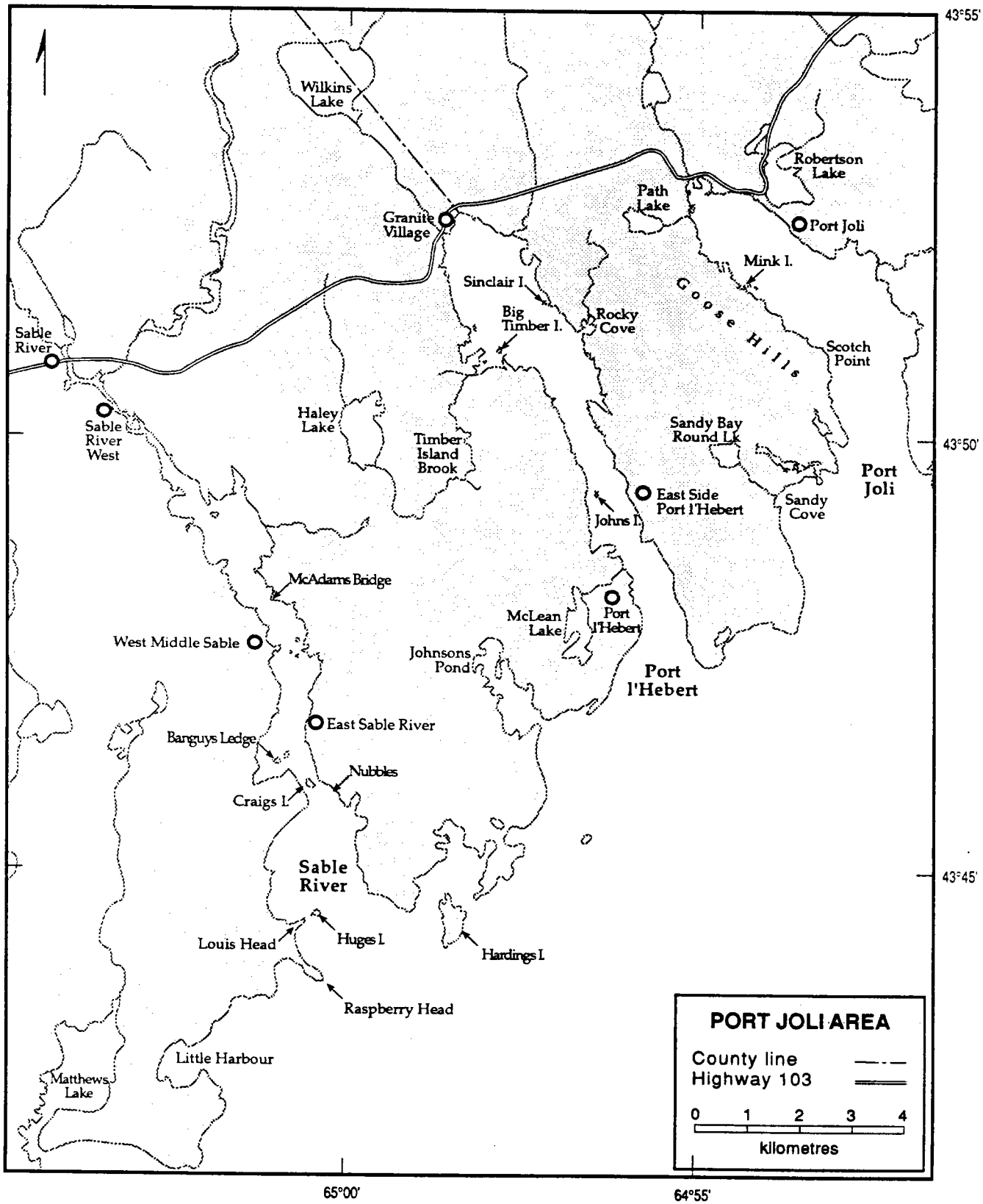

Figure A-1 The Port Joli area, Queens and Shelburne Counties, N.S., with place-names cited in Chapters II-IV.

Table A-1. Climatic data for centres in the Maritime Provinces, from *Climatic Summaries for Selected Meteorological Stations in the Dominion of Canada*, Dept. of Transport, Canada

Locality (Region)	Mean maximum/minimum temperatures (°C) in			Annual precipitation (mm)	
	Dec.	Jan.	Feb.	Total	Snow x 0.1[1]
Liverpool (South Shore)	+3/-6	+1/-10	+1/-11	1510	170
Annapolis Royal (Bay of Fundy)	+2/-6	0/-9	0/-9	1050	190
Saint John (Bay of Fundy)	0/-8	-2/-12	-2/-12	1070	180
Sydney (Cape Breton Island)	+2/-10	-1/-10	-2/-12	1270	250
Charlottetown (Prince Edward Island)	0/-8	-3/-12	-3/-13	1000	285
Chatham (Gulf of St. Lawrence)	-3/-12	-5/-17	-4/-17	1030	270

[1] The "water-equivalent" of snow was traditionally equated to one-tenth of the measured snowfall.

Owing to thin and unproductive soils and cool damp climate, tree growth is poor. Much of the land area, after wood-cutting and fires in the past, has only shrubby cover, mostly of alder (*Alnus rugosa*) and sweet-gale (*Myrica gale*) in damper areas, and hardhack (*Spiraea latifolia*) or bayberry (*Myrica pensylvanica*) on well-drained sites. Bogs, with leatherleaf (*Chamaedaphne calyculata*), Labrador tea (*Ledum groenlandicum*), and sheep laurel (*Kalmia angustifolia*), are frequent. Stunted white spruce (*Picea glauca*) is the main tree on the outer headlands, but black spruce (*P. mariana*) is prevalent on less well-drained soils and farther inland. Better tree growth, including some red oak (*Quercus borealis*), occurs inland, starting near the heads of the inlets and over the granite sub-stratum.

The mud flats, near and below the low tide mark, support lush growths of eel-grass (*Zostera marina*), particularly in the upper reaches of Port Joli and Port L'Hebert where windrows of detached plants mark the high-tide line. Sea-lettuce (*Ulva lactuca*) is common on muddy shoals near the harbour mouths, and rockweeds (*Fucus* spp. & *Ascophyllum nodosum*) coat wave-swept rocks on the outer coast, with kelps (*Laminaria* spp.) below the tidal zone. There are only small areas of salt-marsh, vegetated with cord-grasses (*Spartina alterniflora* & *S. patens*) and *Juncus gerardii* along the harbour edges, but more extensive grassy meadows, including dune-grass (*Ammophila breviligulata*) as well as cord-grasses, adjoin the barrier-beach lagoons. Extensive beds of mussels and clams occur on the gravel bars near the mouth of Port L'Hebert.

Port Joli and Port L'Hebert are up to 2 km wide in their inner areas, but the major feeding areas for geese are within gunshot of the shores in the northern ends of the bays. Sable River is much narrower, that estuary widening only below Louis Head Beach. The current from Sable and Tidney Rivers keeps certain areas within that estuary free of ice except in the most severe cold spells.

The Canada Land Inventory (field studies 1965–68) indicated generally low potential in the Port Joli area for forestry, agriculture, recreation, ungulates, and waterfowl production, with only its suitability as migration or wintering habitat for waterfowl ranking above average. Habitat development in the area was considered more likely to be productive if pursued with waterfowl and related recreational use as the primary objectives.

3. Historical and social background

Most people who do not hunt think that bird sanctuaries and refuges are created primarily to provide places where game-birds will not be disturbed by human activities and especially by hunting. Conversely, many hunters, and some provincial wildlife biologists, hold that bird sanctuaries are justified mainly to concentrate game birds so as to improve hunting nearby. When sanctuaries are established in areas far from cities, among people who traditionally used birds for food whenever they were available, these differing perceptions may be expected to cause problems. Such a situation has existed for many years in the Port Joli area, on Nova Scotia's South Shore.

In recognition of its importance as a wintering area for geese, perhaps as part of the wider conservation thrust that soon afterwards produced the Migratory Birds Convention (between the United States and Great Britain—for Canada) in 1916, a sanctuary in Port Joli to protect "wild geese" was first established by provincial statute in 1915. Protection was extended to other waterfowl in addition to geese in 1919, when areas at Port L'Hebert and Sable River were similarly protected (see below, section 4, by MacKinnon *et al.*).

No special enforcement efforts in the Port Joli area were made in the early years, partly on the assumption that public concern, having requested local sanctuaries, would ensure that they were respected. After the (Canadian) federal government entered the migratory bird protection field in 1917, Migratory Bird Sanctuaries were established in various parts of the country. Requests were soon made to have the provincial sanctuary areas near Port Joli transferred to federal jurisdiction and, after prolonged negotiations, this was done in 1941. Enforcement there of the Migratory Bird Sanctuary Regulations, however, was not attempted seriously before a paid caretaker was appointed in 1947.

The boundaries caused problems from the start. The sanctuary for many years was delimited only by the (mean) high tide mark on the mainland shores, thus including no land except outlying rocks and islands until after 1980. In the early years, local practices included shooting from the shores into the sanctuary, in effect moving all boundaries one gunshot (70 m+) inward. When this practice was declared illegal in 1947, protests arose immediately. Hunters still could legally stand at the boundary of the sanctuary to shoot at birds flying overhead, but recovery of birds so shot that fell inside the sanctuary was illegal. Efforts to resolve this situation by extending the sanctuary to adjoining land along the shorelines, largely in private ownership and thus requiring individual consent, were fruitless. Violations of the sanctuary were, and remain, difficult to prove, except where use of a boat was involved, owing to the vaguely defined boundaries.

Another recurring complaint, often considered to justify former hunting in violation of the boundaries, was that the sanctuary areas were so extensive as to include most areas used by geese, and thus hunting opportunity was seen as unduly restricted. In 1949-50, H.R. Webster of CWS investigated the conflicting complaints about lax enforcement and restricted hunting opportunities. Following his recommendations, the area of the sanctuary was reduced by about one-third in October 1950 (see below, section 4, by MacKinnon *et al.*). Complaints continued, despite the various changes in area of the sanctuary. It was sometimes suggested that most problems were caused by a few hunters opposed to **any** restrictions on their own hunting. In the South Shore region before 1970, such hunters were not in such a minority that they were much influenced by any opinions of the generally law-abiding public, as neither enforcement nor conservation education had been pursued in the area effectively or recently.

In response to recurring complaints, further investigations were made into the local situation as it related to the conservation and hunting of geese. Webster's study, of the boundaries vis-a-vis hunting opportunity, in 1949-50 was mentioned above. Webster and G.F. Boyer (of CWS) attempted to band Canada Geese and Black Ducks in the area during the winters of 1950 to 1952, with very little success. B.C. Carter and C.O. Bartlett (also of CWS) made brief reports on the local situation in 1954 and 1958, respectively. Operational visits to the Port Joli area, to inspect and post sanctuary boundaries and to monitor eelgrass stands, were made annually since 1966 by staff from C.W.S. Habitat Section. The chapters following report on three intensive investigations, by a C.W.S. biologist and by two M.Sc. candidates sponsored by C.W.S., between 1960 and 1980 (chapters II-IV), and three regional summaries (chapters I, V, VI).

4. Historical summary of boundary and regulation changes affecting the Port Joli area sanctuary system, 1915–1993 1/

1/ extracted and condensed from public discussion document by C.M. MacKinnon, D.L. Amirault and R.J. Hicks, CWS–AR, dated February 1993.

4.1. Preamble

Review of the Port Joli area Migratory Bird Sanctuaries (MBS; Fig. A-1) was prompted by the large amount of public interest and controversy over the present level of local prohibition of hunting through sanctuaries and other restricted areas. The inner part of Port Joli (inlet) was first established as a Provincial Sanctuary in 1915 to protect "wild geese" from hunting pressure. The original sanctuary consisted of only this one unit. Various additions and deletions were made in subsequent years in attempts to reach an appropriate balance between maintenance of goose populations and local hunting opportunity. Since 1980, the four protected areas have been described as separate MBSs. This agrees with local usage, but from a bird conservation standpoint they are more logically treated as units in one sanctuary system, as was the official practice before 1980.

The history of boundary changes reveals that many problems and questions raised in recent years are old problems revisited. Recent land-use changes, including creation of the Kejimkujik National Park Seaside Adjunct at Cadden Bay in 1986 (it was a provincial sanctuary from 1985) and the Thomas Raddall Provincial Park at Sandy Cove in 1992, have enlarged the local areas closed to hunting, resulting in renewed allegations of excessive limitations on hunting opportunity. The following account summarizes the changes in sanctuary boundaries and regulations in six periods, minor variations within a period being covered by supplementary notes.

4.2. Changes in sanctuary boundaries and regulations over six periods

1915–1926 (Fig. A-2)

A provincial sanctuary was created covering the water areas of inner Port Joli in 1915, the boundary being the "high-water mark". The water areas of the head of Port L'Hebert and of Sable River above MacAdams Bridge were designated as provincial sanctuaries in 1919.

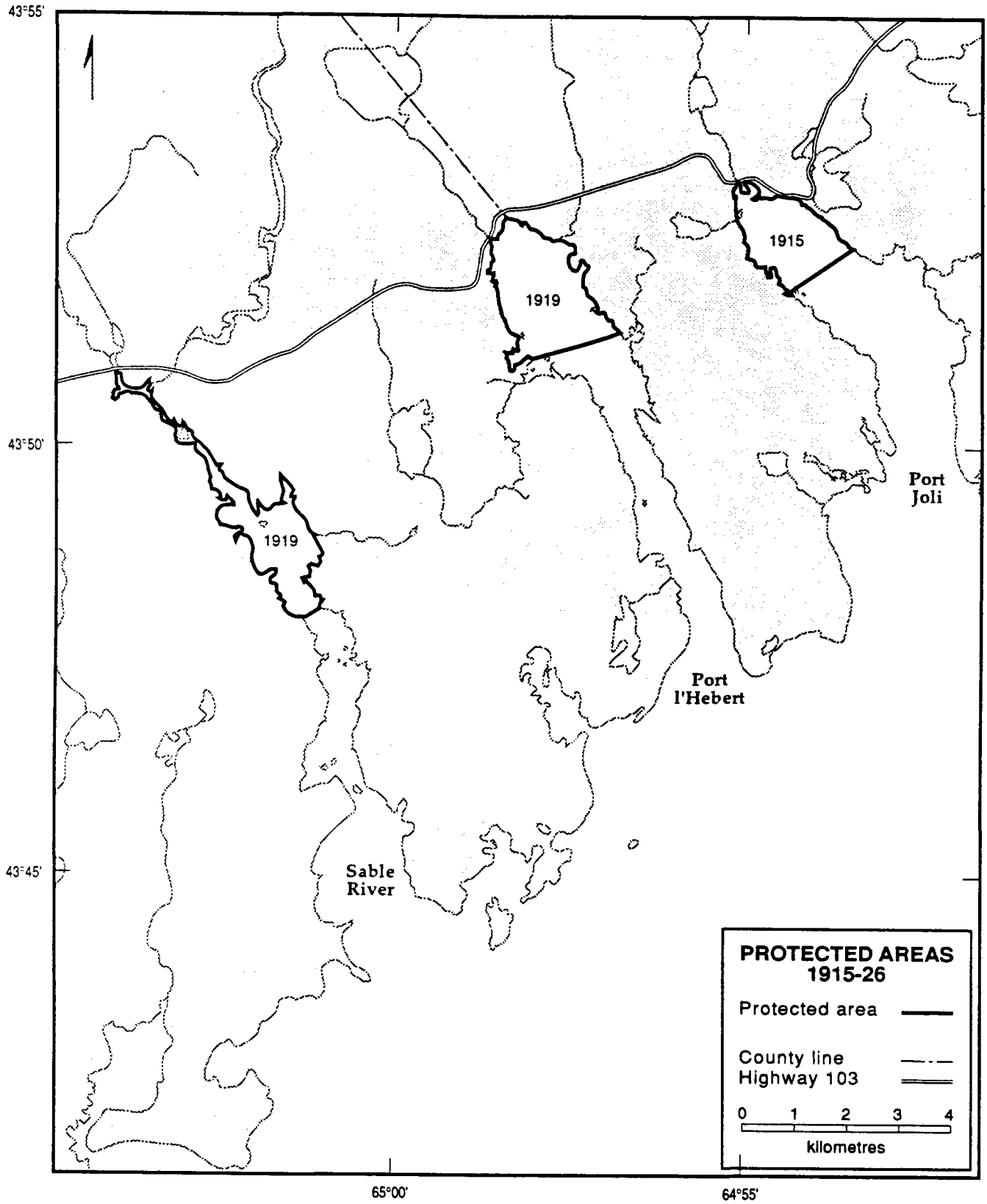

Figure A-2 The Port Joli area bird sanctuary/sanctuaries, showing boundaries in 1915-1926.

1926–1950 (Fig. A-3)

The sanctuary at Port Joli was extended seaward in 1926, roughly doubling its area, when a small area nearer the mouth of Port L'Hebert was also declared as sanctuary. A minor adjustment, excluding two bays on the mid-eastern shore of Port Joli (shown by broken line in Fig. A-3), was made in 1935. In 1941, all the local provincial sanctuaries were united under the name Port Joli MBS; the boundaries were effectively unchanged by this transfer of jurisdiction to the federal government, as the relocation of the upriver boundary of the Sable River unit (2 km S) involved an area with little waterfowl use.

1950–1975 (Fig. A-4)

Following complaints of too little area open for goose hunting, a review of the situation produced a major reduction in sanctuary area in 1950. The middle part of Port Joli and the seaward section at Port L'Hebert were deleted (thus reversing the 1926 additions), and the west side of Port L'Hebert north of Timber Island Brook was opened to hunting. Landward boundaries in all units remained the mean high-water mark. The 1950–75 situation prevailed during the studies reported in Chapters II and III (this volume), and similar status was restored, with minor modifications, after the experiments described in the next two paragraphs.

1975–1976 (Fig. A-5)

Recommendations from Martell's study (Chapter III, this volume) led to experimental modifications to regulation of hunting in the Port Joli area. All units of the long-standing MBS were cancelled in 1975. The whole of Port Joli was opened to hunting, and all of Port L'Hebert north of the East Port L'Hebert wharf was closed to hunting by designation as a management zone, with boundary 200 yards (183 m) landward of the water's edge; Sable River was opened to hunting until 2 or 3 January each year, with hunting excluded thereafter in a management zone bounded by the roads parallelling the river to east and west. Haley Lake was established as a management zone, with hunting excluded, in 1976.

1977–1980 (Fig. A-6)

Use of Port Joli by geese having virtually ceased with hunting there in the open season (fall–winter), the former MBS unit was reinstated in 1977, with addition of a 100-m strip of land along the west side. The former MBS unit at Port L'Hebert was also reinstated, but without a buffer strip. Sable River and Haley Lake continued as described in the preceding paragraph. Thus, the regulatory situation during the study by Newman Smith (Chapter IV, this volume) differed only at Sable River and Haley Lake from that during the earlier studies.

1980–1993 (Fig. A-4)

The arrangements in place in 1950 to 1975 were largely restored after 1980, with the following exceptions: at Port Joli, the 100-m buffer strip on the west side was maintained, and lands acquired by CWS on the east side (most lands between the shore and the road) were added to the (now separate) MBS; Port L'Hebert MBS and Sable River MBS had the same areas as protected in those units in 1950 to 1975; Haley Lake MBS included the area earlier protected in that management zone. The creation and closure to hunting of new national and provincial park areas has somewhat changed the context of the local MBS system, but the new closed areas were more significant for sea-ducks than for goose hunting. Public review of the sanctuary system is underway at this time, but changes acceptable to both hunting and conservation interests seem likely to be minor.

Literature cited

Bellrose, F.C. 1976. Ducks, geese & swans of North America. Stackpole Books, Harrisburg, Pa. 544 pp.

Denys, N. 1672. The description and natural history of the coasts of North America (Acadia). Publ. Champlain Soc. 2. 625 pp. Toronto.

Erskine, J.S. 1966. Birds of yesterday. N.S. Bird Soc. Newsletter, 8(3): 27–29.

Lloyd, H. 1923. Observations on the wintering flocks of Canada Geese in Nova Scotia. Can. Field-Nat., 37(2): 26–28.

Martell, A.M. 1969. A study of winter waterfowl ecology at Port Joli, Nova Scotia. Unpubl. M.Sc. thesis, Acadia Univ., Wolfville, N.S. 275 pp.

Taylor, F.C. 1967. Reconnaissance geology of Shelburne map-area, Queens, Shelburne, and Yarmouth Counties, Nova Scotia. Geol. Surv. Can. Memoir 349. 85 pp.

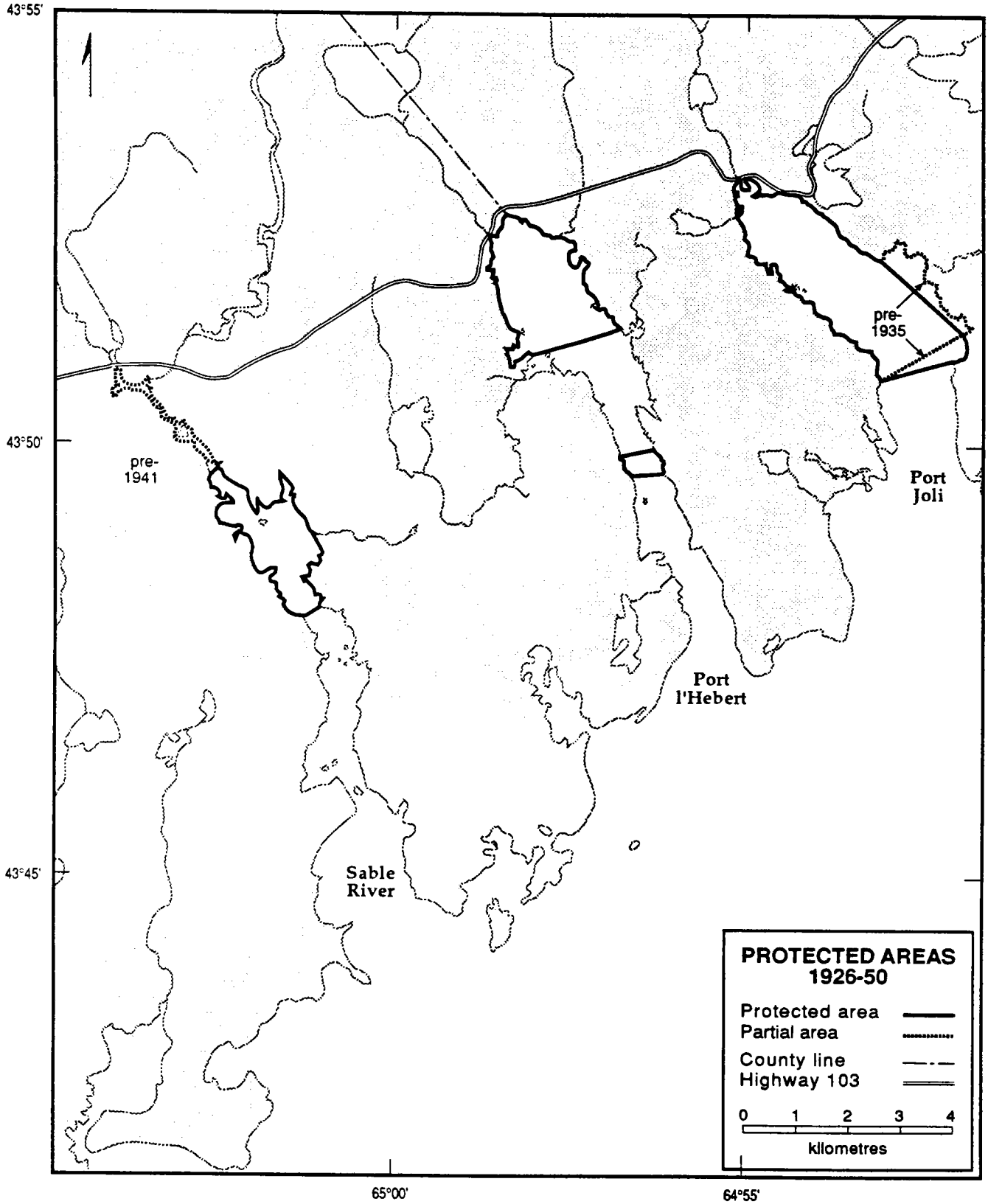

Figure A-3 The Port Joli area bird sanctuary/sanctuaries, showing boundaries in 1926-1950.

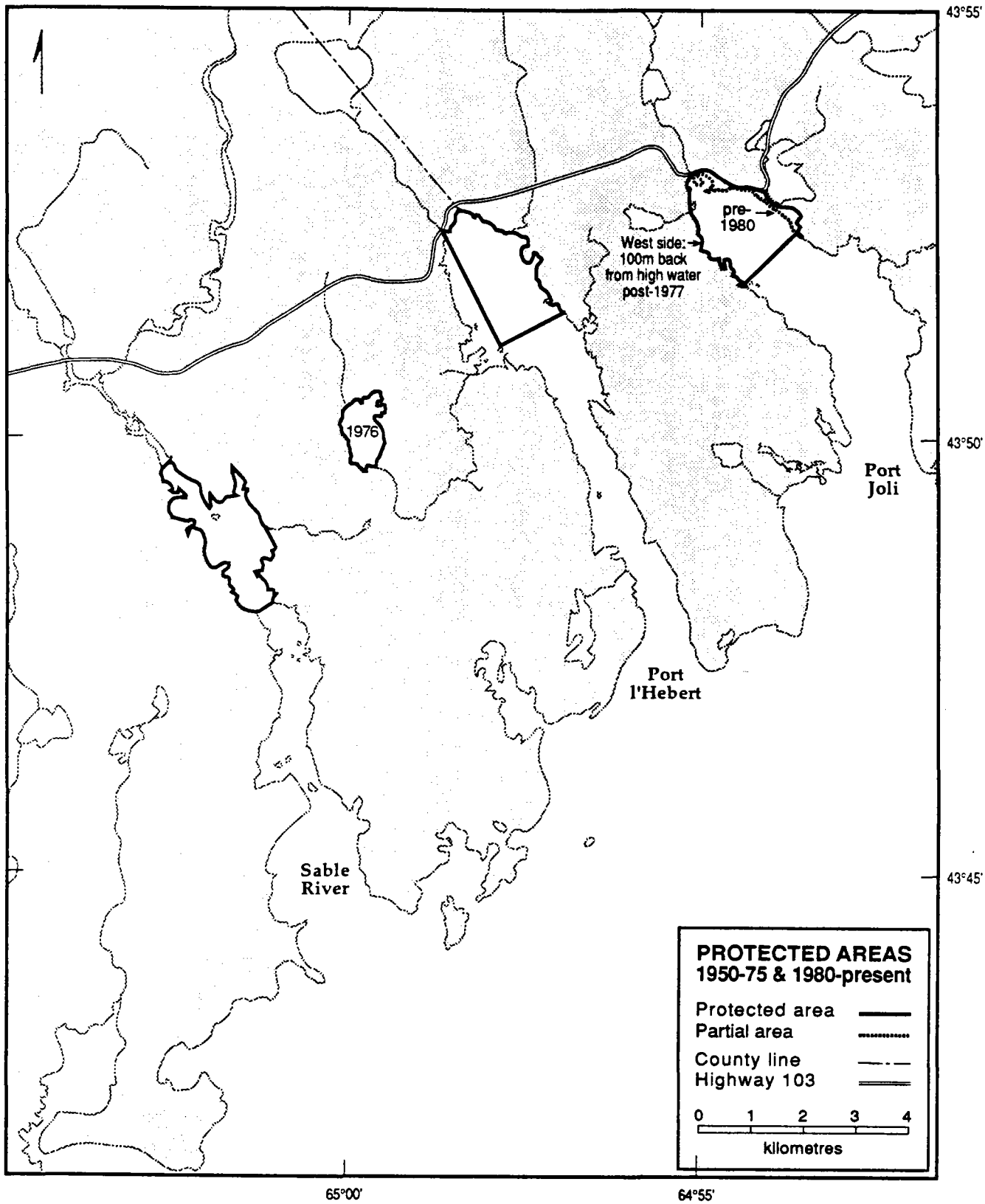

Figure A-4 The Port Joli area Migratory Bird Sanctuary/Sanctuaries, showing boundaries in 1950-1975, and 1980-present. (These boundaries applied during the studies reported in Chapters II and III.)

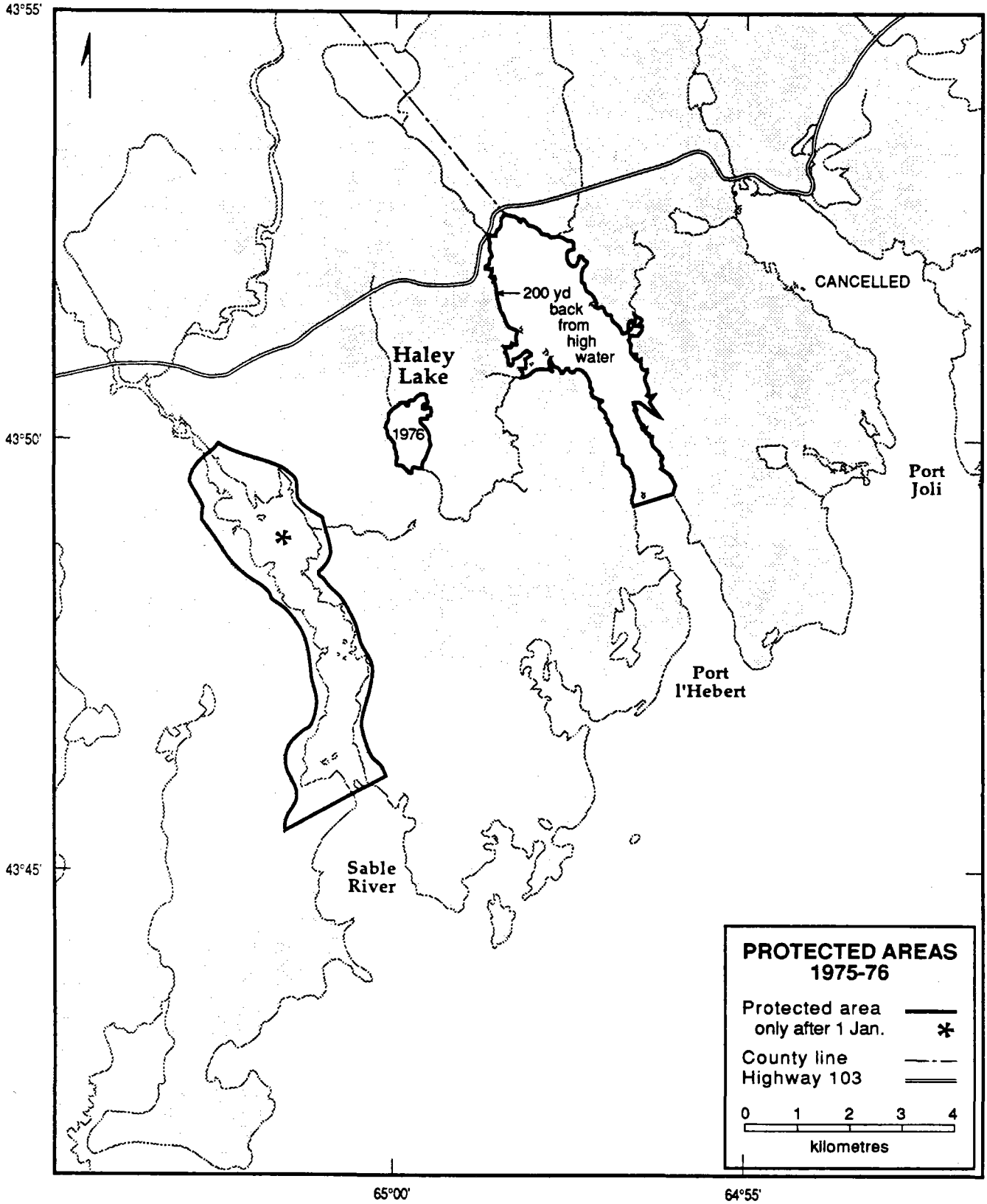

Figure A-5 The Port Joli area migratory bird hunting management zones, showing boundaries in 1975-1976 (some continuing later).

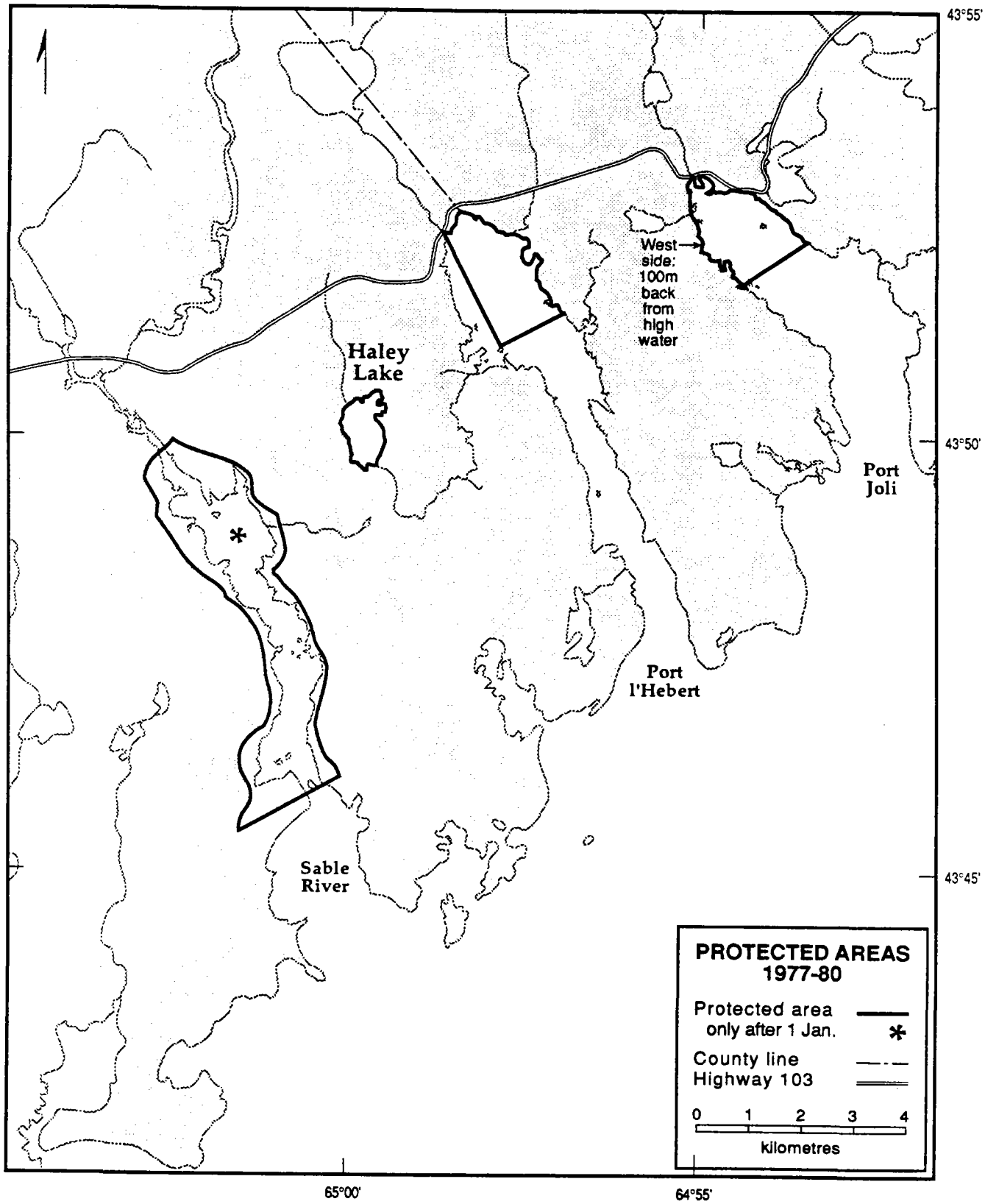

Figure A-6 The Port Joli area Migratory Bird Sanctuaries and hunting management zones, showing boundaries in 1977-1980. (These boundaries applied during the study reported in Chapter IV.)

I. CANADA GEESE STAGING AND WINTERING IN YARMOUTH COUNTY, NOVA SCOTIA

by A.J. Erskine 1/ and F.J. Payne 2/

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1. Abstract

No systematic studies have been made of Canada Geese in Yarmouth County, Nova Scotia, but occasional surveys have been made in many recent years. Autumn arrivals are in October, later than elsewhere in the Maritimes. Staging numbers peak in November and December, with up to 3000 to 4000 present in some years. After the Melbourne (provincial) sanctuary freezes in late December or early January, numbers decrease, presumably through migration to New England, with only 1000 to 1500 geese over-wintering. Spring departure is mainly in March, and seldom includes larger numbers than had wintered in the area. Movements to and from the area seem to be mainly along the outer coasts of Nova Scotia.

2. Introduction

Migrating Canada Geese presumably frequented the shores of Yarmouth County, in extreme southwestern Nova Scotia (Fig. I-1; 43°35–50'N, 65°45'–66°10'W), long before Europeans first visited the area, but their occurrence there was scarcely noted in earlier publications. Numbers evidently were less than in the well-known concentration area around Port Joli only 70 km farther east. In the absence of systematic surveys by either volunteers or professionals, geese in Yarmouth County earlier were assumed to be transients en route to or from wintering areas in the United States. This chapter summarizes the information accumulated since 1960 on the occurrence of geese in Yarmouth County.

2.1 Study area

The Yarmouth County shoreline is underlain by "old, generally very hard rocks of the Meguma group", and "Differential erosion of softer slate and harder greywacke has created a ridge and valley topography" (Simmons *et al.* 1984). "Drumlins occur both onshore and as offshore islands." The coast has been progressively submerged with the post-glacial rise in sea level over the past 10 000 years, and it is among the most dissected in Nova Scotia, with long headlands and many islands both inshore and farther off. The tidal range is small, 2.5–3.5 metres (8–12 ft). Shore ice forms throughout, but the winters are comparatively mild. Frequent fog and high precipitation influence terrestrial vegetation through cool temperatures and high humidity. A "dominant feature ... is the extensive areas of salt marsh." Most goose usage was of tidal marshes and inshore waters until ice restricted access there, when flocks moved offshore to ledges and reefs, or departed.

3. Materials and methods

Most data on wintering geese were from aerial surveys conducted by the Nova Scotia Wildlife Division, Department of Natural Resources, with about one-third from CWS surveys. Migration chronology was based mainly on records published in *Nova Scotia Birds* (formerly *Nova Scotia Bird Society Newsletter*).

Aerial surveys usually extended only from Yarmouth Harbour to Pubnico Harbour, including both mainland and island shores. It was not always clear whether areas with no data shown for a date had then been surveyed. Ground surveys were selective, focussing on traditional concentration areas such as Melbourne Game Sanctuary (Chebogue Lake—tidal, brackish).

4. Results

4.1 Fall migration

First arrivals usually were in early October, an extreme date being 20 September 1976, when 4 geese were seen at Melbourne sanctuary. Aerial surveys 25 September 1964 and 24 September 1974 found no geese at all, but 500–600 were at Melbourne sanctuary 3 October 1970, and 250 at Salt Bay (Lr. Eel Brook) 12 October 1975. Fall goose numbers peaked in late October or early November, with 2000 by mid-October in 1978 and 1984, and up to 3000 10 November 1973 and 19 November 1971. In many years, however, maximum estimates were under 1000 geese. By late November, numbers inshore had decreased from the earlier peak.

4.2 Winter numbers and areas used

Aerial surveys were mostly in January and February. The largest numbers were usually at Melbourne sanctuary until mid-January. Later in the season, the sanctuary was frozen, and the smaller numbers found were in nearshore channels around Roberts Island, Tusket River, and Chebogue Harbour. The largest number reported, 4000, was on the Yarmouth Christmas Bird Count (CBC) 28 December 1969, a winter in which high goose numbers were noted elsewhere on Nova Scotia's Atlantic coast (see later chapters). Nearly all large ground counts included (CBCs) or were restricted to the Melbourne sanctuary. Peak seasonal estimates, not all segregated

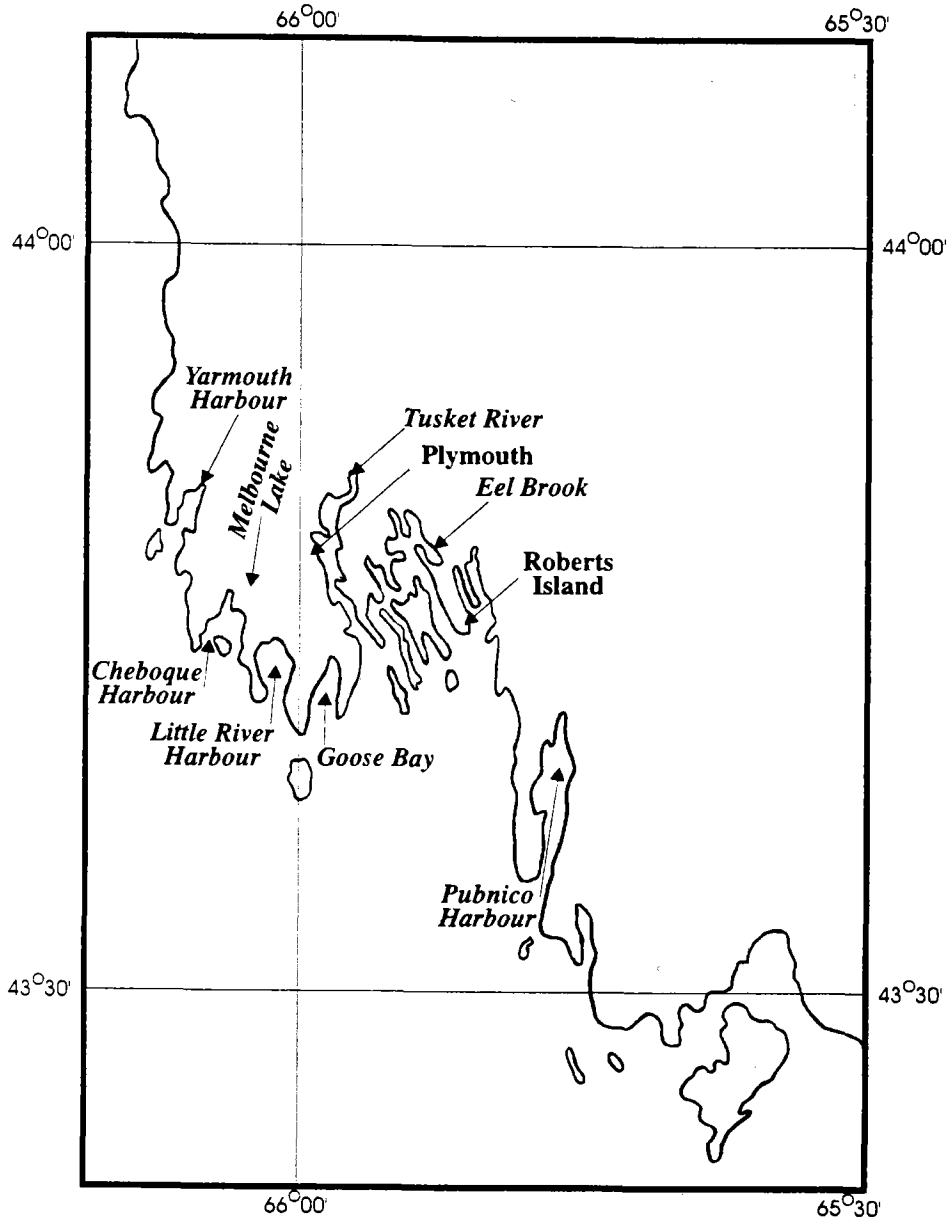

Figure I-1 Yarmouth County, Nova Scotia, showing staging and wintering areas for Canada Geese.

Table I - 1. Peak estimates of geese 1 December–29 February in Yarmouth County, Nova Scotia, 1953–92, ground surveys marked *, others from aerial surveys. The three (if available) highest figures in each 5-year period are shown, with only one count in any winter.

Period (no. of winters with surveys)	High counts			Comments
1950–54 (1)	825*			Jan.
1955–59	n.d.[1]			—
1960–64 (1)	435			Jan.
1965–69 (4)	4000*	2500	750	Dec., Jan., Feb.
1970–74 (5)	3175	2250*	1890	Jan., Dec., Feb.
1975–79 (5)	1480*	1100*	980	Dec., Dec., Feb.
1980–84 (4)	1499*	916*	550*	Dec., Dec., Dec.
1985–89 (4)	3000*	1342*	1250	Dec., Dec., Feb.
1990–92 (3)	1318*	1299	700	Dec., Jan., Jan.

[1] n.d. = no data

to particular areas, varied widely (Table I-1). No sustained trend in numbers was evident from the data, which suggested that fewer than 1500 geese wintered in Yarmouth County in most years.

4.3 Spring migration

Geese seldom were seen inshore in large numbers in spring, with few estimates much exceeding 1000 birds. Migration extended through March, with flocks passing Eel Brook 28 March 1977, and 2000 seen near Plymouth 23 March 1976, but none were found on an aerial survey 24 March 1973. Another aerial survey 2 April 1975 noted 4500 geese, mostly from Tusket River to Roberts Island, with 600 at Pubnico Harbour. Most were gone before mid-April.

5. Discussion

Yarmouth County was remarked as an important wintering area for Black Ducks before 1950, but wintering geese there received little notice before the late 1960s. Earlier, it was assumed that geese continuing southwest beyond the Port Joli area in fall might stop briefly in Yarmouth County before moving on to wintering areas in the United States. There was no suggestion that more than a few hundred geese wintered in Nova Scotia southwest of the Port Joli area, unless exceptionally, as in 1950 when illegal hunting drove geese away from Port Joli in early fall.

Numbers of geese in the Yarmouth area increased conspicuously around 1968 to 1972, when estimates over 2000 were first reported. Similar increases were noted in Halifax County in the same period (Chapter VI, this volume). Subsequently fewer geese were detected, but numbers probably remained at higher levels than before 1968. The scarcity of data precludes definite conclusions on trends, but no obvious change in numbers either of wintering or transient geese was apparent in Yarmouth County since the peak around 1970. The preponderance of ground counts in December among the highest estimates (Table I-1) supports the consensus that this region is used more as a staging area than for over-wintering. The decreases after December indicated that some geese, but seldom if ever more than a few thousand, continue southwestward to wintering areas in the United States. Presumably, some (perhaps many) of these return northward by the reverse route, but spring counts in Yarmouth County seldom exceed 1000 geese.

As yet, there is no firm evidence that many geese reach Yarmouth County overland or by way of the south shore of the Bay of Fundy in fall. Geese occur regularly around Minas Basin, and much less often in Annapolis Basin, Nova Scotia; estimates in the latter area showed only a few hundreds at any time in fall, though larger numbers sometimes appeared there in early spring. Occasional small groups are seen inland over western Nova Scotia, but the sparse human population there has never reported a substantial overland movement of geese to or from Yarmouth County. It seems best to treat this area within a migration corridor following the outer coasts of Nova Scotia, with a continuation of varying magnitude across the Gulf of Maine.

6. Literature cited

Simmons, M., Davis, D., Griffiths, L., Muecke, A. 1984. Natural history of Nova Scotia. Nova Scotia Department of Education and Department of Lands and Forests, Halifax. 2 vols., 807 pp.

II. INVESTIGATIONS OF CANADA GEESE IN AND AROUND THE MIGRATORY BIRD SANCTUARY NEAR PORT JOLI, NOVA SCOTIA, 1960–61

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1. Abstract

Canada Geese move southwestward through the Port Joli area from September through mid-January each year, the duration and size of the migration varying with timing and extent of freezing in goose staging areas to the northeast. Numbers of geese at Port Joli during hunting season fluctuated between 1000 and 12 000, with the wintering flock usually averaging 3000–5000 birds.

Goose hunting seemed to be effective mainly under severe ice conditions, which most often occurred in January. A late freeze-up might leave little hunting opportunity during the open season, but an early freeze might find local hunters still reluctant to leave the lucrative lobster fishery to hunt. After unemployment insurance benefits became available for fishermen after 1957, more people turned earlier to hunting, resulting in much greater numbers in the area than formerly. Undesirable and unsporting hunting practices were obvious at times in 1960-61. Lax enforcement had allowed some problems to develop in the area, although the recent assignment there of provincial Rangers had improved that situation in 1960-61. Future changes in regulations should aim to eliminate vagueness, both in sanctuary boundaries and in hunting hours.

Kill data, in the absence of a waterfowl hunting license to provide a sampling framework, were meagre and unsatisfactory. The legal kill in recent years (before 1960) seemed to be in the range of 500 to 1000 geese, a tolerable utilization (10–35%) of the wintering flock from which almost the whole kill was taken. Migrant flocks suffered very little kill in the area then.

The ultimate solution to local hunting problems called for more organized management, including control of land areas near the sanctuary from which shooting occurs. Acquisition of such lands and staff to manage hunting there were seen as pre-requisites for lasting resolution of hunting problems there.

2. Introduction

A normally riotous public meeting to discuss migratory bird hunting regulations, in Shelburne, N.S., 9 February 1960, convinced federal authorities that the Canada Goose situation in the Port Joli area warranted more study. When I joined the Canadian Wildlife Service a month later, I was assigned that task. Examination of previous correspondence indicated that most perceived problems involved illegal hunting practices, undesirable hunting practices, or excessive kill of geese.

As background for assessing those problems, during the winter of 1960–61 I investigated

(a) numbers of geese frequenting the sanctuaries at different dates, compared with those present in earlier winters;
(b) movements of geese, under varying weather and ice conditions, within and between the sanctuary units, and into and out of the sanctuary units; and
(c) total kill of geese in the area.

This account, based on a report I wrote in February to March 1961, combined my findings with earlier data, while addressing then-current hunting practices and the degree of utilization of the wintering goose flocks, and it outlined possible improvements in goose harvest management in the area. The account is dated, as the situation has changed substantially since then, but it is the earliest extensive summary of information covering the first 40 years of the goose sanctuaries, and many of the source documents then used are no longer (1992) available.

3. Methods and sources of data

I visited the Port Joli area 11 August, 4 November, and 21 November through 4 December, in 1960, and 23–26 January 1961. During the main late fall visit, I walked all shorelines from Southwest Port Mouton to Jones Harbour, and spot-checked the shores of Sable River and Matthews Lake (see Section A, Fig. A-1). Coverage on other visits was restricted to spot-checking, and was much less extensive. On each visit, I made notes on numbers, locations, and movements of geese (and other birds). My observations were supplemented by data from diaries of the CWS sanctuary caretaker (Russell MacAdams), and other reports and letters in Canadian Wildlife Service files, and by oral communications from local residents. The latter were ignored when contrary to other, apparently reliable, evidence, but such reports sometimes helped to fill gaps in the picture. Data on goose kill were obtained largely from the caretaker, and from Edward Turner, Sub-Ranger with Nova Scotia Department of Lands and Forests (now Natural Resources), with a few reports from the Royal Canadian Mounted Police, Liverpool and Shelburne Detachments.

4. Results

4.1 Ice conditions

In 1960-61, the sanctuary area (see Section A, Fig. A-4) started to freeze 12 January, according to the caretaker's diaries. Icing eased somewhat in the next week, but the area froze almost completely 21–23 January, remaining frozen for nearly a month. In 1959-60, the sanctuaries froze about 8 January, but opened again 20

January. In 1958-59, freeze-up occurred 9–11 December, and the area was frozen until late December; it froze again 8–20 January. Details on earlier winters were not available.

4.2 Numbers of Canada Geese in the sanctuary area

My estimates of geese in various areas in 1960-61 appear in Table II-1. Other people present agreed with some of my estimates; others were not checked. I used those counts to arrive at considered estimates of the total numbers of geese present during late fall and mid-winter 1960–61 (Table II-1).

4.3 Migrations and local movements of geese

No geese were seen in the sanctuary 11 August 1960, when large, post-breeding flocks of Black Ducks were present. The caretaker's diaries and other letters to Canadian Wildlife Service personnel (Appendix 1) reported that the first geese usually appeared in mid- to late September, with the first large flight during October and sometimes extending into November. A second major flight passed through the area in December or January. Geese returning northeastward usually began to arrive at Port Joli from late February, and flocks also started to leave then. The main spring exodus was usually 5–25 March (Appendix 1).

Within the Port Joli area, geese were reported to move locally up and down all three inlets, and overland across the "Goose Hills" between Port Joli and Port L'Hebert. They also flew at night to Wilkins and Haley Lakes for fresh water and gravel, as long as the lakes were open or until hunting there drove the birds away. Flighting was said to occur especially in wind, snow, rain, or fog, whereas in fine weather the flocks were more sedentary. My notes (Appendix 2) confirmed that few such movements occurred in the generally fine or at least calm weather during my November to December 1960 visit, and these involved few geese. During my January visit, I saw small flocks of geese moving up and down Sable River, running a gauntlet of gunfire in either direction, but most geese remained huddled on river ice in the sanctuary during the severe cold. My limited observations of goose movements generally supported the descriptions by local residents.

As long as the best feeding grounds near the heads of Port Joli and Port L'Hebert were ice-free, the main goose flocks remained there most of the time. Some geese still rested on the ice of those inlets during the severe cold of January 1961 when those sanctuary areas were almost entirely frozen. Few geese occurred at Sable River until ice restricted the open-water area in the other inlets in January.

4.4 Hunting practices

Before freeze-up, hunters shot from the many small islets and points along the shores of the inlets to seaward (south) of the sanctuary units. Often decoys were used, but geese were said not to decoy well until most of the area was frozen. The kill of geese early in the season was very small, but most ducks shot then were obtained over decoys.

Another hunting method practiced throughout the season was shooting at geese passing over the (Port Joli) Goose Hills, where flocks often flew low in cloudy weather and especially at dusk and after dark. Many hunting cabins are in that area, and I saw up to 30 cars parked along the road there in late afternoon on my late fall and winter visits.

As winter progressed and water areas in the larger inlets became restricted, geese began to frequent Sable River where current from the rivers maintained open water longer. The sanctuary in Sable River is narrow, and the causeway of MacAdams' bridge (the southern boundary of that sanctuary unit) narrows the channel to about 70 m. Geese that rested on the ice at Port Joli and Port L'Hebert had ample space to rise above shotgun range before leaving the sanctuaries, but at Sable River, where the only protected fresh water persisted during cold periods, most departing geese had to pass within gunshot range of hunters along the river as they flew southward towards the sea.

Hunters lined MacAdams' bridge daily during my January visit, and every point and ledge down Sable River for a kilometre bore a blind, built of ice-cakes and snow and bristling with guns. The concentration of hunters in that area was so great as to cause friction among them. The caretaker's diaries for 1960-61 repeatedly mentioned "more hunters than I ever saw here", and reports from the RCMP and provincial Rangers were similar (Appendix 3).

Hunting under those conditions was quite effective. MacAdams estimated 150 geese taken by 150 men 27 January, and 200 geese by 275 hunters 30 January, and RCMP bag checks showed 31 geese shot by 45 men at Louis Head, and 62 by 67 hunters at nearby Latham's Ledge, on 28 January. Some flocks of 5 to 10 birds coming into decoys were all killed. There usually was a rush of boat-owners and dogs to secure each goose knocked down. The person who retrieved a bird usually kept it, unless he already had one or more geese and felt constrained to yield it to another hunter with none who insisted vehemently that he had killed it. The large kill resulted from geese visiting Sable River for fresh water, the rest of the sanctuary being frozen, at a time when many people were free to go hunting.

Table II-1. Estimates (by AJE) of Canada Goose numbers at Port Joli Migratory Bird Sanctuary, winter 1960–61.

Date	Time	Numbers of geese Port Joli	Port L'Hebert	Sable River	Estimated Total
November					
21	15:30		2000		
23	13:30	1700			
24	a.m.			none	
	14:00	1300			
25	12:30		2400		
	15:00	1400			
26	a.m.			none	
	15:30	1300			
28	14:30	1600			
29	a.m.		1000+[1]		
	p.m.	looked fewer			
December					
2	17:00	700			
3	11:00		2200		
	11:30	750			
	p.m.		none		
					not over 4500
January					
24	10:30			500	
	12:00	1200			
25	11:00		500		
	13:00	500			
	15:30			200	
26	10:00	800			
	14:00		500		
	15:00			1100	
					not over 3000

[1] Water too rough for accurate estimate.

Although Nova Scotia's South Shore hunters then had a reputation for disregard of game laws, this did not translate into obvious and widespread violations around the Port Joli area in 1960-61. Provincial Rangers were stationed in the area in fall and winter, as in several years before and afterwards, and their presence certainly reduced violations of the sanctuaries. Reports by the caretaker and the Rangers suggested that few hunters attempted to shoot inside the sanctuaries, and attempts to retrieve dead or injured birds there were the cause of most convictions for sanctuary violation. The presence of the Rangers may also have discouraged the reported practice of "stirring up" geese in the sanctuaries by use of rifles, as provincial regulations forbade the carrying of small-bore rifles during the deer-hunting season. Boats seldom disturbed geese in the sanctuary, as nearly all fishing boats in 1960-61 worked from the outer wharves at St. Catherines River, East Side Port L'Hebert, Jones Harbour, and Little Harbour, and the old wharf halfway down Port Joli had been abandoned.

It seemed doubtful that individual bag limits were often exceeded legally, and proof of this would have been almost impossible to secure at Sable River in January, given the concentration of hunters. The large numbers of hunters probably tended to ensure that the geese retrieved were distributed relatively evenly. Some persistent hunters may have exceeded possession limits, but convictions would be improbable at that season when game need not be kept in a freezer. I heard one allegation that wild geese were being sold in Liverpool, but no specific instances were available, and it seemed unlikely that legal goose hunting would have given any one hunter enough birds to support serious marketing of game.

4.5 The goose kill in 1960-61 and earlier

Neither federal nor provincial regulations required a license for waterfowl hunting in Nova Scotia in 1960-61, so mail surveys of kill were not practicable then. Bag checking stations were not operated for long enough and in enough locations to include most of the kill, and road-checks early in the hunting season were not productive.

RCMP bag-checking in November and December showed only two geese killed in 82 man-days. Russell MacAdams and Edward Turner assembled data through opportunistic bag checks and enquiries (Table II-2). Their data were obtained independently, thus providing a rough check on each other; no other verification was possible, but it seemed likely that some errors cancelled out, kills over-stated being balanced by others unreported. Turner's estimate included at least 16 geese not reported by MacAdams, and 56 others in RCMP bag-check data were not in either total, so the total kill was at least 774. Given the few and public places where most of the known kill occurred, it seemed unlikely that the legal kill much exceeded 1000 geese. By months, MacAdams' data showed 24 taken in November, 60 in December, and 690 in January, 608 of those 24–31 January at Sable River after the other inlets froze.

A private enquiry instigated by the then-Director of Conservation (provincial), Clarence Mason, suggested that the total kill, both illegal and legal, might have exceeded 3000 birds. That figure is not credible in view of the goose numbers present during the period when most of the kill occurred. Also it implied illegal kill on a scale that could not have failed to be noticed and to have aroused concern by the enforcement personnel in the area. No further reference is made here to that enquiry.

Data from other winters were fewer, and gave generally lower estimates. A 1959–60 kill estimate, obtained by polling the hunters present (believed to include one-third to one-half of all those active) at the meeting in Shelburne 9 February 1960, was 400–600 (i.e. 197 reported, times 2–3). MacAdams, working from memory the next winter, estimated 450 geese killed in 1959-60, including 14 at Port Joli, about 100 at Port L'Hebert, and over 300 at Sable River, mostly during January. His diaries referred to geese being killed mainly between 8 and 20 January when the harbours were frozen, but gave no overall estimate. No total estimate emerged for the 1958–59 winter. Most references in MacAdams' diaries and bag-check notes were of geese killed in late December, during the early freeze-up. MacAdams inspected or heard of at least 213 geese shot that winter in the area around the sanctuaries.

4.6 Survival of wintering geese

Geese shot 26 and 31 January 1961 were considered by MacAdams to be in good condition. However, on 2 to 3 February Turner and Dr. H.F. Lewis (of West Middle Sable; formerly of CWS) concluded that the wintering geese generally were in poor condition. Efforts to clear ice from feeding areas in Sable River and to supply grain there were continued until the end of the cold spell 18 February. MacAdams, in his February 1961 diary, suggested that the feeding operations then had not been necessary, but on 23 December 1958 (two weeks after the early freeze-up that winter) he had written, "quite a lot of [the geese] are not too fat right now as they soon get thin when a big freeze-up comes".

5. Discussion

5.1 Temperatures and ice conditions

There was no obvious relationship between time of freeze-up and accumulated degree-days below various temperatures, nor with mean temperatures during the periods preceding freezing of the bays. No statistical tests were attempted, as the only daily records of temperature then available were from Halifax, N.S., 150 km to the northeast. Freeze-up seemed not to have occurred in months with mean temperature at Halifax above –2°C (+28°F) (Table II-3). The sanctuary caretaker reported general freezing of the harbours only in the italicized months, which were the only months in those winters with mean temperatures below –2°C. Long-term data from Halifax (Table II-4) showed that in 1870 to 1959 the January mean temperature was –2°C or lower in 79 of 90 years, but December temperatures averaged –2°C or lower in only 41 years. The decade immediately preceding my study (1950–59) was the mildest up to that date in the Halifax records. That is important, as ice conditions seemed to be one of the two factors having most influence on the goose kill. The cold spell of January to February 1961 evidently was less exceptional than suggested at the time by the short memories of local residents.

5.2 Numbers of geese in the sanctuary area

Estimates of large flocks of waterfowl vary greatly, even when experienced observers are involved, as birds come and go. Guesses of past numbers of geese wintering around Port Joli ranged up to half a million birds, but all estimates over 20 000 in recent decades were probably unrealistic (see also Chapter IV, this volume). The earliest published figure I found (Lloyd 1923) involved 6100 geese, and recent estimates by experienced observers never exceeded 12 000 birds at one time (Table II-5). The largest numbers were present only for short periods during the migrations, and the main wintering flock during January and February rarely exceeded 6000, as shown by the annual Midwinter Waterfowl Inventories (MWI; Table II-5). Differences in independent estimates probably reflected movements between inlets or into and out of the sanctuary area.

I estimated about 4500 geese in the area in late November 1960, and about 3000 in late January 1961 (Table II-1), which seem plausible totals for the low period between early and late migration peaks and for the wintering flock, respectively. Yet MWI reports (Table II-5) from several independent observers indicated that numbers of geese present in early January 1961, between my visits, were much larger than I found, and far more than usual. Observers agreed that goose numbers had increased early in January, and declined when the sanctuaries froze after 19 January. MacAdams' diary showed flocks arriving from the east 10 January, the day after his MWI estimate of 12 000, and flocks leaving westward on 21 January. Data from other years (Appendix 1) also showed that geese arrive from the east and leave for the west through mid-January.

Table II-2. Estimated goose kill in Port Joli area, winter 1960–61.

Area	Estimate by MacAdams	Turner
Sable River + Matthews Lake	614	588
Port L'Hebert + Wilkins & Haley Lakes	20	
Port Joli + Goose Hills	53	
Area not determined	15	
Total	702	

Table II-3. Mean monthly temperatures at Halifax, Nova Scotia, compared to months (italics) in which freezing of coastal waters occurred in the Port Joli Migratory Bird Sanctuary.

Winter	Mean monthly temperature (°C) November	December	January	February
"Normal" (1921–1950 mean)	+4.1	-1.8	-4.2	-4.8
1958–59	+5.0	*-5.2*	*-3.7*	*-6.1*
1959–60	+6.5	+0.4	*-3.4*	-0.3
1960–61	+5.8	-0.9	*-5.7*	*-4.6*

Table II-4. Long-term mean monthly temperatures at Halifax, Nova Scotia, from Halifax Weather Office Summary Reports.

Decade	Number of years with mean temperature (°C) December >-2	-2	<-2	January >-2	-2	<-2	February >-2	-2	<-2
1870–1879	2	0	8	1	1	8	0	1	9
1880–1889	6	0	4	1	0	9	0	0	10
1890–1899	6	2	2	1	0	9	1	0	9
1900–1909	5	2	3	1	1	8	0	3	7
1910–1919	6	0	4	1	1	8	0	1	9
1920–1929	4	0	6	0	1	9	1	0	9
1930–1939	6	1	3	2	1	7	1	0	9
1940–1949	6	1	3	0	1	9	1	1	8
1950–1959	8	0	2	4	2	4	4	2	4
Totals	49	6	35	11	8	71	8	8	74

5.3 Migrations and local movements of Geese

The existence of the two fall migration peaks in the Port Joli area seemed plausible based on what we knew or inferred in 1961. The first involved birds coming direct from northern breeding areas, where the first snows may come in October. The second movement included birds that remained in intermediate staging areas until forced out by ice in December or later. The severe cold in late January 1961 also caused the goose flocks reported on the MWI (9 January) at Port Morien on Cape Breton Island and at Cole Harbour and Martinique Beach east of Halifax to move away, presumably to Port Joli or farther.

Table II-5. Mid-winter inventories and other winter counts of Canada Geese in the Port Joli Migratory Bird Sanctuary, Nova Scotia (see Tables III-4 and V-1 for similar data in later years).

Year	Month	Number of Geese	Comments
1947	January	3000	by H.F. Tufts
1948	January	5000	by G.F. Boyer
1949	January	11 500	several estimates range 8000–22 000, the highest by MacAdams; 11 500 was used in the MWI report
1950	January	3650	by G.F. Boyer; another 13 000 scattered along coast for 80 km west, after geese disturbed on arrival at Port Joli; an "open" winter.
1951	January	11 000	two independent estimates 10 500 and 11 500.
1952	January	4200	by MacAdams
1953	January	3035	by MacAdams with others
1954	January	3180	by MacAdams with others
1955	January	1700	by RCMP; MacAdams estimated 1025.
1956	January	3000	MacAdams estimated 3000 for Port Joli alone; others had 2900 for all sections of sanctuary.
1957	January	7000	aerial count (C.O. Bartlett) had total of 8125 for shore Halifax to Yarmouth; other counts included 4500 for Port Joli unit, and 2408 for entire sanctuary.
1958	January	5800	from ground counts; aerial count by Bartlett had 5030 for all south shore.
1959	January	6000	two independent ground counts, 2685 & 11 000; aerial count (Bartlett) 6385 for south shore.
1960	January	5000	two independent ground counts, 4735 and 5000; aerial count by I. Moss had 9270 for all south shore, mostly at the sanctuary.
1961	January	12 000	two independent ground counts 9 January, 12 000 and 12 500; aerial count by Moss 15 January had 3097, nearly all at the sanctuary.

In 1961, I thought the first peak might be geese coming direct from Labrador and the second might be geese from Newfoundland plus birds from Labrador that had stopped off in the southern Gulf of St. Lawrence. Evidence presented in succeeding chapters (this volume) indicates that most geese that pass through or winter in the Port Joli area originate on the island of Newfoundland. The general pattern proposed in 1961, of early migrants coming direct from breeding areas whereas later-moving geese had staged somewhere in between, still fits the observed data. Goose flocks might be expected to leave for more southern regions when ice conditions and hunting pressure became adverse, until their migratory urge waned. The departure to the west of flocks on 21 January 1961 and arrivals from the east on 7 January 1960 and 10 January 1961 indicated that movement continued well into January in some years. The decline in 1961 from 12 000 geese in the Port Joli area 9 January to 3000 on 25 January suggested the scale of such movements during severe ice conditions. In February 1961, numbers were similar to those in late January (E. Turner, *in litt.*), in spite of intense hunting through 31 January and general icing for nearly a month. Perhaps after mid-January any urge to continue southward is balanced by the increasing day-length which stimulates northward migration. Severe icing conditions in December may induce southward migration in waterfowl that might have wintered in the Maritimes (compare Common Mergansers; Erskine 1972, p.28), and northward migration in these species also begins during late February (Appendix 1).

5.4 Hunting participation and practices

There is no commercial agriculture on the South Shore of Nova Scotia, and the sparse human population depends for most income on seasonal fishing and intermittent lumbering. Unemployment insurance (UI)

benefits were extended to fishermen first in 1957. Thereafter, financial necessity was less likely to compel local men, already used to a low standard of living, to continue fishing under severe winter conditions. The local lobster fishing season opened 1 December, and from then through Christmas most men went lobstering daily. Thereafter, UI benefits could be, and were, used to buy shells to go goose hunting. The numbers of men ready to go hunting, instead of lobstering, was much greater in January than earlier in the season, and local hunting pressure increased annually from 1957 through 1960-61. Newly paved highways also allowed hunters, not all drawing UI, to come in from centres up to 200 km distant (e.g. Halifax, Annapolis) to hunt in the Port Joli area. Accommodations and eating places were (and still are) lacking there, so this influx of hunters provided little if any economic benefit to the area.

The excessive concentration of hunters obviously detracted from the "quality" of the sport. With up to 300 hunters in a restricted area, each firing two or three shots at any goose flock within range—and at many far out of range, there could be no sure answer to the question "Who killed that goose?" Even with all 10 birds in a flock shot over decoys in front of one ledge, not all of the 20–30 men on the ledge could be satisfied, although each probably hit one or more geese. A hunter or pair of hunters with only one day a week to hunt could not prevent others from joining them on a ledge, even when the latecomers had been out every day since the season opened. Within the bag and possession limits, there was nothing illegal in such practices. Local hunters often claimed to dislike hunting thus, but "Where else does a man have as good—or any—chance to bag a goose?" So they persisted, and the recreational value of the hunting declined as the numbers of hunters increased.

5.5 The goose hunting situation in 1960-61 and earlier

The pattern that emerged was of geese being killed mainly at Sable River and during periods when the other inlets were frozen. As noted in the section on ice conditions, prior to 1950 the freeze-up frequently occurred in December. During the next ten winters (including 1960-61), freezing of the sanctuaries probably did not occur before February in at least four years, and only twice in December. Goose hunting opportunities in the 1950s must have been less than had been usual in previous decades. Before 1955, the hunting season also closed earlier, usually before mid-January, so that even a January freeze-up might not have provided much hunting opportunity; hunting has not extended into February for many years. UI benefits did not cover fishermen until 1957, and since then probably few stopped lobstering—unless a freeze-up was so severe as to preclude fishing, as in December 1958—until they had accumulated sufficient time to qualify for UI benefits. This was more likely to occur in January than in December. Evidently 1960-61 provided near maximum goose hunting opportunity in the Port Joli area, with a severe and lasting freeze-up just when most men were ready to turn to hunting.

5.6 Effect of hunting kill on local goose populations

Illegal hunting early in the season, or before it, when geese were first arriving in the area in numbers, was alleged (in letters to CWS from G.L. Edwards, 1950) to have deterred geese from wintering in the sanctuary. Table II-5 showed that numbers in the sanctuary in 1950 were lower than in 1949 and 1951, but near the long-term average. Before 1955, with hunting seasons starting before mid-November, early hunting may have disturbed the migrating flocks more, and the few data from bag-checks suggested that a larger proportion of geese were killed early in the hunting seasons in 1951 to 1954.

If supplemental feeding in February 1961 really was necessary, one should conclude that the goose flocks could not have sustained the intense hunting pressure of that year beyond 31 January. An earlier and lasting freeze-up of comparable severity would have required premature closure of hunting, as is allowed for in the Migratory Bird Regulations. CWS policy opposes winter feeding that may encourage waterfowl to winter north of where they can survive on their own, which is understood to exclude areas where over-wintering occurs only in mild winters. As Canada Geese had wintered around Port Joli for years, that area was considered part of their normal winter range. Losses in that wintering flock varied between years, and might have been unusually severe in 1960-61, even after hunting ceased, in the absence of supplemental feeding. Feeding the geese there may have set an undesirable precedent, as policies and regulations generally must apply to average situations, taken over a series of years, rather than trying to accommodate all the ups and downs in individual years.

The estimated total kill of 800 to 1000 geese, relative to the final wintering flock of 2500 to 3000, may not have been excessive (say 25–35%). A higher kill, if spread through the season, also would not be unreasonable. A much greater number of geese pass through the area in migration (October through January) than over-winter, and most of the migrants are scarcely disturbed at all. The actual wintering flock may only sustain about two weeks of heavy hunting pressure under severe ice conditions, and precautions should be taken to ensure that it is not called upon to do so.

5.7 Local goose hunting problems, and how they might be resolved

I gained the impression, largely from hearsay and anecdotal evidence, that violations of the sanctuary were not frequent or serious in 1960-61 with the level of enforcement then provided by provincial Rangers and the Shelburne RCMP detachment. The most active and effective of the Rangers (Turner) was a local resident, which argued against excusing the caretaker's lack of enforcement activity on grounds of local pressure. Except with deep snow, a rare occurrence in that area, the sanctuary areas are not too large for one man to patrol daily alone, although he can only be in one place at a time. MacAdams' time, as shown by his diaries, also included

patrolling Jones Harbour and Louis Head Beach (well outside the sanctuary areas), helping drag for drowned hunters down Port L'Hebert, and other activities in the wider area around the sanctuaries. Such extensions of his working area contributed to his gathering information on ice conditions, goose numbers and kill, and numbers of hunters, but they cut into time available for enforcement of the sanctuaries, the purpose for which he was ostensibly employed. It seemed unlikely that his habits would change much after he had been 14 years in the position, even with the provincial Rangers working in the wider local area, so CWS should not rely on this type of position for effective enforcement of the Migratory Bird Sanctuary Regulations around Port Joli.

It seemed probable that the wintering goose flocks were not being overhunted, even in 1960-61, and migrants were strikingly under-utilized. Although the winter flock might be overexploited during extreme ice conditions, public pressure probably would call for premature closure of hunting if slaughter became excessive and the geese clearly in poor condition. In the 1950s, with generally mild winters, even illegal kill may have achieved only a reasonable total kill from the wintering flock. The hunting methods current in 1960-61 appeared to be quite effective under severe ice conditions, when they permitted as large a kill of wintering geese as could be tolerated even without illegal practices.

Legal methods for effectively exploiting the migrant flocks seemed to be lacking there. Most suggested changes in the sanctuary boundaries or in permitted hunting methods seemed to me more likely to drive geese out of the area without increasing the kill appreciably. For example, legalizing the former practice of shooting from the shore all around the sanctuary, i.e. of moving the boundaries inward by about 70 m, with all use of boats banned, would simplify enforcement, but geese on the main feeding areas near the heads of Port Joli and Port L'Hebert then would be exposed to hunting (in daylight) all season. With current hunting pressures acting on those areas, goose numbers that could be supported by the sanctuaries would be reduced. Opening any unit of the sanctuary also would reduce the capacity of the area to hold geese in winter, at least while hunting continued.

Undesirable hunting practices may have been more of a problem than illegal hunting. During severe icing, most hunters concentrated at Sable River, with up to 300 men in an area little over one kilometre long immediately south of (*outside*) the sanctuary. As hunters expected the sanctuary to enhance hunting opportunities in the surrounding areas, it could function effectively only as part of a larger area, not all of which was subject to the Migratory Bird Sanctuary Regulations. To manage local goose hunting equitably for people and responsibly for geese, management agencies needed to control the shoreline lands adjoining those that were closed to hunting, and also the areas where most hunting took place. If such "management areas" could be established, hunting methods might be regulated so as to avoid the extreme congestion and generally poor "sport" seen in 1960-61, while distributing the opportunity among most interested hunters. Control of most of the needed land areas could only be achieved through purchase, an approach up to that time not attempted by CWS, which then lacked suitable mechanisms for acquisition and landholding.

Another suggestion was to spread the geese and thus (some of) the hunters through creation of new sanctuaries, but similar problems would be anticipated unless management of new areas also included adjoining land areas from which shooting might occur. Earlier proposals for goose sanctuaries, at Cole Harbour and Musquodoboit Harbour east of Halifax and at Jordan Bay and Clyde River west of Sable River, indicated that purchase of land would be required at any of those sites to secure a suitable sanctuary with controlled hunting adjacent to it. That will become more and more essential as hunting pressures increase, and expropriation is likely to be the only feasible way to secure all of the required lands. Acquired lands inevitably will require paid staff to implement the regulations appropriate to a sanctuary or public hunting area. There is no cheap and easy solution to the management of a desired and limited resource.

6. Literature Cited

Erskine, A.J. 1972. Populations, movements and seasonal distribution of mergansers in northern Cape Breton Island. Can. Wildl. Serv. Rep. Ser. no.17, 35 pp.

Lloyd, H. 1923. Observations on the wintering flocks of Canada Geese in Nova Scotia. Can. Field-Nat. 37(2): 16–28.

Appendix 1. Movements of Canada Geese through the Port Joli area, Nova Scotia, reported in the caretaker's diaries and in letters to CWS

1. Arrivals from the east in fall

1949: during October, numbers increased from 20,000 to 50 000(!?);
1950: 7 arrived 13 September; arrivals noted 10 and 17 October;
1951: 21 arrived 13 September; 6–19 October numbers increased from 500 to 10 000; another influx occurred 30 November to 24 December;
1952–58: no data;
1959: 12 present 1 October; arrivals noted 6,12,14,16,30 October, 6,20,28 November, 30,31 December, 7 January 1960;
1960: 200 present 1 October; large influx 14,15,18,25 October; more 17 November, 14,15 December, 10 January 1961.

2. Departures to the west in fall

1949: no data;
1950: main flock at Sable River left 23–24 November;
1951: large exodus 19–26 November;
1952–58: no data;
1959: four flocks left to west 8 October; numbers on 8 December fewer than two weeks earlier;
1960: some went west 18 October; others moved west 14,15 December and 21 January 1961.

3. Transients from west to east after midwinter

1949: no data;
1950: first arrivals from west 22 February; large influx through 15 March; main exodus 22–27 March;
1951: one flock from west 9 January [probably local movement only; AJE]; first large influx 10–18 February; flocks left to east 22 February to 14 March; last stragglers 19 April;
1952: large influx 5–11 March; large exodus 20–22 March;
1957: main exodus 10–12 March;
1959: large exodus 2–4 March;
1960: no data;
1961: main exodus 24–31 March.

Appendix 2. Movements of Canada Geese observed (by AJE) in the Port Joli area, Nova Scotia, 1960

22 Nov. 20:30, geese heard flying inland towards Wilkins Lake (after dark);
23 Nov. [opening day of waterfowl hunting season]
07:00, 20 geese flew inland towards Wilkins Lake;
10:00–13:00, geese flying in Port Joli: 15 north, 4 south, 9 north, 10 north, 43 south and north again, 300 north;
13:45, one goose flew into Port Joli, low over Goose Hills;
14:20, 45 geese flew into Port L'Hebert over Goose Hills;
14:55, flocks of 69, 63, 92 geese flew into Port L'Hebert over Goose Hills;
28 Nov. 13:45, 12 geese flew out of Port Joli to south;
14:00, 500 geese, disturbed by row-boat, rose from Port Joli, circled, and re-alighted there;
1 Dec. 19:00, geese heard flying out of Port L'Hebert over Goose Hills (after dark);
3 Dec. 15:30, geese heard flying inland towards Wilkins Lake;
15:45, 26 geese flew into Port L'Hebert overland from west.

Appendix 3. Reports of unusual hunter numbers in the Port Joli area, Nova Scotia, 1960–61, from the caretaker's diaries and other sources

10 Dec. "48 men";
22 Dec. "plenty of hunters ... as most of the men are done lobstering";
24 Dec. "more hunters than any day yet. School being closed";
2 Jan. "more hunters in this area today than I have ever seen in one day", 98 counted, from as far away as Halifax and Annapolis;
21 Jan. 71 men at MacAdams' bridge alone;
23 Jan. 76 at MacAdams' bridge, plus 21 on ledges below the bridge;
24 Jan. "70 or 80 men";
28 Jan. "one can see heads sticking up from behind ice cakes and on every ledge", estimated 200 men;
30 Jan. "more hunters than I have ever seen", estimated 275 men;
31 Jan. "over three hundred men", "two ledges alone had forty-seven". [This was the last day of hunting season.]

III. CANADA GOOSE ECOLOGY IN WINTER AT PORT JOLI, NOVA SCOTIA, 1967–69 1/

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1/ extracted and condensed from author's M.Sc. thesis (Martell 1969).

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1. Abstract

Numbers of Canada Geese wintering in the Port Joli area of Nova Scotia changed little between 1900 and 1969. Geese around Port Joli moved up and down the inlets, overland between the inlets, and to nearby freshwater lakes, for feeding, resting, and bathing. Most birds were seen in the Sanctuary throughout their stay but, when ice-cover closed feeding areas at Port Joli and Port L'Hebert, more frequented Sable River, Matthews Lake, and Jones Harbour in mid-winter.

Most time was spent, both for feeding and resting, in areas where eelgrass grew abundantly, in the upper reaches of Port Joli and Port L'Hebert. Eelgrass cover had changed rather little between 1945 and 1968, but it may not have returned to the high density prevailing before the widespread die-off around 1930. Geese fed in a preferred depth of water, as demonstrated by their moving towards or away from shore as the tide rose or fell.

The principal food of Canada Geese around Port Joli was the leaves and rhizomes of eelgrass. The crude protein content of eelgrass blades in winter (14.8%) was considered adequate for maintenance of Canada Geese. Results of previous studies suggested that geese wintering at Port Joli might have been stressed under the feeding and temperature conditions measured, but no evidence of stress was noted.

The large sanctuary area then in effect might be reduced to include only Port L'Hebert, provided that adjacent land areas were included and that suitable hunter management could be effected at Sable River, Jones Harbour, and Haley Lake. Such modifications might alleviate recurring waterfowl management problems in the area.

2. Previous studies on feeding and foods of wintering Canada Geese on the east coast of North America

In northern areas of their winter range, geese may be subjected to environmental stress due to adverse weather conditions. Lefebvre and Raveling (1967) related the weights of different subspecies of Canada Geese to their resistance to low temperatures in wintering areas, and predicted that large forms start to experience stress with sustained temperatures below –10°C.

Eelgrass was long known as among the most important foods of migrant and wintering geese on the Atlantic coast (Audubon 1840; Norton 1909; Forbush 1912; Bent 1925). Bent also noted geese eating sea-lettuce and various algae, and Martin *et al.* (1951) reported use of cord-grasses (*Spartina* spp.), widgeon-grass (*Ruppia maritima*) and spikerush (*Eleocharis* spp.). These authors mentioned that some small molluscs, crustaceans, and other marine animals are also taken.

Eelgrass is the most widely distributed sea grass in North America, occurring on both coasts from Alaska to Mexico and from Greenland to South Carolina (Philips 1964; Dawson 1966). It generally grows in shallow lagoons and bays; in areas of abundance, it supports a great variety of marine animal life. The leaves grow most rapidly in summer, but with some growth even in winter; leaves drop off year-round, but especially in autumn (Ostenfeld 1908; Thomas 1968). The accumulation of eelgrass leaf debris on the bottom is a main source of organic matter there, and it forms an important part of the basic food pyramid in many areas (Thomas 1968).

A conspicuous die-off of eelgrass was reported on the Atlantic coasts of North America in 1930 to 1932 (Lewis 1932; Cottam 1934), with the causative agent thought to be *Labyrinthula*, an amoeba-like organism with mycetozoan affinities (Renn 1936). Recovery was gradual, with many setbacks, and was nearly complete in many areas by the 1950s (Cottam and Munro 1954), with some notable exceptions. Many marine invertebrates associated with eelgrass declined following the die-off (Stauffer 1937; Dexter 1944).

3. Methods

3.1 General

Field work in the Port Joli area[1] of Nova Scotia was carried out in October 1967 to June 1969. In the first winter, field work was restricted to a few weekends and occasional aerial surveys. From July to September 1968, a floral survey was carried out, with further checks in May and June 1969. During the second winter emphasis was placed on observation of movements and feeding habits of waterfowl in the area. A faunal survey was carried out during that winter along with periodic checks on the condition of the eelgrass beds. Waterfowl gizzards were collected during the study and analysed for food habits.

3.2 Eelgrass Survey

Port Joli, Port L'Hebert, Sable River, and Matthews Lake were surveyed from a 3.6-m fibreglass boat with a 3 h.p. motor to determine the distribution, density, and other

[1] Place-names as in Section A (this volume).

characteristics of the eelgrass beds. The beds in several areas, especially the head of Port L'Hebert, were examined during the year for seasonal changes which were recorded qualitatively. Several older residents of the area were interviewed with regard to changes which may have resulted from the eelgrass die-off of 1932.

3.3 Eelgrass analysis

Eelgrass samples were collected five times between 18 August 1968 and 12 May 1969, all from the same area near the head of Port L'Hebert, except that, owing to ice cover then, the 8 February sample was taken on the west side of Sable River below MacAdams bridge. The samples were raked from the bottom using a garden rake. Each sample, after washing, was separated into rhizome, meristem, and upper blades; loose portions of the upper blades, separated in handling, were also segregated in the two final samples. The separate sub-samples were each dried in an oven at 38°C for 10 to 12 h before analysis for crude protein (Kjeldahl total nitrogen method, at Soils & Crops Branch, Nova Scotia Department of Agriculture, Truro). A large undried sample collected 12 May was analysed at the same laboratory for moisture, fibre, ash, protein, and carbohydrates.

3.4 Aerial surveys and aerial photography

Censuses of waterfowl were made on 21 December 1967, 18 January, and 8 March 1968 from aircraft flying at 180 m. Aerial photographs of large goose flocks were taken using Ektachrome film as an aid to censusing. Large-scale "panchromatic minus blue" air photos were taken for delineation of eelgrass beds. The desired combination of very low tide (less than 2 feet above Chart Datum) in early morning or evening, good flying weather, and a suitable aircraft delayed this coverage until 21 September and 5 November 1968, and patchy cloud cover interfered with photography even on these dates. Previous air photo coverages of the area by provincial government agencies in 1927, 1945, 1955, 1965, and 1968 were used for comparison, particularly of changes in salt-marshes and eelgrass beds.

3.5 Waterfowl feeding and resting areas, and local movements between them

Feeding and resting areas were determined from field observations and, to some extent, from aerial surveys conducted for censusing. Binoculars and a telescope were used as appropriate. Waterfowl movements were determined primarily from field observations. Feeding, resting, and movements were correlated with tidal and climatic factors. Older residents of the area were interviewed as to possible changes in use of areas and movements.

3.6 Waterfowl populations

All available records of past counts of waterfowl in the Port Joli area were collected and analysed. Periodic counts in the three units of the sanctuary and at Matthews Lake had been made by R.E. Turner, N.S. Dept. of Lands & Forests, Wildlife Division, each winter from 1961. During the winter of 1968–69, the entire study area was censused twice a month at approximately the same tide level, with data recorded separately for twelve sections (Fig. III-1).

3.7 Waterfowl food habits

Analysis of the food material followed the "percentage-by-volume" method practiced by the U.S. Fish & Wildlife Service (e.g. Cottam 1939). Hartley (1948) summarized the main drawbacks to that method, including varying rates of digestion of different items, and the poor correlation between bulk and nutritive value in many foods. The primary source of food material was from hunter kills, and was restricted to gizzard contents as many hunters submitted only gizzards. The contents of crops or proventriculi, when available, were used as an aid to the identification of material in the gizzards. Identifications followed standard texts, and were confirmed for difficult items by local experts. All food items were measured volumetrically to the nearest 0.1 ml. Gizzards in which food items did not constitute at least 20% of total volume were not considered in summaries. An attempt was made to determine seasonal changes in goose foods by analysis of droppings (after Ranwell & Downing 1959). Droppings were collected in autumn and preserved in 15% formalin until comparisons (on slides) with leaves of common food plants were made under a microscope.

4. Results

4.1 Eelgrass survey

The primary eelgrass beds were mapped from the air photos, using three density categories (Fig. III-2). Various minor beds, often with high densities, were too small to be shown at this scale. Field observations showed that eelgrass growing on mud flats (Port Joli and Port L'Hebert) had generally longer and wider blades than plants growing on sand or sandy mud (Sable River). It was not clear whether a given air-photo density-class value in sandy areas indicated a higher density of plants but with narrower leaves than the same density-class value in muddy areas. Seasonal changes in density of eelgrass were striking. The beds in July and August, apparently at maximum growth, were very luxuriant. Fresh (green) eelgrass drift became common in September, and continued through October, with large drifts accumulating along the shore. Dead eelgrass also accumulated on the bottom, providing favourable substrate for increasing stocks of certain invertebrates. By December plants were much reduced in size, but plant density remained high. Practically no blades were visible in March, but rhizomes were common under the surface of the mud. New green shoots began to appear in April, both from rhizomes and germinating seeds, and a dense growth was present by mid-May.

Comparison of air photos suggested no observable changes in extent of eelgrass beds since 1945 at Port

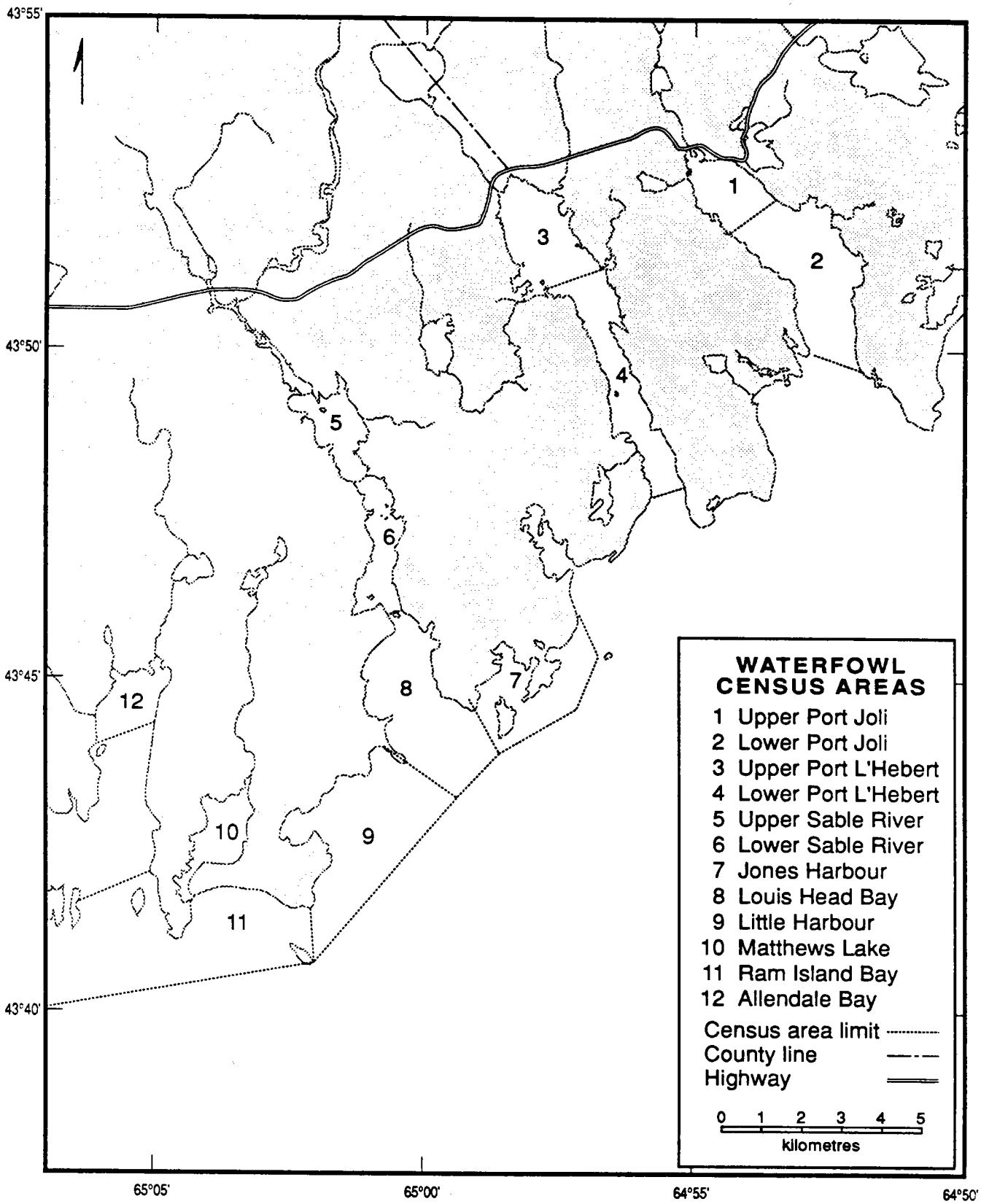

Figure III-1 The wider Port Joli area, showing sub-areas used in waterfowl surveys. Areas 1, 3 and 5 comprised the Sanctuary.

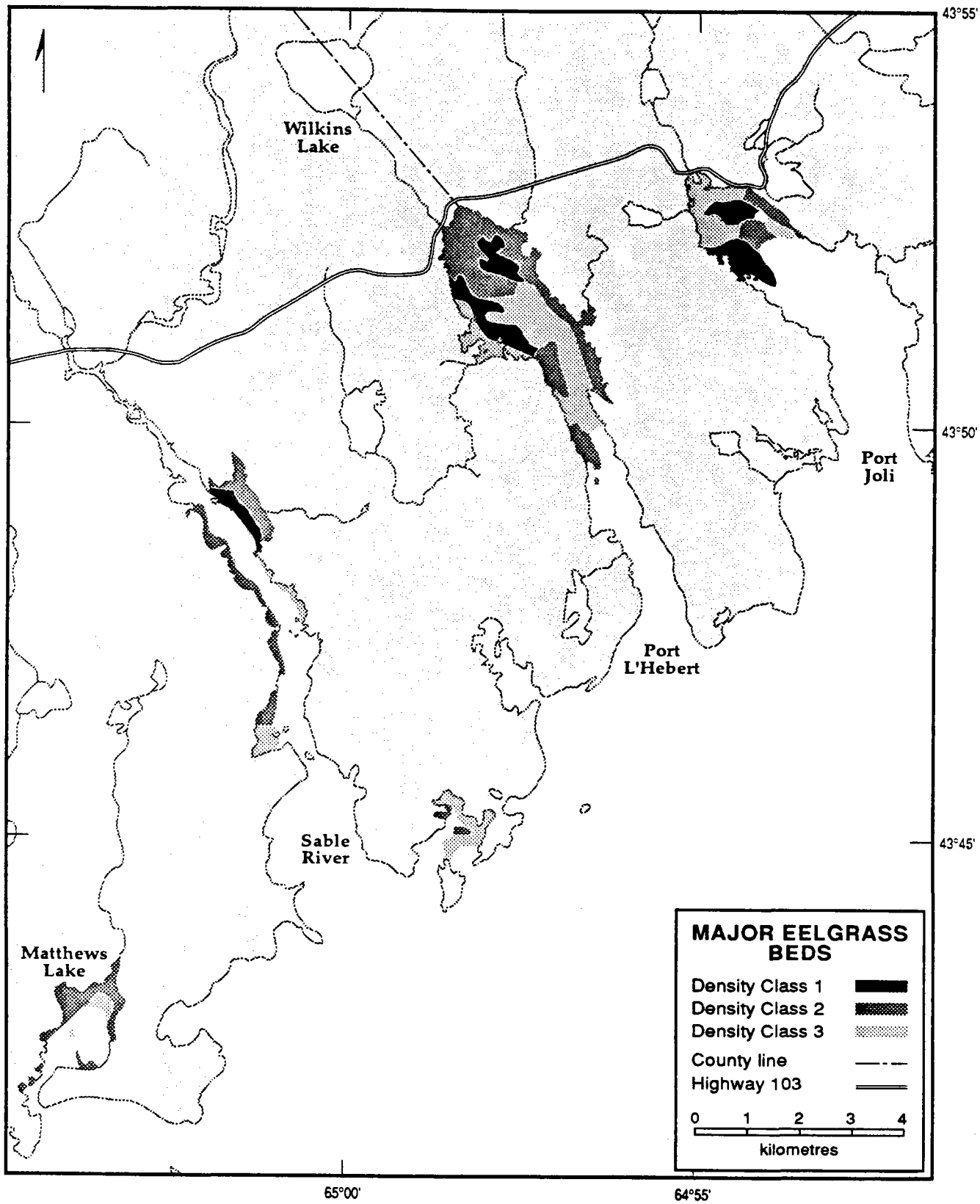

Figure III-2 The Port Joli area, showing extent of eelgrass beds by density class, 1968-69.

L'Hebert, Sable River, and Jones Harbour. At Port Joli, eelgrass spread south (seaward), covering nearly twice as much area in 1968 as in 1945, whereas at Matthews Lake the formerly complete eelgrass coverage was much reduced since 1945 (Fig. III-2). The partial air photo coverage in 1927 suggested that eelgrass at the head of Port Joli before the die-off was much denser than in any area in 1968.

4.2 Eelgrass analysis

Crude protein content of eelgrass rhizomes increased in fall and remained constant through the winter, whereas in meristem and blades there was little difference from early fall to winter (Table III-1). The complete analysis of moist samples (Table III-2) showed carbohydrate roughly equivalent in rhizomes and meristem/leaves, although protein was much higher in the latter.

4.3 Resting and feeding areas

The most used resting and feeding areas for Canada Geese (Fig. III-3) were the west side of the head of Port Joli, the east side of upper Port L'Hebert, and a bay on the east side of Sable River just below Haydens Island. Some use occurred almost everywhere in the upper parts of Port Joli and Port L'Hebert and the middle part of Sable River. Before mid-October, most use occurred in Port Joli, but thereafter and until January most geese used Port L'Hebert. Sable River and Matthews Lake were used mainly when other areas were ice-covered, late in the winter. Jones Harbour also was used mainly during periods when other areas were frozen. Historically, Matthews Lake was not used until the barrier dune was breached and eelgrass became established there, around 1930, and lower parts of Port Joli were more used before the eelgrass die-off. Geese also frequented Wilkins Lake and Haley Lake during September and October, when up to 1000 geese occurred there, and occasionally other freshwater lakes were visited by smaller numbers.

Geese fed on eelgrass whenever beds were covered by water, even if too shallow for the birds to swim. Thus, the flocks moved away from or towards the shore depending on whether the tide was ebbing or flooding, but feeding was not associated with any specific phase of the tide.

4.4 Local movements

Most movements in the study area were up and down the inlets and between the major feeding areas there (Fig. III-4). Movements to and from freshwater lakes were more common in early fall than later. During periods of severe cold and freezing, movements were at a minimum. Overland flight paths sometimes followed valleys, e.g. between Port L'Hebert and Wilkins Lake, but often passed over higher land such as the "Goose Hills" where hunters assembled to shoot at low-flying geese, especially in the evenings. Local movements mostly involved small flocks (<25 birds), but after mid-November flights of 100 or more geese were seen occasionally. Most flocks appeared to be multiples of assumed family groups. Vocalizations among resting flocks increased shortly before and during daytime departures, but this was not evident at night.

4.5 Freezing and temperature

Temperature data for 1959 to 1969 from Western Head (near Liverpool, 15 km east of the study area; Table III-3) provided correlations with periods of freezing in the sanctuary. Freezing severe enough to affect waterfowl access occurred when the mean monthly temperature fell below the overall monthly mean. Usually the mean minimum temperature for those months was also below the overall mean minimum. Many of those cold periods correlated with drops in the waterfowl counts (see below).

Temperature, however, was not the only factor affecting ice formation. Thin "shell" ice often formed at night but broke up next day through tidal action or offshore winds. Only when winds were light for several days did such ice accumulate to cover the inlets. A combination of warmer weather and offshore winds was then necessary to clear the harbours. Port Joli usually cleared first, because of its broad mouth, followed by the lower part of Sable River. The narrow outlets of Port L'Hebert and upper Sable River delayed the break-up of ice there. During the severe freeze in January 1968, the ice near the head of Port L'Hebert was ca. 45 cm thick, and quite clear. Bands of dead eelgrass were included in the lower two-thirds of the ice pan, apparently incorporated into the pan while it rested on the mud during low tide periods. A broken band of ice around the shoreline absorbed the tidal action. A less severe freeze occurred in late February 1968 but did not last long. In 1968 to 1969, a minor freeze occurred in late December, with Port Joli frozen only at night and Port L'Hebert and Sable River frozen halfway down their sanctuary areas. By late January, only a narrow ice-shelf remained along the shores. The major freeze that winter was in early February, but it was less severe than in the previous winter; ice in Port Joli cleared out most days and the "Goose Hole" at Sable River (SW of Haydens Island) remained open. By late February most of that ice was gone.

Table III-1. Crude protein analyses of eelgrass from the Port Joli area, Nova Scotia (per cent dry weight).

Sample	Rhizome	Crude protein (%) in Meristem and blades	Loose upper blades
1968			
18 August	2.0	10.2	
1 October	3.1	9.7	
17 November (1st sample)	5.9	15.5	
17 November (2nd sample)	6.8	14.2	
1969			
8 February	6.0	13.3	9.1
12 May	6.7	16.5	14.6

Table III-2. Chemical analysis of eelgrass from the Port Joli area, Nova Scotia, 12 May 1969 (per cent wet weight).

Percentage in Category		
Rhizomes	Meristem & blades	
Crude protein	0.63	2.15
Fibre extract	0.15	0.19
Fibre	1.49	2.16
Ash	3.32	2.96
Moisture	90.30	87.00
Nitrogen-free extract	4.11	6.55

Table III-3. Monthly temperature (°C) for Western Head, Nova Scotia, 1959–69, thus: mean minimum; monthly mean[1].

	Temperatures (as above) in winter									
Month	59–60	60–61	61–62	62–63	63–64	64–65	65–66	66–67	67–68	68–69
October	+6;+10	+5;+9	+7;+11	+6;+10	+6;+11	+6;+9	+4;+8	+4;+8	+5;+9	+7;+11
November	+3;+6	+2;+6	+3;+7	+1;+4	+3;+6	0;+4	-2;+3	+3;+6	+1;+4	0;+3
December	-3;+1	-5;-1	-3;+1	-5;-1	-9;-5	-4;0	-4;-1	-3;+1	-4;-1	-4;0
January	-7;-3	-9;-5	-8;-3	-4;-1	-7;-3	-9;-5	-6;-2	-6;-2	-10;-6	-11;-2
February	-3;0	-9;-4	-11;-6	-9;-4	-7;-3	-8;-5	-8;-4	-10;-5	-10;-6	-4;-2
March	-4;-1	-4;-1	-3;0	-4;-1	-4;-1	-4;-1	-3;+1	-7;-3	-3;0	-4;0

[1] Monthly means underlined when below -2°C and below the overall mean for the month.

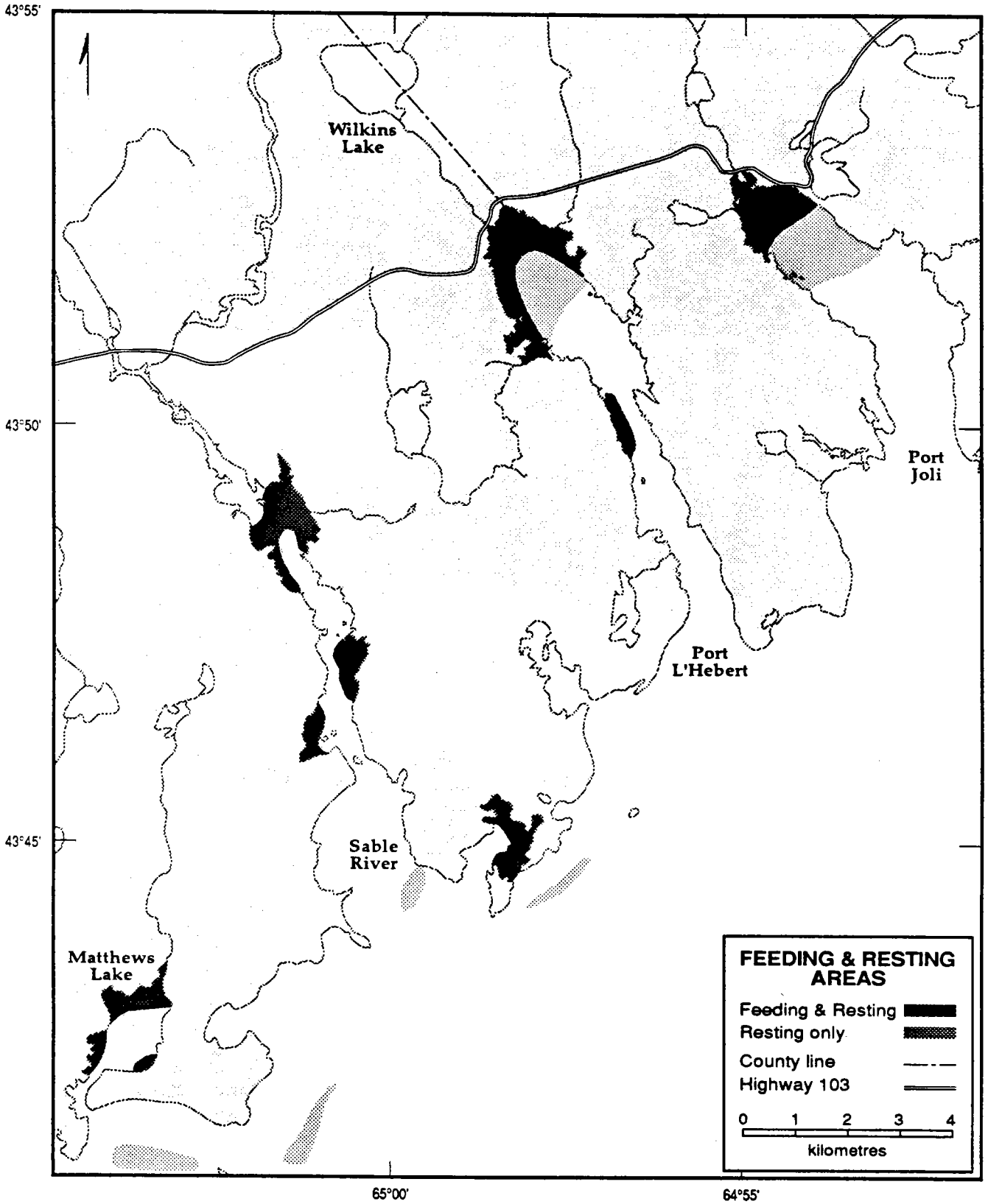

Figure III-3 The Port Joli area, showing areas used by Canada Geese for feeding and resting, winter, 1968-69.

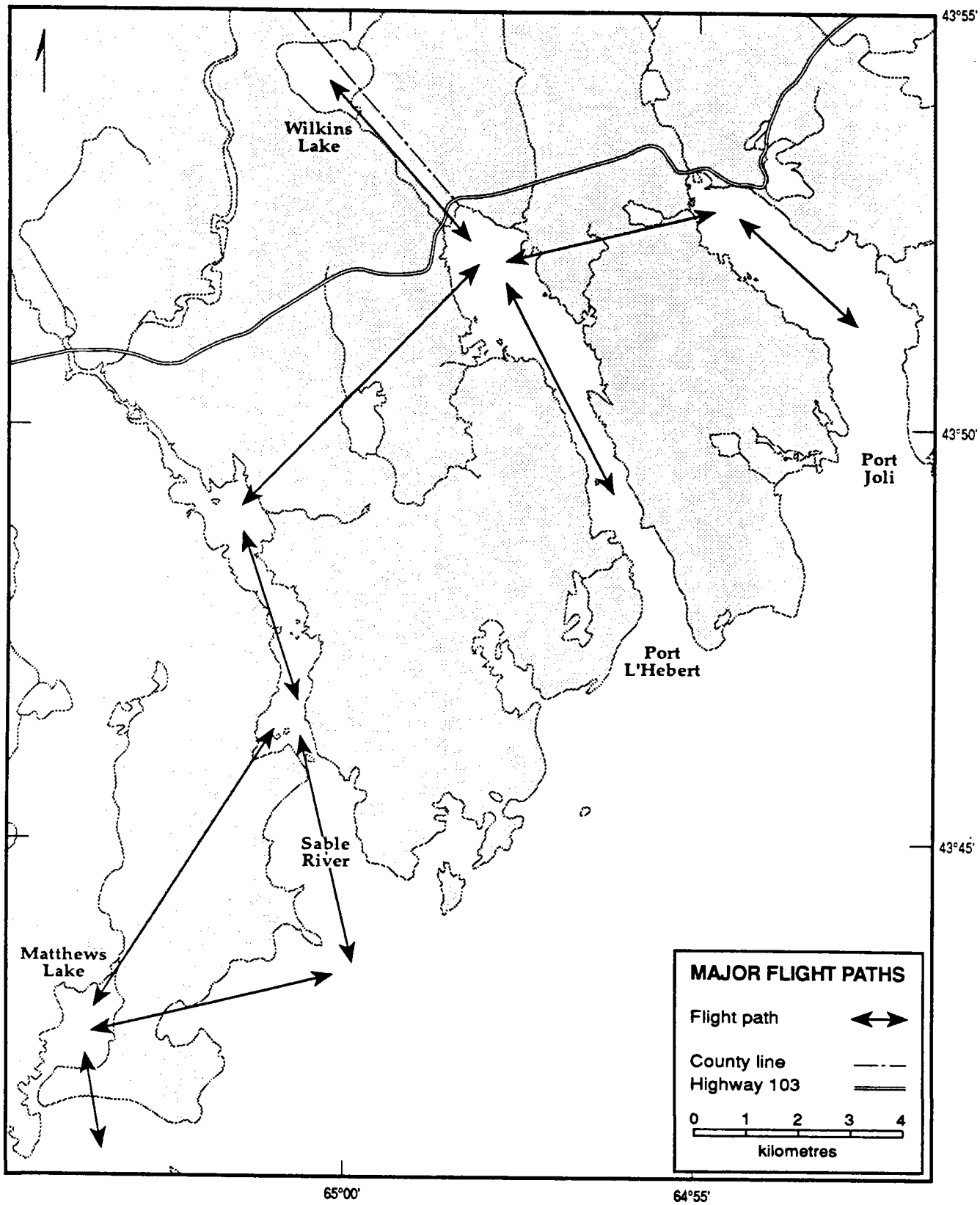

Figure III-4 The Port Joli area, showing main flight-paths used by Canada Geese in local movements, 1968-69.

Comparisons of the major freeze of 1960–61, the most severe in recent memory (compare Chapter II, this volume), with that of 1967–68 indicated that ice cover was more extensive in 1960-61. However, mean weekly temperatures then were no lower than, if as low as, in 1967-68, so other factors, presumably combinations of wind and tide during the period while the ice cover was developing, influenced the extent of ice cover.

4.6 Goose populations

In the more distant past, local traditions asserted that Canada Geese had always wintered in large numbers in the Port Joli area. This conflicted with their status as common migrants in accounts by several early Nova Scotia naturalists (More 1873; Gilpin 1882; Downs 1890), who might have been expected to know of geese wintering there in view of what they reported concerning other waterfowl along the South Shore. Reports of the Commissioner of Forests and Game showed Canada Goose numbers in the Port Joli area as stable 1908–10, decreasing 1911–14, stable 1916–17, and steadily increasing 1918–25.

Estimates from historical sources (Table III-4, plus earlier data in Table II-5, this volume) supplemented those from the Midwinter Waterfowl Inventories without altering the pattern discussed in the preceding chapter. There seems to have been little variation in the wintering population in the 20th Century, with the usual numbers between 3000 and 5000 birds.

Waterfowl numbers varied both seasonally and from year to year. The aerial counts attempted in 1967-68 proved of limited value. Lack of experience in assessing the large flocks encountered limited the obtaining of representative counts. Geese usually did not flush if the aircraft remained above 150 m, but identification of ducks was not practicable from that height. In the fall of 1968, geese often flushed when the aircraft was at 250 m. None of the film-types used for photographing large goose flocks provided consistently reliable images for estimating numbers.

Canada Goose counts, by survey area (Fig. III-1), are summarized in Table III-5. Areas 1, 3, and 5 comprised the sanctuary (plus the west side of upper Port L'Hebert), and combined counts for those areas were compared with estimates by Turner in 1962 to 1968 (Table III-6). The sanctuary estimates were lower and more variable than estimates for the entire area, presumably because of local movements into and out of the sanctuary. In general, numbers peaked in late November and again in early February, with fewer in the intervening period. In 1968-69, the peaks were somewhat earlier, in late October and January, but the overall pattern was similar.

Dale (1920a,b,c; 1921a) reported first arrivals of geese in late October or early November 1919–20. In contrast, MacAdams' diaries noted the first geese of the fall on 12 September 1950 and 11 September 1951. In 1962 to 1968, R.E. Turner's observations also indicated that Canada Geese arrived in the study area in late August or early September, nearly two months earlier than in 1920.

4.7 Food habits of Canada Geese

A total of 22 Canada Goose gizzards, collected in October through January, was received. Nineteen gizzards were used in the assessment, with mean volume of gizzard contents 19.8 ml (range 8.5–32.5 ml). The results of the analysis (Table III-7) showed that eelgrass was the primary food, with the blades and rhizomes usually being eaten together. Fresh green blades of *Spartina alterniflora* were consumed by two birds in early October. A crippled goose collected in late February had fed on old stems and blades of this grass; this bird had been isolated from the rest of the flock and from the eelgrass beds.

The attempt to monitor goose food habits by faecal analysis was unsuccessful. Cell characteristics of the meristem and the upper blades of eelgrass and salt-marsh cordgress tended to confuse identifications. With more time available and more experience of plant anatomy, this technique might prove workable.

5. Discussion

5.1 Food requirements of Canada Geese

Canada Geese in the Port Joli area depended largely upon one food species, eelgrass, which left them vulnerable to changes in availability of food caused by local conditions. The food requirements of wintering geese may be approximated thus:
(a) average food consumption/bird/day is roughly 10% of wet body weight of the bird (Sincock 1962); and
(b) this was equivalent to the eelgrass blades on 1 square metre per bird per day, for geese in Alaska (McRoy 1966), without allowing for consumption of eelgrass rhizomes.

The ability of eelgrass to supply the nutritional requirements of the geese depends on both the composition of the plants and their digestibility, which vary through the year. The crude protein content of local eelgrass (Table III-1) was lower than that for *Zostera nana* in England (Ranwell and Downing 1959), but similar to a sample from Prince Edward Island (Thomas 1968). The P.E.I. sample contained 4160 cal/g and the local samples averaged 4046 cal/g (ash-free dry weight), similar to results from Alaska (McRoy 1966). P.E.I. eelgrass was found to be only 35% digestible for cattle (noted as "very low for fodder"; Thomas 1968). As digestion in geese, unlike cattle, is a mono-gastric process, one would expect its digestibility by geese to be even lower. One cause of this low digestibility of eelgrass may be its high content of pectose instead of cellulose (Petersen and Boysen-Jensen 1911).

Table III-4. Mid-winter inventories and other winter counts of Canada Geese in the Port Joli Migratory Bird Sanctuary, Nova Scotia, not summarized earlier; see also Table II-5 (Erskine, this volume), of which the data were included in Martell's thesis, and Turner's periodic counts in 1962–68 (Table III-6, below).

Year	Date (as given)	Number of geese	Comments
1914	January 1	3500	Port L'Hebert only; Forbes (1921)
1919	December	5000	Port Joli only; Dale (1920a,b,c,)
1921	January 1	2500–3000	Port Joli only; Dale (1921a,b)
1922	February 26-27	6100	Port L'Hebert only; Lloyd (1923)
1931	Winter	20 000	Port Joli & Port L'Hebert only; R.W. Tufts, in Lewis (1931)
1951	January 10	3500	by G.L. Edwards (letter to CWS)
1953	January 13	6750	aerial count by G.F. Boyer (covering all South Shore?)
1961	January	3800	estimate for sanctuary for month by R.E. Turner; counts 24–26 January by Erskine (Table II-1) gave not over 3000, as did an estimate by Turner 13 February.
1962	January	2234	mean of 3 Sanctuary counts by J. Cameron; Sanctuary estimate for month by Turner was 4100; aerial count of South Shore (I. Moss) was 2515.
1963	January	4500	Sanctuary estimate for month by Turner; aerial count for South Shore (I. Moss) was 2465.
1964	January	4150	aerial count for all South Shore (I. Moss).
1965	January 22-23	4500	by F.J. Payne
1966	January 8	3050	by R.E. Turner; Turner estimated 3300 and 6000 geese on other dates in same month.
1967	January 8	1800	by Turner; Sanctuary estimate for month was 4000.
1968	January	4000	Sanctuary estimate for month by Turner; mean count for all Port Joli area was 4185.
1969	January	5450	by Martell; mean of 2 Sanctuary counts by Turner was 6500; aerial count of South Shore (G. Freeman) was 5050, all in Port Joli area.

Table III-5. Canada Goose estimates, Port Joli area, Nova Scotia, 1968–69. Areas (numbered as in Figure III-1) were counted in numerical sequence, except area 4 counted before area 3.

	Number of geese estimated in area											
Date	1	2	3	4	5	6	7	8	9	10	11	12
29 August	2											
12 September	325											
24 September	4900	7								300		
10 October	1800		2200							130		
23 October		1800	5500	500		125				275		
07 November	2200		4500			500	20			500		
21 November	900		4000			600	30			300		
09 December	250	750	3900							23		9
20 December		1100	3000	1800						50		
06 January	3300	300	500			2500	500	600[1]	650[1]	25	1100[1]	
21 January	3700	23	1100		300	800				700		
07 February	5200	125	1000			3				85		
09 March						3700				420		
25 March	85				1500					107		
04 April	11									18		

[1] These counts may involve some duplication, as geese were flying in the bays; the estimated total count that day was 7125.

Table III-6. Canada Goose estimates, Port Joli Migratory Bird Sanctuary, Nova Scotia, 1962–63 through 1967–68 (no data 1964–65; all counts by R.E. Turner, N.S. Lands & Forests, Wildlife Division). n.c. = no count.

Count period	Geese estimated[1] in winter				
	62–63	63–64	65–66	66–67	67–68
01–15 October	1200[1]	2400[1]	1300	n.c	n.c.
15–31 October	100	2400	n.c.	4000	n.c.
01–15 November	2600[1]	3000[1]	4800	n.c.	5300
16–30 November	3000[1]	1000	n.c.	7100	5500
01–15 December	1700[1]	900	3500	3500	4600
16–31 December	1100	1000	n.c.	n.c.	5300
01–15 January	2400[1]	3300[1]	3100	900	4000
16–31 January	3200[1]	4000	n.c.	7000	3900
01–14 February	n.c.	n.c.	3500	n.c.	7100
15–28 February	n.c.	n.c.	n.c.	n.c.	n.c.
01–15 March	n.c.	n.c.	700	n.c.	n.c.

[1]In periods with several estimates, the highest was used.

Table III-7. Food habits of Canada Geese, Port Joli area, Nova Scotia, 1968–69.

Species	Volume		Frequency	
	ml	%	No.	%
Vegetable foods				
Zosteraceae				
Eelgrass (*Zostera marina*)	191.0	93.9	17	89.5
Blades	51.5	25.3	6	31.6
Blades & rhizomes	114.0	56.0	10	52.6
Rhizomes	25.5	12.5	1	5.3
Gramineae				
Saltmarsh cordgrass (*Spartina alterniflora*)	12.5	6.1	2	10.5
Sub-Total	203.5	100.0	19	100.0
Animal foods				
Snails (Gastropoda) unidentified	trace	trace	1	5.3
Total food	203.5	100.0		
(per cent of total volume)		54.0		
Grit	173.5	46.0	19	100.0

Diets containing 14–18% crude protein are considered desirable for maintenance of various domestic poultry (Merritt and Aitken 1961; Ewing 1963). The late fall and winter protein content of eelgrass blades at Port Joli should be adequate for Canada Geese, but the early fall level may be too low. As the leaves become less available in late fall, geese turn for food to the eelgrass rhizomes, which are much lower in protein content, so would require the processing of much larger quantities of carbohydrate in order to obtain the required protein.

Lefebvre and Raveling (1967) found, for another race of large Canada Geese, the lowest long-term temperature tolerated at moderate work level was in the range –7° to –13°C, although Williams (1965) found a captive bird with "maximum potential energy intake" could survive (briefly?) at temperatures as low as –40°C. As local Canada Geese are exposed to extended periods with temperatures below –7°C, monthly minima often falling below –10°C in January and especially February (Table III-3), the birds must be subject to some physiological stress in winter. In 1968-69, mean weekly minimum temperatures

during the two freeze-up periods reached –20° and –16°C, respectively. The geese might have been expected to be severely stressed then, but no overt signs of stress such as complete cessation of flight, lack of movement, huddling together on the shore, tucking bill and feet into feathers, were noted. [Ed. comment: All of these behaviours were noted, in varying degrees, in January 1961. Large birds such as Canada Geese probably tolerate negative energy balances for several days in preference to undertaking further migration beyond a traditional wintering area.] An investigation into cold stress and nutrition of geese at Port Joli would help us to understand the ecology of Canada Geese wintering at the northern limit of their range (compare Chapter IV, this volume).

5.2 Management recommendations

There was no indication that either food or quality of habitat were direct limiting factors for the waterfowl wintering in the Port Joli area. Adverse climatic conditions tended to restrict the available feeding, and hunting was the greatest mortality factor. When ice-cover prevented use of feeding areas in the Sanctuary during hunting season, hunting pressure often restricted the use of alternate feeding areas. At such times, Canada Geese, which are dependent on the intertidal eelgrass beds for food, may be severely stressed. A better distribution of sanctuary and management areas might help to alleviate this problem without greatly reducing hunting opportunity or waterfowl kill.

A Migratory Bird Sanctuary comprising Port L'Hebert north of the southern "narrows" (from Taylors Island on the west side and from Long Cove on the east), with adjoining lands back to 400 m from the shore, if rigorously enforced, might provide adequate refuge (feeding and resting) area for present winter waterfowl populations. This area would be closed to hunting at all times.

Three other areas would require management of hunting, and thus some control over use of adjoining lands: (a) Sable River, from the present northern sanctuary boundary south to John Island (off Louis Head Beach), inland to the roads parallelling the east and west shores; (b) Jones Harbour, from the main road south along the Jones Harbour road and the west shore to the tip of Harding Point on the west, and from the mouth of Johnston Pond to the southeast point of Green Island on the east; and
(c) Haley Lake, comprising the lake and the surrounding land back to 400 m from the lake.

Hunting would be permitted during the regular waterfowl seasons in those areas, but with several restrictions. No hunting would be allowed after 1 January on Sable River and probably also at Jones Harbour, as those are the principal refuge areas during periods of widespread ice-cover; Haley Lake usually would be frozen before that date. Experimental hunting restrictions, including use of specified blinds at Haley Lake, and perhaps on numbers of shells permitted each hunter at Haley Lake and Jones Harbour, might also be appropriate, assuming adequate enforcement. Establishment of the Jones Harbour and Haley Lake areas would be straightforward, as no homes exist in those areas. Settlement along both shores of Sable River would complicate land acquisition there, and leasing might be an alternative. Effective control over adjoining lands is essential for management of water areas for both waterfowl and hunting. If those areas were controlled and managed as suggested, Port Joli could be opened to hunting, which might end many of the present complaints and enforcement problems in that relatively thickly settled area. This would greatly increase the available hunting area, and the reduced availability of goose feeding area might be tolerated if undisturbed feeding at Port L'Hebert were assured. Matthews Lake would remain open to hunting as at present.

6. Literature cited

Audubon, J.J., with J.B. Chevalier, 1840–44. The birds of America. Vol. 6. 457 p. (Dover reprint 1967)

Bent, A.C. 1925. Life histories of North American wild fowl. Part 1. U.S. Nat. Mus. Bull. 130. 244 p. (Dover reprint 1962)

Cottam, C. 1934. The eel-grass shortage in relation to waterfowl. Trans. Amer. Game Conf., 20: 272–279.

Cottam, C. 1939. Food habits of North American diving ducks. U.S. Dept. Agric. Tech. Bull. 643. 140 pp.

Cottam, C. and Munro, D.A. 1954. Eelgrass status and environmental relations. J. Wildl. Manage. 18: 449–460.

Dale, B. 1920a. Wild goose shooting in Nova Scotia. Rod and Gun in Can. 21(11): 1241–1245.

Dale, B. 1920b. Goose hunting on Christmas Day. Rod and Gun in Can. 22(7): 752–755.

Dale, B. 1920c. A few notes on the wild goose along the Atlantic coast. Rod and Gun in Can. 21(9).

Dale, B. 1921a. Watching the flight of the wild goose. Rod and Gun in Can. 23(6): 548–550.

Dale, B. 1921b. Wildfowling without a gun: a Christmas Day yarn. Rod and Gun in Can. 23(7): 639–642.

Dawson, E.Y. 1966. Marine botany. Holt, Rinehart and Winton, Inc., New York. 371 pp.

Dexter, R.W. 1944. Ecological significance of the disappearance of eel-grass at Cape Ann, Massachusetts. J. Wildl. Manage. 8: 173–176.

Downs, A. 1890(=1888?). A catalogue of the birds of Nova Scotia. Proc. & Trans. N.S. Inst. Natur. Sci. 7: 142–178.

Ewing, W.D. 1963. Poultry nutrition. Fifth Ed.(Rev.). The Ray Ewing Company, Pasadena, Calif. 1475 pp.

Forbes, J.F.E. 1921. My first experience with the Canada Goose. Rod and Gun in Can. 23(5): 482–484.

Forbush, E.H. 1912. A history of the game birds, wild-fowl and shore birds of Massachusetts and adjacent states... Mass. State Bd. Agr., Boston. 622 pp.

Gilpin, J.B. 1882. On the semi-annual migration of sea fowl in Nova Scotia. Proc. & Trans. N.S. Inst. Natur. Sci. V(2): 138–151.

Hartley, P.H.T. 1948. The assessment of the food of birds. Ibis, 90: 361–381.

Lefebvre, E.A. and Raveling, D.G. 1967. Distribution of Canada geese in winter as related to heat loss at varying environmental temperatures. J. Wildl. Manage. 31: 538–546.

Lewis, H.F. 1931. The relation of Canada Geese and Brant to commercial gathering of eel-grass on the St. Lawrence estuary. Can. Field-Nat. 45: 57–62.

Lewis, H.F. 1932. The eel grass situation on the Atlantic coast. Trans. Amer. Game Conf. 19: 411–421.

Lloyd, H. 1923. Observations on the wintering flocks of Canada Geese in Nova Scotia. Can. Field-Nat. 37: 26–28.

Martell, A.M. 1969. A study of winter waterfowl ecology at Port Joli, Nova Scotia. Unpubl. M.Sc. thesis, Acadia University, Wolfville, N.S. 275 pp.

Martin, A.C., Zim, R.S., and Nelson, A.L. 1951. American wildlife and plants. McGraw-Hill Book Company, Inc., New York. 500 pp. (Dover reprint 1961).

McRoy, C.P. 1966. The standing stock and ecology of eelgrass (*Zostera marina* L.) in Izembek Lagoon, Alaska. M.S. thesis, U. Washington, Seattle. 138 pp.

Merritt, B.S. and Aitken, J.R. 1961. Raising geese. Can. Dept. Agr., Res. Br. Publ. 848. 19 pp.

More, J.P. 1873. The history of Queens County, ... Nova Scotia Printing Co., Halifax. 250 pp.

Norton, A.S. 1909. The food of several Maine water-birds. Auk 26: 438–440.

Ostenfeld, C.H. 1908. On the ecology and distribution of the grass-wrack (*Zostera marina*) in Danish waters. Rep. Danish Biol. Stn. XVI, 61 pp.

Petersen, C.G.T. and Boysen-Jensen, P. 1911. Valuation of the sea. I. Animal life of the sea bottom, its feed and quantity. Rep. Danish Biol. Stn., Copenhagen. XX. 76 pp.

Philips, R.C. 1964. Comprehensive bibliography of *Zostera marina*. U.S. Dept. Int., Fish & Wildl. Serv., Spec. Sci. Rpt., Wildl. 79. 35 pp.

Ranwell, D.S. and Downing, B.M. 1959. Brent goose (*Branta bernicla* (L.)) winter feeding pattern and *Zostera* resources at Scolt Head Island, Norfolk. Anim. Behav. 7(1–2): 42–56.

Renn, C.S. 1936. The wasting disease of *Zostera marina*. I. A phytological investigation of the diseased plant. Biol. Bull. 70: 148–158.

Sincock, J.L. 1962. Estimating consumption of foods by wintering waterfowl populations. Proc. Ann. Conf. Southeast Assoc. Game & Fish Comm. 16: 217–221.

Stauffer, R.C. 1937. Changes in the invertebrate community of a lagoon after disappearance of the eel grass. Ecology 18: 427–431.

Thomas, M.L.H. 1968. Studies on the biology of eel-grass (*Zostera marina*) in the Maritimes. Fish. Res. Bd. Can., unpubl. MS. 47 pp.

Williams, J.B. 1965. Energy requirements of the Canada Goose in relation to distribution and migration. Ph.D. diss., U. Ill., Champaign. 108 pp.

IV. THE UTILIZATION OF PORT JOLI, PORT L'HEBERT AND SABLE RIVER BY MIGRATING AND OVERWINTERING CANADA GEESE, 1977–79 1/

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1. Abstract

A study of winter feeding ecology of Canada Geese (*Branta canadensis* L.) was conducted in Port Joli, Port L'Hebert and Sable River, Nova Scotia, in 1977 to 1979. The main purpose was to investigate goose distribution and activity within the study area and to examine the relationship between the geese and eelgrass (*Zostera marina*).

The mean number of geese in the study area between September 1978 and April 1979 was 3604. The peak was 5700 in January 1979. Goose numbers were lower (max. 4145) and peaked earlier (mid-November) in 1977-78. Location of disturbances, biomass of eelgrass, and location of fresh-water outlets and gravel bars contributed, in decreasing order of importance, to the distribution of geese within the inlets. Activity was significantly related to tidal phase.

Eelgrass was the main food ingested by geese and also the dominant aquatic vegetation in the study area. Of the winter foraging day, 58–83% was spent in active feeding behaviour. Feeding on floating pieces of eelgrass, when the intact plants were inaccessible during high tide, effectively increased the amount of time available for feeding. Eelgrass provided sufficient protein for wintering geese on a maintenance diet. The digestible energy of eelgrass was 0.94 kcal/g in early fall and 1.19 kcal/g in early spring. A wintering goose in the study area would have to ingest 2800–3500 g(wet weight)/day of eelgrass. Based on this requirement, Port L'Hebert could support at least 750 000 goose-days, Port Joli at least 250 000 goose-days, and Sable River at least 75 000 goose-days during the wintering period, totals equal to or larger than those of actual usage during the 1978–79 winter.

2. Introduction

The southwestern shore of Nova Scotia has long been known as a migration stopover and overwintering area for Canada Geese in the Atlantic Flyway (see general introduction, A., this volume). In 1915, legislation to protect geese in the Port Joli area[1] was enacted (Martell 1969). Since then, sanctuary and management zone boundaries and regulations have been altered several times (Martell 1969; P. Barkhouse, CWS, unpubl. rep. 1976) in efforts to serve the interests of both waterfowl and hunters.

Several investigations by Canadian Wildlife Service personnel (including Erskine, this volume; R. Fyfe, CWS, unpubl. rep. 1966; Barkhouse, unpubl. rep. 1976) and one major study on waterfowl ecology (Martell 1969, this volume) were conducted in the Port Joli area since 1950. Both Martell and Barkhouse identified a need to investigate in more detail the winter ecology of geese in the Port Joli area.

Although many authors since Audubon (1840) recognized the importance of eelgrass, the most common sea grass in shallow and sedimented waters of the North Atlantic Ocean (Harrison and Mann 1975), as a food source for Canada Geese, little research has delved into the relationship between geese and eelgrass. Martell (this volume) concluded that the crude protein content of eelgrass blades was adequate to maintain wintering geese, but that of eelgrass rhizomes was not. However, he noted that more information was needed on the carbohydrate content before the nutritional adequacy of eelgrass as a winter diet for geese could be assessed. Work on feeding by geese in Europe (Ranwell and Downing 1959; Owen 1975) indicated that eelgrass was often selected over *Enteromorpha* spp. because of nutritional criteria, including nitrogen content. However, Owen (1972a) also noted that, because geese are inefficient at digesting plant food, maintaining high rates of food intake may be more important for them than selection for nutrition.

Martell (1969) found no constant relationship between feeding habits and stage of tide, although Butcher (1941) referred to different feeding methods at low and high tides. Owen (1972b) found that White-fronted Geese (*Anser albifrons*) in Great Britain spent more than 90% of daylight hours feeding during the short days of midwinter, and van der Bilt and Helming (1978) reported similar findings for Brant (*Branta bernicla*) in the Netherlands. Owen (1972b) also concluded that disturbances that caused interruptions in feeding activity and shortening of the available time for feeding caused birds to lose weight and possibly to desert the feeding area.

[1] Place-name usage as in A and Chapter II, this volume.

In 1977 the Canadian Wildlife Service sponsored a study of the fall and winter ecology of geese in the Port Joli area. The specific objectives included

(a) monitoring goose numbers;
(b) investigating goose distribution within and use of the study area;
(c) studying the activities, especially feeding, of wintering geese;
(d) determining the extent, availability and nutrient value of eelgrass and relating it to goose use; and
(e) monitoring the effects of disturbances on goose activity and movements.

3. Methods

3.1 Numbers

Counts were conducted at least every four days in 1977-78 (1 October to 9 March) and every five days in 1978-89 (2 October to 28 March, except during February) in the upper parts of the three inlets. Most of Port Joli was viewed from vantage points at the old government wharf on the east side and from the highway at the head of the inlet. Port L'Hebert was less easily viewed without resorting to a boat or extended foot travel; the upper part of the harbour was viewed from the Nova Scotia Lands and Forests (now Dept. of Natural Resources) cabin site at the north end. Sable River was easily accessible from the roads along both east and west sides. Counts were generally made on the ebbing tide, when most geese had returned from the freshwater lakes, so as to ensure as complete coverage as possible of the local population. Birds were counted individually, using binoculars or a telescope, when flocks were dispersed, but concentrated flocks were estimated in multiples of ten individuals.

3.2 Activity

3.2.1 Observations

Activity observations were irregular during October 1978, but beginning 1 November observations were scheduled in three 8-day periods each month (the rest of the time was used for the eelgrass sampling). Activity observations at Port Joli and Sable River were made from a vehicle parked at locations whence the entire flock could be watched. Observations at Port L'Hebert were made from the best viewing point accessible on foot. Feeding movements were categorized as passive feeding (pecking at the surface without submerging the head), active feeding (feeding from the surface with head submerged, with or without tipping-up, or on the exposed mudflat), loafing/roosting, or preening. Between 08:30 and 11:30, and from 12:30 to 15:30, or as long as conditions permitted, the proportion of the flock estimated as engaged in each of these categories was recorded every 30 minutes. Disturbances, weather conditions and low/high tide times were also noted on the activity data sheets.

3.2.2 Statistical analysis

For analysis, daily observation times were converted to half-hour time intervals ranging from 6 h before to 6 h after low tide. Observations of different types of activity were summed for each time interval relative to low tide, RxC contingency tables were established, and the null hypothesis that activity and tidal stage varied independently was tested with chi-square. For further analysis, the varying numbers of activity observations in each time interval were averaged to provide a uniform figure for all intervals; the time intervals were ranked separately before and after low tide, and the number of times an activity was observed in each time interval was ranked before and after low tide. The differences in ranks for the paired variables were calculated, and Spearman's coefficient of rank correlation was determined for each activity in each inlet. Significance was tested using Student's t-test with n-2 degrees of freedom and $P<0.001$.

3.3 Distribution

During systematic observations in each inlet, flock locations were recorded regularly at 08:30, 12:30, and 15:30. Flock distribution was described and mapped (Fig. IV-1(b)) on overlays of aerial photographs according to the areas (units) established for eelgrass sampling (Fig. IV-1(a)). Observations were summed for each unit by month and over the winter as a whole, by time before or after low tide, and for each type of activity. Small samples precluded statistical analysis of relationships between tide stage and distribution. Spearman's rank coefficient was used to test relationships between goose distribution and eelgrass area within units or with nutritional variation between inlets.

3.4 Movements

All movements of geese and all disturbances to geese were recorded daily on overlays of the study area map. A parabolic reflector and microphone were used on six occasions to determine (by vocalizations) whether geese were using at night areas that would be subject to disturbance by hunting during daylight hours.

3.5 Eelgrass distribution and analysis

3.5.1 Distribution

Eelgrass beds were delineated on maps with the aid of aerial photographs and by direct observation from a 4.9-m aluminium boat. The three inlets were subdivided into three, six, and three sampling units, respectively (Fig. IV-1(b)), based on sanctuary boundaries, prominent landmarks to facilitate boundary recognition, and the need for sampling areas of convenient size. Beds were categorized as dense, medium, or sparse (Fig. IV-1(a)), using aerial photographs and direct observations. The area (ha) of each density class in each unit was determined using a planimeter.

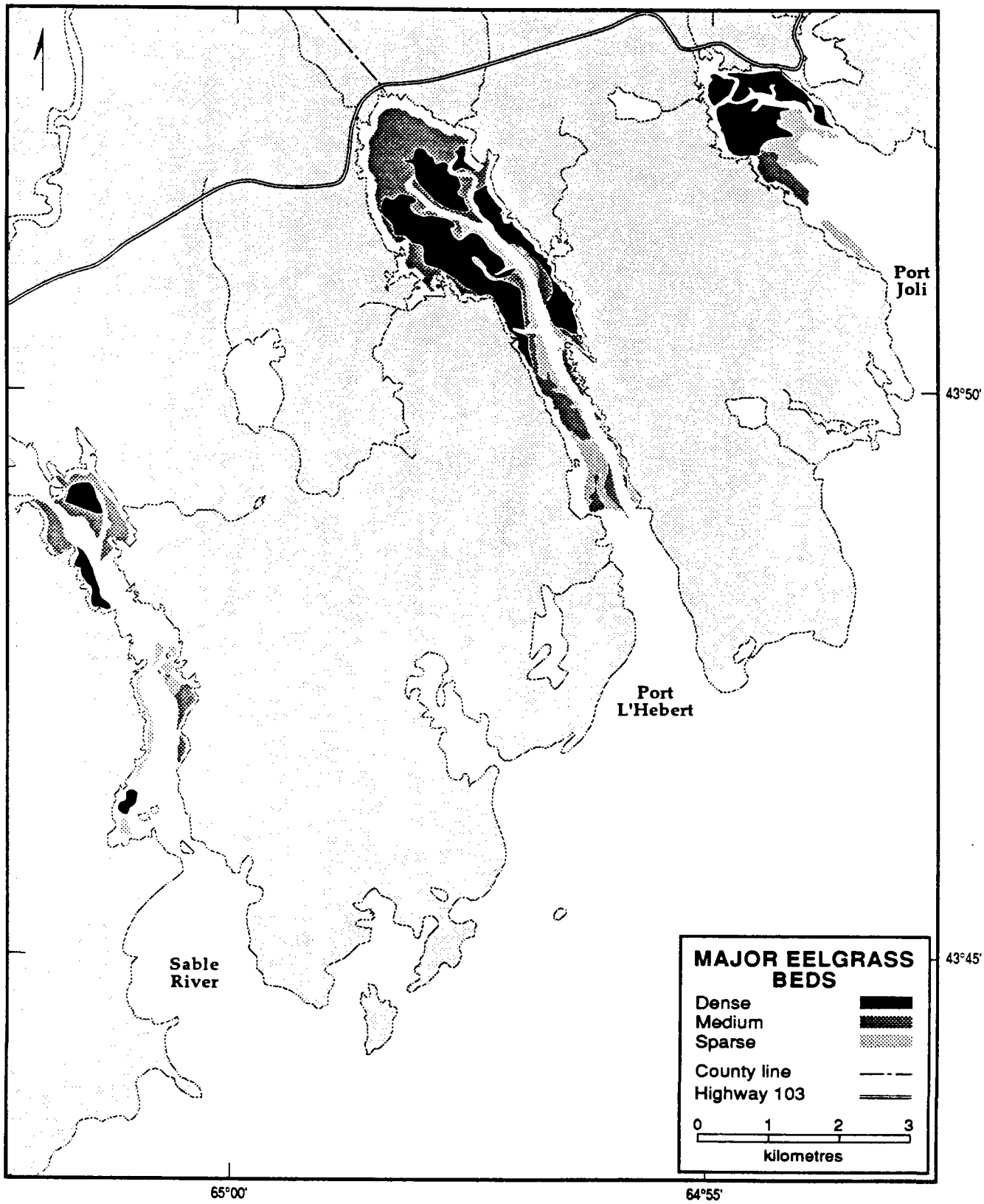

Figure IV-1a The Port Joli area, showing locations and density classes of eelgrass beds, 1978-79.

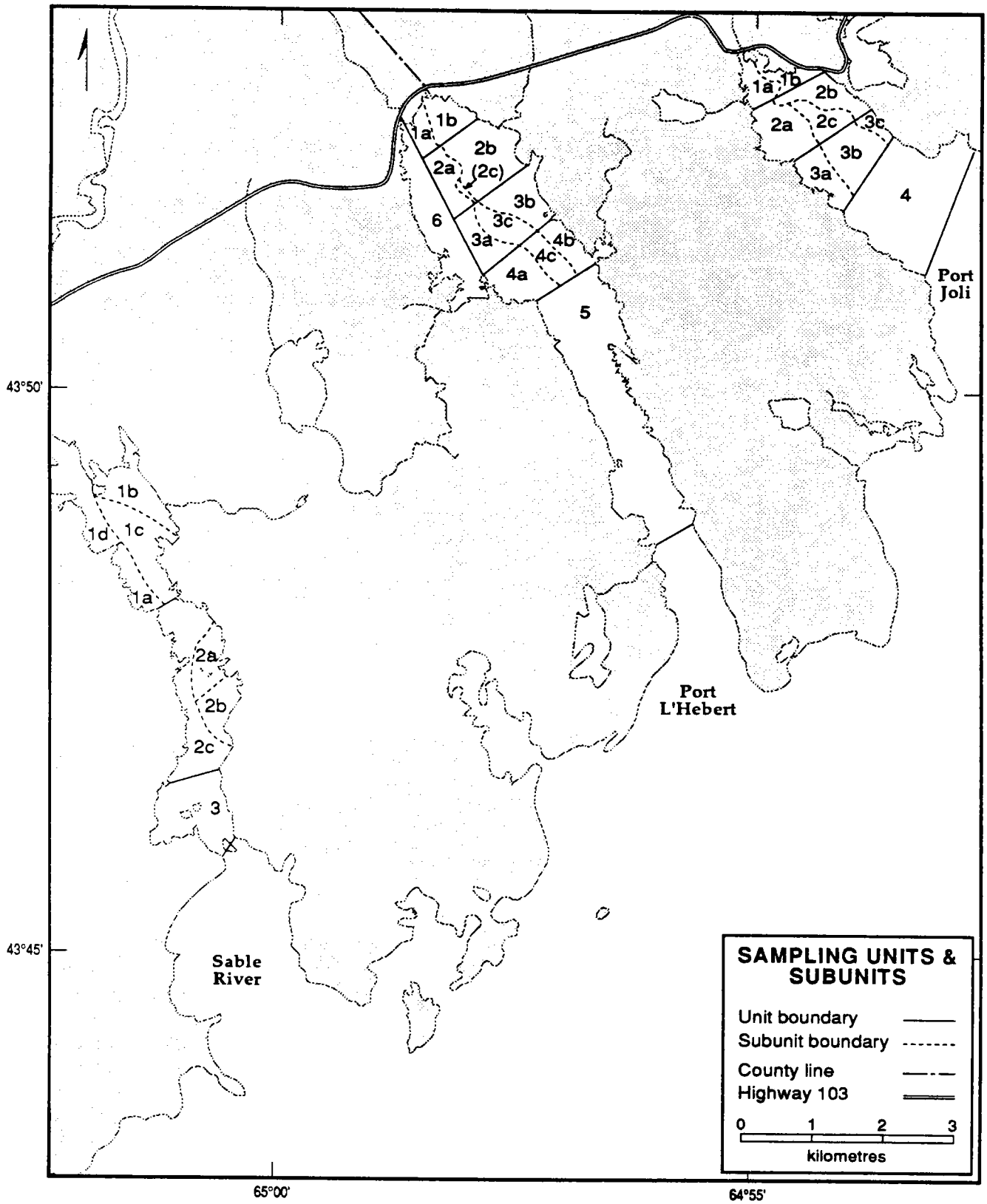

Figure IV-1b The Port Joli area, showing sampling units and subunits (1a, 2c, 3d etc.).

3.5.2 Sampling and analysis

Each unit was sampled during spring (low) tides in September/ October 1978 and again in March/April 1979 to determine eelgrass conditions in each inlet at the beginning and end of the study period. During the intervening months, only the unit in each inlet with the greatest goose use was sampled, the sampling dates being weather-dependent. Eelgrass samples were collected every 20 m along 200 m transects. Transect location and direction were based on access to and configuration of the bed being sampled. Three compass bearings to prominent landmarks allowed precise relocation on later sampling days. Where the substrate was too soft for easy walking, plywood mud shoes to distribute body weight over a larger surface area were used, following the practice of hunters in Great Britain.

Samples were taken from within a 0.25 sq m wooden frame dropped on the mud surface. All eelgrass within the frame was harvested by hand, using a pulling-twisting motion to simulate feeding by geese. This removed blades and some of the attached root system, with organic debris such as dead eelgrass and loose vegetation. The labelled and bagged samples were subsequently washed to remove mud and mollusks, drained for 45 min, and gently squeezed to remove excess water, before weighing (wet weights) with OHAUS or PESOLA spring scales. Wet volumes were obtained by compacting the eelgrass in a 10 oz can (284 ml) and estimating the proportion filled. From each transect, three samples were randomly chosen for analysis. A subsample from one sample was frozen for future dry weight and volume measurements. The other two samples were sorted into green vs. senescing vs. dead blades vs. roots, each of which had weight and volume measured separately. Subsamples of each were stored frozen for nutrient analysis. At that time, each subsample was dried to constant weight (92+ h)(dry weights), and ground in a blender. Carbohydrate content was determined at the Nova Scotia Research Foundation in Dartmouth. Crude fibre, protein, percent ash, and trace element analysis were estimated at the Nova Scotia Department of Agriculture in Truro.

3.5.3 Biomass

Dry weights for the selected subsamples were used to determine biomass for each of September-October, November, December, January, and March- April, for each transect. Separate values (kg/ha) were determined for blade biomass, root biomass, and root plus blade biomass. Data for individual transects were averaged to provide combined figures for each density class in each inlet.

3.5.4 Nutritional content

Percent nitrogen was multiplied by 6.25 to estimate per cent protein (Kleiber 1971). Calorific values were estimated by summing (% carbohydrate x 4.4 kcal/g) and (% protein x 4.4 kcal/g). As geese convert a negligible proportion of crude fibre to energy, this was omitted from the calculation, as was fat which occurs in eelgrass only in trace amounts.

4. Results

4.1 Goose numbers

The overall counts showed different patterns in the two winters (Fig. IV-2(a),(b)). In 1977-78, total numbers peaked in mid-November with the mean of three counts 4145 geese, and then declined to midwinter levels (1500–2000) by 20 December. The second winter showed two periods with peak numbers present, one in October and another from mid-December to mid-January. The largest one-day totals in the peak periods were 4970 (1 November) and 5700 geese (14 January), with much lower numbers present through the late winter. By the third week of March, continuing migratory movements through the area made counts doubtfully representative of the numbers actually present at any one time. Geese were seen in the area only once after 26 March in 1978 -79, and none were seen after February in the first winter.

Port L'Hebert supported the largest numbers of geese through late November in 1977-78 and through mid-January in 1978-79. Numbers there were near peak levels (ca. 4000 birds) from mid-October to mid-December in 1978, except for early November—corresponding to the period between the two parts of the split season for waterfowl hunting, and around 1 December—when the first ice-cover developed in the upper part of the inlet. Few geese were seen at Port L'Hebert after 11 January in either year.

Goose numbers at Port Joli were lower (ca. 1000), and fairly stable until early December. Thereafter, in 1978-79, numbers increased at Port Joli while they declined at Port L'Hebert, to the peak of 2700 geese on 9 January. After the hunting season ended 16 January, most geese had left Port Joli in both winters.

Only a few geese were noted at Sable River before mid-December 1977 and January 1979, and most of those were on non-hunting days. A general shift from Port Joli to Sable River occurred after the end of the hunting season, with the one count in February 1979 (5th) showing the highest number of geese there in either winter (2300). Most birds noted in March, including spring migrants, were seen at Sable River.

4.2 Activity of geese

Dawn-to-dusk observations (26 d at Port Joli, 13 d each at Port L'Hebert and Sable River) showed a clear inverse relationship between timing of active feeding and of loafing or preening, whereas passive feeding occurred concurrently with all other activities, usually at rather low frequency levels (Fig. IV-3(a),(b),(c)). Active feeding began on the ebb tide 3–5 h before low water, when a peak was reached, and declined during the flooding tide, whereas loafing/preening showed a reversed cycle. These relationships were significantly different, and the null hypothesis of independence from the tidal cycle was rejected for both these activities. Passive feeding also

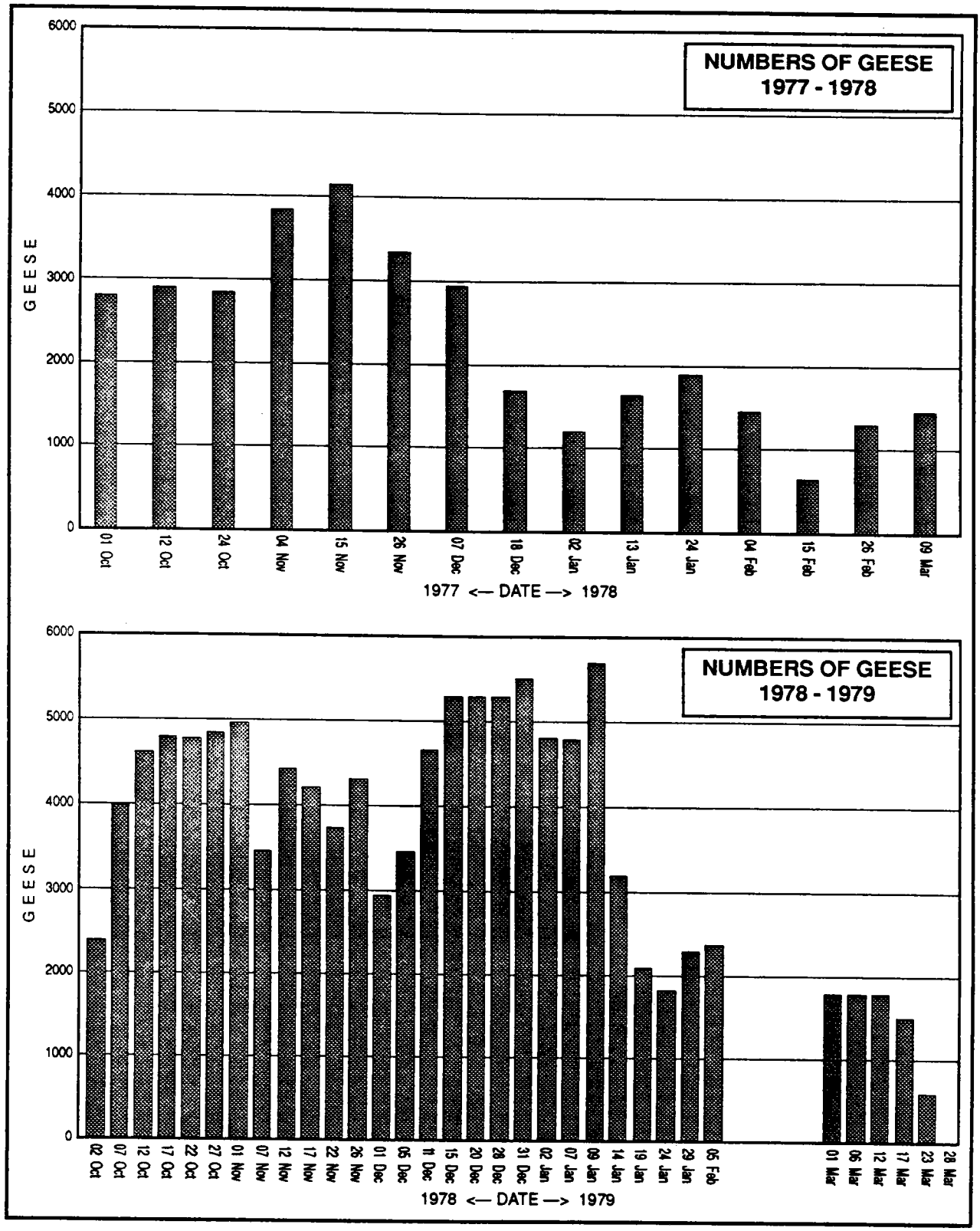

Figure IV-2 Canada Goose numbers in the Port Joli area as a whole, and in each of the three main inlets, through the seasons of 1977-78 and 1978-79.

appeared not to be independent of the tidal cycle, except perhaps at Port L'Hebert, but the relationships were less strongly established than for the other activities.

Correlation coefficients corresponded closely to rs = +1 for active feeding and ebbing tide, and to rs = –1 for active feeding and flooding tide. Conversely, correlation coefficients corresponded closely to rs = +1 for loafing/preening and flooding tide, but for loafing/preening and ebbing tide the correlation coefficient was close to rs = –1 only for Port Joli, with little correlation in the other areas. Passive feeding was not significantly correlated to ebbing or flooding tide, except possibly at Port Joli on the ebbing tide.

4.3 Distribution of geese

During surveys at Port Joli, geese were never seen in the southernmost unit (4), and seldom along the east side (units 3c and 2b). The most use was in the northwest-central part (unit 2a), in all months, and in October only the northwest (units 2a and 1a) was used to any extent (Fig. IV-4(a)). Heavy use of unit 2a reflected partly more difficult human access and thus less frequent disturbance, but the other western areas were not consistently used more by geese than those farther east. Small samples precluded statistical testing of relationships between tidal stage and distribution of geese, in all areas. All types of activity were frequent in unit 2a, whereas loafing/preening predominated in units 3a,b,c except in November. There was no strong correlation between goose distribution at Port Joli and the areas of eelgrass beds within the same units, nor with the September/October biomass of eelgrass in those units.

At Port L'Hebert, the seaward areas (units 5 and 6) were little used by geese at any time, whereas the east side near the north end (unit 2b) had the highest use in all months. The other units on the east side (3b and 1b) ranked next in usage (Fig. IV-4(b)). The three northeastern units (1b,2b,3b) were difficult of access by people and were the least disturbed of all units at Port L'Hebert. The units south of the sanctuary (4a,b,c,5) were used more later in the season, until all geese left Port L'Hebert in mid-January. There was little segregation of activities, feeding and resting generally predominating in the same units. There was no significant correlation between goose distribution at Port L'Hebert and the areas of eelgrass in the various units. However, October[2] goose distribution was significantly correlated to September-October biomass of eelgrass in the same units.

Very few geese were seen at Sable River before January, and those were nearly all in unit 3. Later, when most geese in the area were at Sable River, most geese were in units 1a,b,c during January and units 2a,b in March (activity was not assessed during February) (Fig. IV-4(c)). There was no obvious segregation of activity between units, and there were no correlations between goose usage and area or biomass of eelgrass in the same units.

4.4 Movements and disturbances

In general, most movements were across Port Joli, but longitudinally in the other inlets, between feeding and resting areas. The fall of 1978 was drier than the preceding year, and the brooks carried little fresh water into the inlets then. Goose flocks moved to and from the freshwater lakes (see Appendix 1 for observed movements) more frequently in 1978-79 than in 1977-78. Geese flew out of the inlets on the flooding tide and returned during the ebb tide. Movements within Port Joli were most commonly to or from MacAdams Ledge off Robertson Lake (Fig. IV-5(a)). At Port L'Hebert, nearly all movement was near the east side, especially to and from the gravel bar near Mitchell Brook (northeast corner) (Fig. IV-5(b)). Movements at Sable River were mostly very short, within one or other section of the estuary (Fig. IV-5(b)).

Some movements were precipitated by obvious disturbances; others appeared to be spontaneous. Geese moved only short distances when disturbance by Bald Eagles (*Haliaeetus leucocephalus*) (10 times), a Great Black-backed Gull (*Larus marinus*) (once), or seals (probably *Phoca vitulina*; 3 times) was observed. Human disturbances had greater effects. The use of boats within the sanctuary areas resulted on several occasions in part or all of the geese present leaving that inlet, and they were not seen to return before dark. Although the use of boats within the sanctuary was not explicitly prohibited, these disturbances were believed to be directed at the geese and thus would have been in violation of the regulations prohibiting harassment of birds there. Hunter activity also restricted movement and distribution of geese; on six occasions, geese were determined, by use of a microphone and parabolic reflector, to be using areas at night where hunting occurred during daylight hours. Also, geese were seen at Sable River and on the west side of upper Port L'Hebert, both areas otherwise open to hunting only on Sundays when hunting was prohibited by provincial regulations.

4.5 Eelgrass

4.5.1 Distribution of beds and biomass

The areas of eelgrass beds by unit and density class in the three inlets are shown in Fig. IV-1(a). At Port Joli, with a total area of 177.1 ha of eelgrass beds, most of the dense growth was found near the head of the inlet, with over half the total in unit 2a (Fig. IV-1(a)). Port L'Hebert had a total area of 496.4 ha of eelgrass beds. Unlike the situation at Port Joli, dense beds did not occur at the head of the inlet, but were widespread on both sides in the middle part (Fig. IV-1(a)). At Sable River, the total area of eelgrass beds was 125.4 ha, but dense beds were few and of small size (Fig. IV-1(a)).

[2] Stated in thesis as September, but no counts were reported in that month.

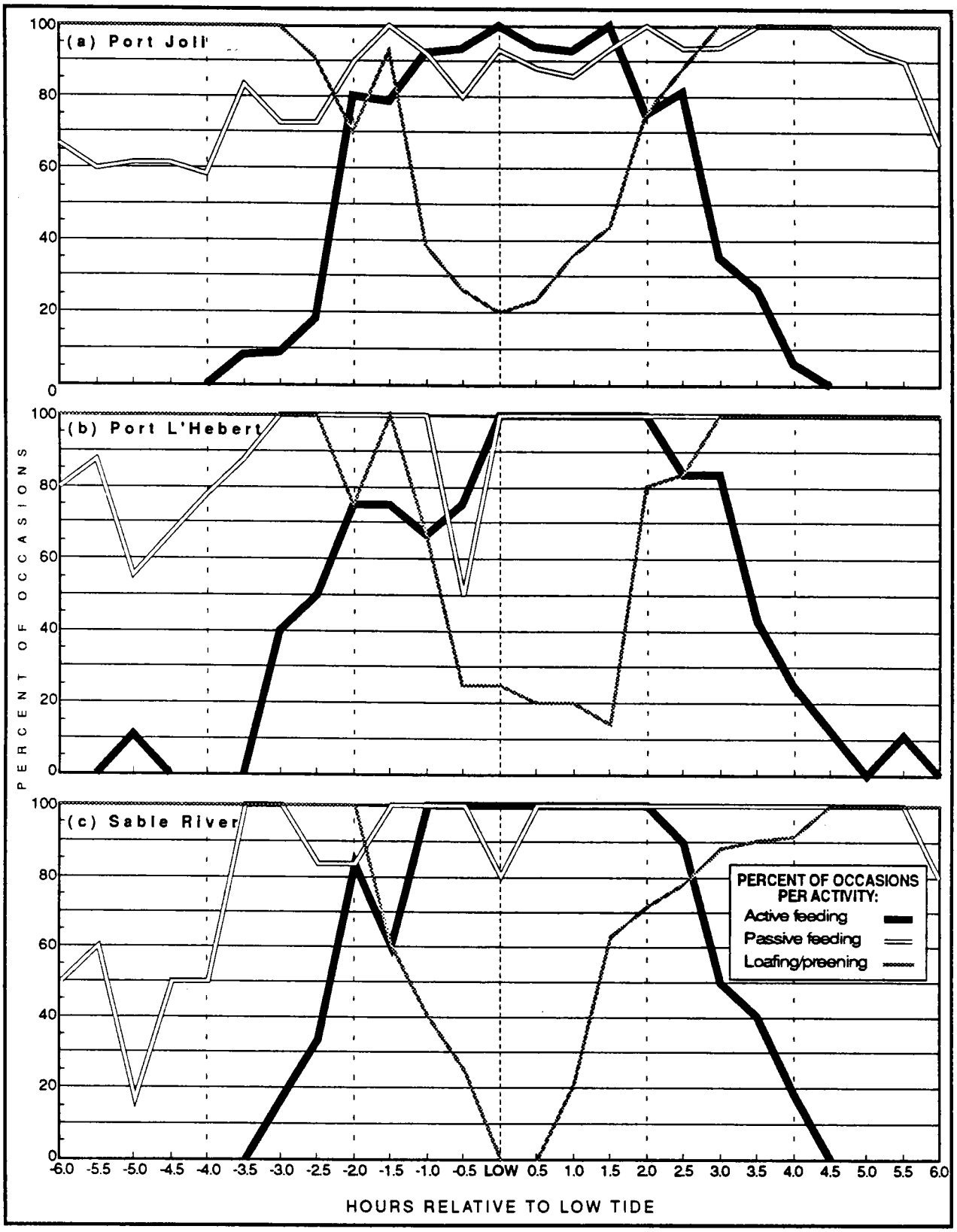

Figure IV-3 Canada Goose activity at different stages of the tidal cycle in the Port Joli area, winter 1978-79: (a) Port Joli, (b) Port L'Hebert, (c) Sable River.

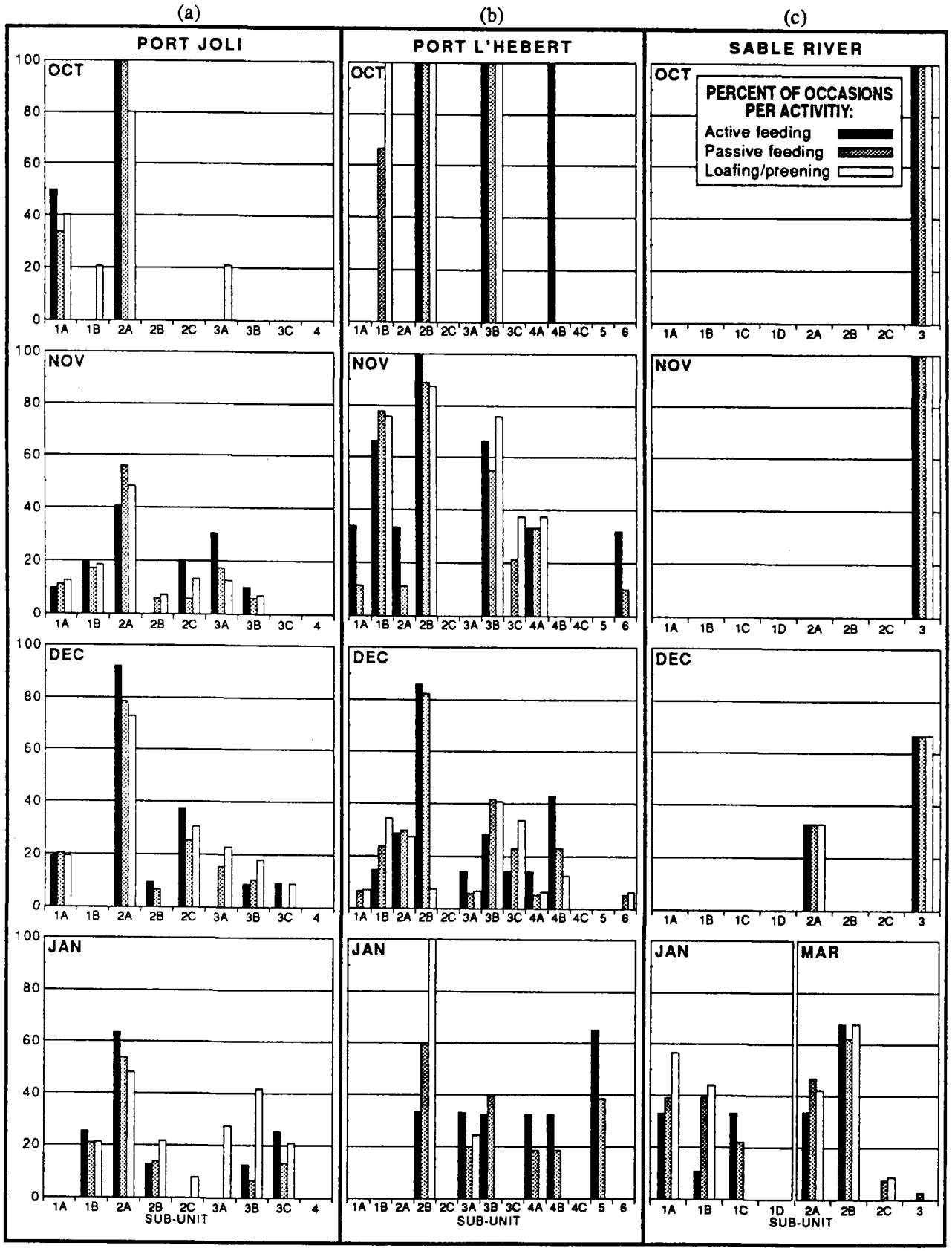

Figure IV-4 Distribution, by month and subunit, of Canada Goose activities in the Port Joli area, winter 1978-79: (a) Port Joli, (b) Port L'Hebert, (c) Sable River.

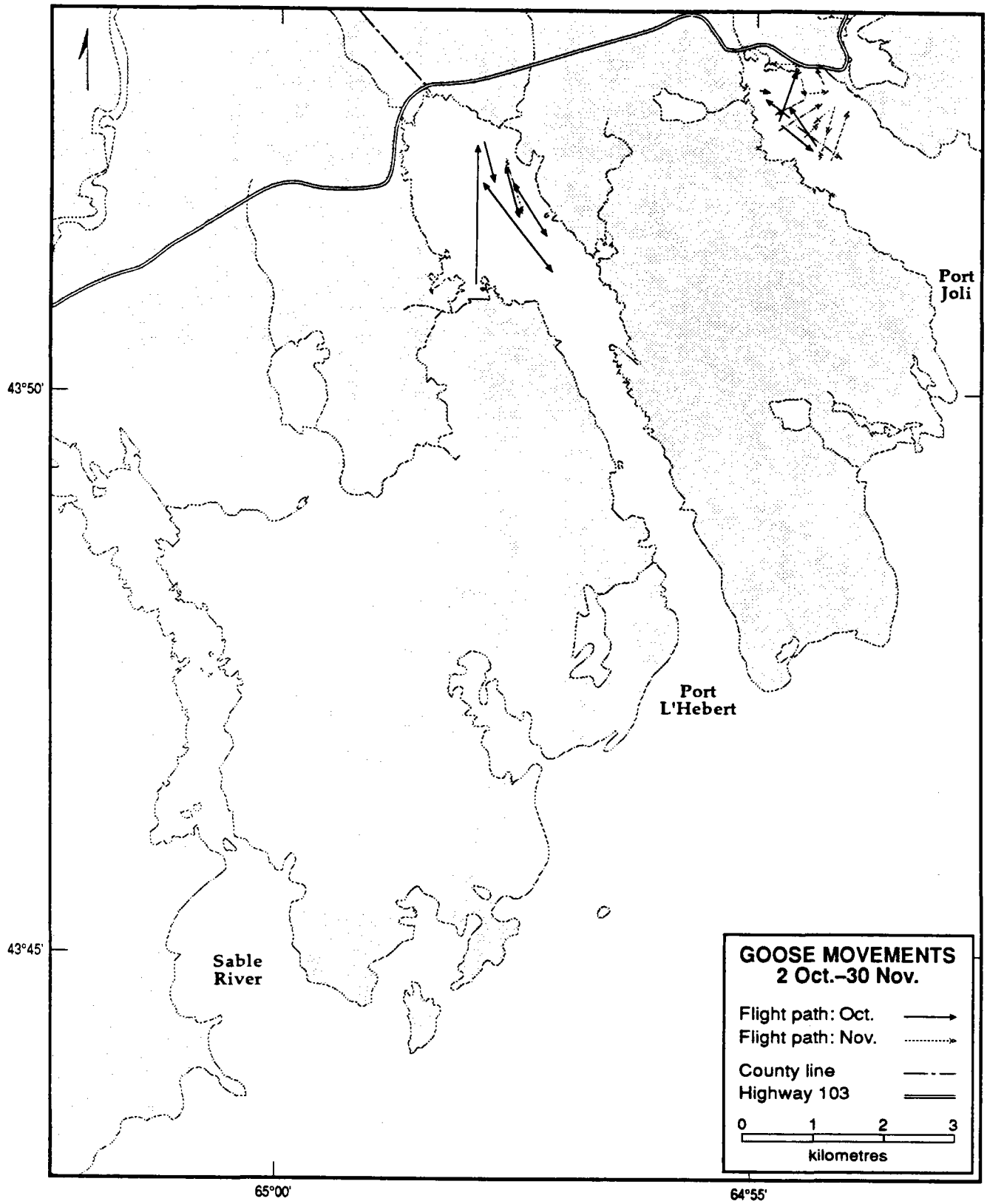

Figure IV-5a Local movement patterns of Canada Geese within the Port Joli area, winter 1978-79: October-November.

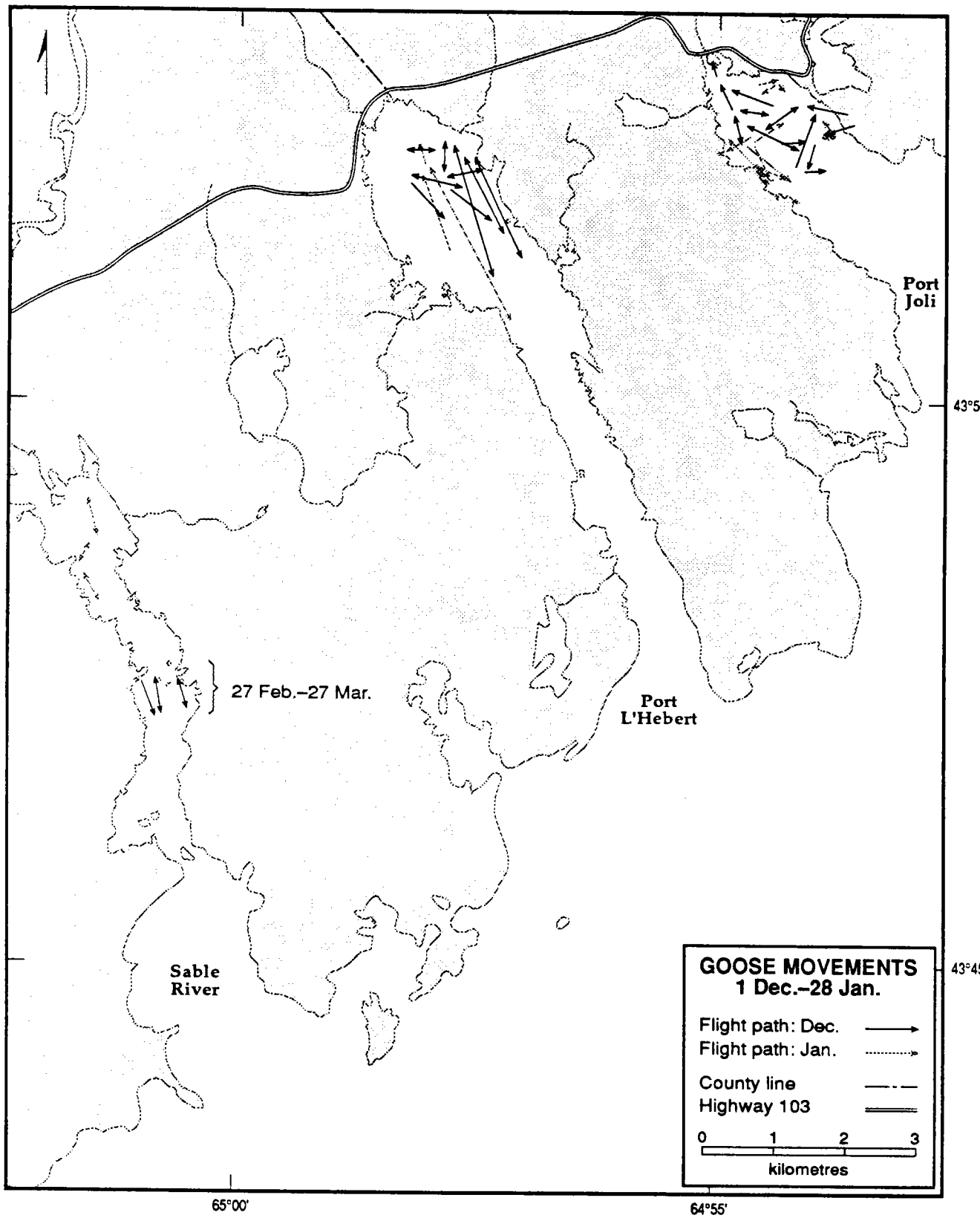

Figure IV-5b Local movement patterns of Canada Geese within the Port Joli area, winter 1978-79: December-January, plus March (Sable River only).

Table IV-1. Changes over time in average eelgrass biomass (kg/ha) by density class, Port Joli area, Nova Scotia, 1978–79. Number of samples in density class in parentheses.

Density of beds	Mean biomass (kg/ha) in month Sept./Oct.	November	January	Mar./Apr.
(a) Port Joli				
Dense	5561.2 (6)	2812.0 (6)	1976.8 (3)	884.8 (6)
Medium	3207.3 (3)	1052.0 (3)	(0)	72.4 (3)
Sparse[1]	2850.4 (6)	(0)	(0)	1817.6 (3)
(b) Port L'Hebert				
Dense	6526.4 (6)	2449.6 (3)	2410.0 (4)	519.2 (6)
Medium	3662.0 (5)	(0)	(0)	1298.4 (6)
Sparse	2850.4 (6)	(0)	(0)	1817.6 (3)
(c) Sable River				
Dense	2726.4 (3)	(0)	1658.0 (3)	104.4 (2)
Medium	1790.4 (3)	1027.2 (3)	(0)	464.4 (3)
Sparse	886.4 (3)	(0)	(0)	297.6 (3)

[1] Values from Port L'Hebert used here (see text).

Table IV-2. Changes in total eelgrass biomass (tonnes) over time, Port Joli area, Nova Scotia, 1978–79.

Density of beds	Total estimated biomass (tonnes) in month Sept./Oct.	November	January	Mar./Apr.
(a) Port Joli				
Dense	608.8	307.8	216.4	96.9
Medium	71.1	23.3	n.d.	1.6
Sparse[1]	129.1	n.d.	n.d	82.3
Total	809.0	331.1+	216.4+	180.8
(b) Port L'Hebert				
Dense	1556.2	584.1	574.6	123.8
Medium	827.0	n.d.	n.d.	293.2
Sparse	9.6	n.d.	n.d.	58.4
Total	2392.8	584.1+	574.6+	475.4
(c) Sable River				
Dense	90.0	n.d.	54.7	3.4
Medium	124.7	71.5	n.d.	32.3
Sparse	20.2	n.d.	n.d.	6.8
Total	234.9	71.5+	54.7+	42.5

[1] Based on biomass density from Port L'Hebert (see text).

No transects sampled the sparse density class of eelgrass beds at Port Joli, so the biomass/ha could not be calculated directly for that category there. As these values for other density classes at Port Joli were similar to those at Port L'Hebert, the figures for sparse density eelgrass at Port L'Hebert were used for estimating Port Joli biomass/ha in preference to those at Sable River, or to the mean of values at Port L'Hebert and at Sable River, which differed more.

Eelgrass biomass decreased over the season (Table IV-1). Rhizome biomass was greater than that of blades both at the beginning and the end of the season in all three areas, except in autumn at Sable River. The total biomass of eelgrass in each inlet (Table IV-2) reflected both the area and the density of eelgrass beds, the larger units with mostly dense beds having the greatest biomass.

4.5.2 Nutritional content of eelgrass

Although sample sizes were too small for statistical testing, it appeared that there were no substantial differences in carbohydrate, nitrogen, protein, crude fibre, percent ash, available energy per gram, or trace elements, between density classes within each inlet, or between inlets; or between areas within each inlet, so all areas were combined (Table IV-3). It appeared that carbohydrate content of rhizomes did not change over time, but that in blades decreased from autumn to spring. Conversely, nitrogen, and consequently protein, appeared to increase through the season in both rhizomes and blades. Available energy per gram also increased from autumn to spring.

5. Discussion

5.1 Numbers and seasonal turnover

Martell (1969, this volume), summarizing data on goose numbers from 1914 to 1969, found little variation in winter counts. Average winter numbers were between 3000 and 5000, with possible extremes of 1700 and 11,500. Results from the present study fell within those ranges in both winters, peaking at 4145 geese in mid-November 1977, and with a mean figure (September 1978–April 1979) of 3604 and a maximum of 5700 in January 1979. The tendency of Port L'Hebert to harbour more geese than Port Joli, which in turn harboured more than Sable River, probably reflects in part the eelgrass biomass in each area, as discussed later.

Markgren and Mathiasson (1963) suggested that Bean Geese (*Anser fabalis*) in Sweden exhibit two types of migratory behaviour:

(a) early-migrating populations whose migratory behaviour is regulated mainly by internal (physiological) factors, and
(b) late-migrating populations of which the migration is influenced more by external (ecological) factors.

Occurrence of similar types of behaviour in local Canada Geese may explain the two distinct peaks in goose numbers within the study area. The geese that appeared in September and October, presumably moving on an innate (inherited) schedule, continued southward in November, resulting in a decline in numbers present. The second "migratory type" arrived in December and early January, when seasonal weather and freezing forced them out of more northern feeding areas, and such birds perhaps made up most of the wintering flock. Further studies, using marked birds for individual identification, would be necessary to demonstrate conclusively the existence and duration of stopover of such migratory types in the regional goose population.

Martell (1969) reported a gradual advance in time of peak abundance of both early- and late-migrating geese, with recent peaks up to two months earlier than in 1919. The present study suggested even earlier movements than in Martell's study, with peaks around 1 October and 1 January. [Ed. note: Such changes in migration timing argue against both proposed "migratory types". If the early migrants moved on an innate schedule, that should not have changed over time, and the generally milder winters in recent decades would be expected to produce later, rather than earlier, movements among the late-moving geese.]

5.2 Feeding activity

Contrary to Martell's (1969, this volume) findings, feeding activity of Canada Geese in the Port Joli area was found to be clearly related to stage of tide, as found also by Burton and Hudson (1978) for Snow Geese (*Anser caerulescens*) feeding on *Scirpus* spp. in coastal British Columbia. Active feeding by Canada Geese occupied seven to ten hours of each 12-h tidal cycle. If geese feed equally on both daily tide cycles, 58–83% of each foraging day may be spent in feeding activity. Even higher proportions (90–95% of each day) were spent by White-fronted Geese in Great Britain and Brant in Holland (Owen 1972a; van der Bilt and Helming 1978).

Butcher (1941) noted that Brant, while feeding on exposed mudflats in Great Britain, tore up more eelgrass than was immediately consumed. Later, when the tide covered the flats and the growing plants were inaccessible to these short-necked geese, the birds continued to feed on the floating vegetation. This latter activity, termed passive feeding in this study, occurred routinely throughout the tidal cycle here, and it extended the available feeding time towards the proportions found in Britain and Holland.

5.3 Use and food value of eelgrass

Canada Geese in the Port Joli area fed almost solely on eelgrass (Martell 1969; this study). Presumably that was at least partly because of the dominance of eelgrass over all other forms of aquatic vegetation there (other than marine algae).

Crude protein estimates for *Zostera* blades increased from early fall (8–10%) through winter (12–14%) to early spring (15–17%) (Martell 1969; this study). Protein levels in the rhizomes were lower, but also increased through the season. Various sources (Merritt and Aitken 1962; Ewing 1963; V.C. Thomas, pers. comm.) suggested that 12–14% crude protein in the diet is needed for main-

Table IV-3. Mean values of carbohydrate (%), nitrogen (%), protein (%), and available energy (kcal/g) in eelgrass samples, Port Joli area, Nova Scotia, 1978–79. Number of samples in parentheses.

Parameter measured	Mean value in month: September/October Rhizomes		September/October Blades		November/December/January Rhizomes		November/December/January Blades		March/April Rhizomes		March/April Blades	
Carbohydrate	7.5	(8)	12.8	(9)	9.0	(8)	11.2	(7)	8.3	(9)	10.1	(6)
Nitrogen	0.83	(9)	1.36	(9)	1.19	(8)	1.94	(8)	1.29	(9)	2.74	(6)
Protein	5.19	(9)	8.49	(9)	7.47	(8)	12.15	(8)	8.09	(9)	17.16	(6)
Kcal/g[1]	0.54	(8)	0.94	(9)	0.73	(8)	1.00	(7)	0.72	(9)	1.20	(6)

[1] Kcal/g = available energy.

tenance of wintering wild geese. Thus, eelgrass may not provide adequate protein for geese in early fall, but incidental ingestion of invertebrates along with the vegetation might supplement the protein in their diet.

Martell (1969) and McRoy (1966) reported total available energy from eelgrass to be 4.16 and 4.05 kcal/g, in Prince Edward Island and Alaska samples, respectively. However, geese are unable to digest cellulose (crude fibre) (Marriott and Forbes 1970; Mattocks 1971), and thus could use only part of the total available energy. Martell (1969) noted that eelgrass was only 35% digestible for cattle, which are efficient fibre-digesters; if similar digestibility applied for geese, which is unlikely, the total energy available to geese would be not more than 1.4–1.5 kcal/g. By summing only the energy certainly available to geese from eelgrass, i.e. crude protein and carbohydrate, the derived values of 0.9 kcal/g in early fall, 1.0 in mid-winter, and 1.2 kcal/g in early spring may be realistic estimates of the energy accessible to wintering geese on an eelgrass diet in the Port Joli area. Because of small sample sizes, the assumption was made that there were no nutritional differences in eelgrass from different parts of the study area. Because (a) geese are on a maintenance-level diet in winter (Williams and Kendeigh 1982), (b) geese are inefficient digesters (Mattocks 1971), and (c) eelgrass has a very low digestibility, it is likely that little selection for individual plants occurs. As geese are not distributed randomly over all eelgrass beds, other factors, including density of eelgrass, distribution of gravel bars and fresh water, and disturbances all influence the distribution of geese within the study area.

Owen (1972a) and Ebbinge *et al.* (1975) calculated, for White-fronted Geese and Barnacle Geese (*Branta leucopsis*), respectively, that 700–800 g (wet weight) of field grass/bird/day was required in winter, working from basal metabolic rate (BMR), energy required for flight, and energy available from the diet. Similar calculations, with appropriate adjustments, indicated that Canada Geese wintering in the Port Joli area would require considerably more than 800 g of eelgrass/bird/day. The 10% of body-weight/day formula used by Sincock (1962) suggested geese would need 2800–3500 g (wet weight) of eelgrass/day. Similar values were obtained by combining the digestible energy of eelgrass in fall and winter (0.97 kcal/g (ash-free dry weight) with Williams and Kendeigh's (1982) value for existence metabolism (485 kcal/day) of the somewhat larger Giant Canada Goose. As geese must ingest large amounts of eelgrass for maintenance, the available biomass of eelgrass is probably a major determinant of the distribution of geese within the area.

From a mean eelgrass requirement of 3.1 kg/bird/day (derived above) and the biomass estimates from this study, Port Joli with about 800 tonnes of eelgrass in early fall could have supported more than 250 000 goose-days of use. With geese using Port Joli in all months from September through March, that inlet could have supported more than 1400 geese per day. The actual mean number of geese per day at Port Joli in 1978-79 was 1161. Similar calculations suggested that Port L'Hebert, with about 2400 tonnes of eelgrass, could have supported over 750 000 goose-days or over 5000 geese per day from September through February, compared to an observed mean of 2759. Sable River, with only 235 tonnes of eelgrass in early fall, could have supported about 75 000 goose-days, or about 415 geese per day from October through April, vs. the observed mean of 442 geese/day in those months. These calculations suggested that goose use at Port Joli was near to, and that at Sable River at, the carrying capacity of the current eelgrass stocks, although Port L'Hebert could have carried more birds or supported them over a longer period. [Ed. note: The estimates of eelgrass biomass remaining in early spring, about 180 tonnes at Port Joli (22% of the early fall figure), 42 tonnes at Sable River (18%), and 475 tonnes at Port L'Hebert (20%) suggested that all areas were depleted to a similar extent.]

The relationship between eelgrass biomass and goose distribution within subunits of each inlet did not appear significant except perhaps in Port L'Hebert. However, the relationship may have been masked by disturbance. Most of the eelgrass remaining in March/April was in subunits where disturbance was more frequent. Hunting activity, both legal and illegal, is

certainly important with respect to goose distribution and daily activity cycles. In addition, the locations of fresh-water brook outlets and of gravel bars, relative to eelgrass beds, may also influence the distribution of geese within each inlet.

In conclusion, various factors interacted to make the Port Joli area an important wintering and stopover site for Canada Geese. The southern shore of Nova Scotia lacks agricultural areas which might provide alternate feeding for geese. The wintering birds need a maintenance diet, which is provided by the eelgrass. Although the energy value of eelgrass for geese is low owing to its poor digestibility, the plant is abundant and regularly available. With fresh water available nearby, the geese can spend more time feeding (Owen 1972b), an important factor for a species that uses relatively little of the food ingested. Nearby gravel bars provide resting sites and grit without needing long flights, thus lowering the energetic requirements of the geese. The sanctuary includes most of the areas with greatest eelgrass biomass, allowing geese to maximize their feeding time with few interruptions from hunting activity.

6. Literature cited

Audubon, J.J. 1840. The birds of America. vol. VI. [Dover Publ., N.Y., reprint used] 457 pp.

Burton, B.A., Hudson, R.J. 1978. Activity budgets of Lesser Snow Geese wintering on the Fraser River Estuary, British Columbia. Wildfowl, 29: 111–117.

Butcher, R.W. 1941. The distribution of *Zostera* (eelgrass, wigeon grass) and other seashore plants in relation to the migrations of wildfowl. pp.29–49 in Int. Wildfowl Inquiry. vol. I, chap. III. Cambridge Univ. Press.

Ebbinge, B., Canters, K., Drent, R. 1975. Foraging routines and estimated daily food intake in Barnacle Geese wintering in the northern Netherlands. Wildfowl, 26: 5–19.

Ewing, W.R. 1963. Poultry nutrition. 5th ed. (Rev.) The Ray Ewing Co., Pasadena, Calif. 1475 pp.

Harrison, P.G., Mann, K.H. 1975. Chemical changes during the seasonal cycle of growth and decay in eelgrass (*Zostera marina*) on the Atlantic coast of Canada. J. Fish. Res. Bd. Can., 32: 615–621.

Kleiber, M. 1961. The fire of life. 2nd ed. (Rev.) Robert E. Kreiger Publ. Co., Inc. 453 pp.

Markgren, G., Mathiasson, S. 1963. Studies on wild geese in southernmost Sweden. Ecology and behaviour studies. Acta Vertebratica, 2(3): 1–533.

Marriott, R.W., Forbes, D.K. 1970. The digestion of Lucerne chaff by Cape Barren Geese, *Cereopsis novaehollandiae* Latham. Austral. J. Zool., 18: 257–263.

Martell, A.M. 1969. A study of winter waterfowl ecology at Port Joli, Nova Scotia. Unpubl. M.Sc. thesis, Acadia University, Wolfville, N.S. 275 pp.

Mattocks, J.G. 1971. Goose feeding and cellulose digestion. Wildfowl 27:107-113.

McRoy, C.P. 1966. The standing stock and ecology of eelgrass (*Zostera marina* L.) in Izembek Lagoon, Alaska. Unpubl. M.S. thesis, Univ. of Washington, Seattle. 138 pp.

Merritt, E.S., Aitken, J.R. 1962. Raising geese. Can. Dept. Agr. Res. Br. Publ. 848. 19 pp.

Owen, M. 1972a. Some factors affecting food intake and selection in white-fronted geese. J. Anim. Ecol., 41: 79–92.

Owen, M. 1972b. Movements and feeding ecology of white-fronted geese at the New Grounds, Slimbridge. J. Appl. Ecol., 9: 385–398.

Owen, M. 1975. Cutting and fertilizing grassland for winter goose management. J. Wildl. Manage,, 39: 163–167.

Ranwell, D.S., Downing, B.M. 1959. Brent Goose (*Branta bernicla* L.) winter feeding pattern and *Zostera* resources at Scolt Head Island, Norfolk. Anim. Behav., 7: 42–56.

Sincock, J.L. 1962. Estimating consumption of foods by wintering waterfowl populations. Proc. Annu. Conf. Southeast Assoc. Game and Fish Comm., 16: 217–221.

Smith, G. Newman 1983. The utilization of Port Joli, Port L'Hebert and Sable River by migrating and overwintering Canada Geese. Unpubl. M.Sc. thesis, Acadia University, Wolfville, N.S. 60 pp. (+ 28 tables & 25 figures not paginated)

van der Bilt, E., Helming, B. 1978. The winter ecology of the Brent Goose (*Branta bernicla*) on Terschelling. Limosa, 51: 31–40.

Williams, J.E., Kendeigh, S.C. 1982. Energetics of the Canada goose. J. Wildl. Manage., 46: 588–600.

Appendix IV - 1. Observed goose movements within the study area, 1978–79.

Date	Time	Tide	Direction of flight	Possible origin and destination	Numbers
02 Oct.	10:15	ebb	South	Wilkins Lake to Port L'Hebert	400
03 Oct.	08:00	flood	North	Port L'Hebert to Wilkins Lake	150
	10:30	ebb	South	Wilkins Lake to Port L'Hebert	350
	12:45	ebb	West	Robertson Lake to Port Joli	220
05 Oct.	13:00	ebb	South	Wilkins Lake to Port L'Hebert	500
	14:00	ebb	West	Robertson Lake to Port Joli	170
06 Oct.	08:30	flood	West	Port L'Hebert to Haley Lake	200
08 Oct.	10:00	flood	North	Port L'Hebert to Wilkins Lake	500
10 Oct.	06:00	ebb	South	Wilkins Lake to Port L'Hebert	?
	07:30	ebb	West	Robertson Lake to Port Joli	?
11 Oct.	05:30	ebb	South	Wilkins Lake to Port L'Hebert	?
12 Oct.	07:30	ebb	West	Robertson Lake to Port Joli	?
24 Oct.	06:15	ebb	South	Wilkins Lake to Port L'Hebert	?
	07:30	ebb	West	Robertson Lake to Port Joli	?
25 Nov.	08:15	ebb	Southeast	Wilkins Lake to Port Joli	300
	09:15	ebb	East	Path Lake to Port Joli	50
01 Dec.	11:00	ebb	Northwest	Port Joli to Port L'Hebert	300
03 Dec.	13:15	ebb	West	Robertson Lake to Port Joli	5
08 Dec.	11:20	flood	West	Port Joli to Path Lake	9
	13:15	flood	West	Port Joli to Path Lake	19
	13:45	flood	West	Port Joli to Path Lake	5
11 Dec.	09:55	ebb	Northwest	Migration to Port Joli	70
	11:20	ebb	Northwest	Migration to Port Joli	15
	11:45	ebb	Northwest	Migration to Port Joli	42
	11:50	ebb	Northwest	Migration to Port Joli	12
12 Dec.	08:30	ebb	Northwest	Migration to Port Joli	370
01 Mar.	16:00	ebb	Northwest	Jones Harbour to Sable River	130
03 Mar.	14:15	ebb	Northwest	Jones Harbour to Sable River	100
	18:00	ebb	Northwest	Jones Harbour to Sable River	60–70
22 Mar.	14:00	flood	Southeast	Sable River to Jones Harbour	130
	17:00	ebb	Northwest	Jones Harbour to Sable River	70
	17:15	ebb	Northwest	Jones Harbour to Sable River	40
23 Mar.	14:00	flood	Northeast southeast, and east	Migration from Sable River	300

V. STATUS OF CANADA GEESE ON THE SOUTH SHORE OF NOVA SCOTIA, UPDATED FROM THE EARLIER STUDIES

by A.J. Erskine 1/ and F.J. Payne 2/

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1. Abstract

Canada Geese continued to frequent the traditional wintering and staging areas near Port Joli, in Queens and Shelburne Counties, Nova Scotia, since the last compilation over 20 years ago. Christmas Bird Counts provided additional indices to goose numbers in recent years. Wintering numbers near Port Joli declined, from ca. 4500 earlier to about 2500 since 1975, in general agreement with the concurrent increase in wintering geese in Halifax County 200 km farther to the northeast.

2. Introduction

The studies reported in Chapters II-IV (Erskine, Martell, Newman Smith, this volume) had specific goals for which data on the numbers and movements of geese frequenting the Port Joli area were one of several kinds of information used. Since Martell's 1969 summary (Chapter III, this volume), surveys in the Port Joli area continued, although no single series of surveys has been continuous. Perhaps more significantly, information, first summarized in this volume, has accumulated on geese elsewhere in the Maritimes, allowing a fuller perspective on the Port Joli goose flock. This chapter summarizes data for Nova Scotia's South Shore not included in the earlier reports, with more recent information, to provide a fuller picture of this segment of the flyway's Canada Goose population.

3. Materials and methods

Goose data were assembled from *Nova Scotia Birds* (NSB; formerly *Nova Scotia Bird Society Newsletter*, 1957–92), including local Christmas Bird Counts (CBCs) 1975–92. A few earlier CBCs were extracted from *The Canadian Field-Naturalist*. Ground surveys by R.E. Turner, of N.S. Dept. of Lands & Forests, with a few by CWS sanctuary caretakers, were obtained from provincial and CWS files, respectively. Aerial survey data were also extracted from CWS and provincial files.

Most data obtained were from secondary listings, including computer files and hand tabulations, often involving two or more successive transcriptions from the field records, and some errors undoubtedly resulted from the copying. In a few cases, it was not clear whether particular data derived from air rather than ground surveys, and such data are marked with queries. Some aerial survey results were available only as totals, which may have included geese seen away from the Port Joli area, which here comprised all coastal waters and nearby lakes from Cadden Bay to Matthews Lake; more detailed aerial surveys suggested that geese were found only sporadically, though occasionally in substantial numbers, away from the Port Joli area.

The data came from several types of surveys, involving volunteers as well as professionals and spanning varying periods. The CBCs were all in late December. Aerial surveys were scattered in time from September to April, and the Midwinter Inventory (MWI) flights ranged from early January to mid-February, depending on weather and availability of aircraft and observers. We attempted only broad comparisons, with no statistical testing, but the general patterns of goose usage of this region, like those noted in the earlier summaries, were obvious.

4. Results

4.1 Midwinter Inventories (MWIs) and Christmas Bird Counts (CBCs)

Data from midwinter, i.e. late December through mid-February, surveys (Table V-1) extended and enlarged upon data presented in earlier chapters (Tables II-5 and III-4). The MWI column in Table V-1 was based on aerial coverage whenever this was available, but it included data from ground counts by government personnel in years when no flights were made in January or February. The CBCs provided data (from late December) in many recent years when no other air nor ground surveys were made. In years when both were available, the CBCs usually indicated larger total numbers of geese, probably because they were carried out on earlier dates (see below).

4.2 Seasonal variation in total goose numbers

Surveys spanning the full period (within a year) that geese were present near Port Joli were available in only a few years, besides those presented in earlier chapters. NSB data confirmed that the earliest geese appeared in the last week of August or first week of September in 10 of 15 years with arrival dates. The first sightings were of small flocks (5–30 birds), with larger numbers arriving before mid-September (Table V-2). The additional data (Table V-2) confirmed the pattern noted earlier, of larger numbers in late October and in late December-early January, with fewer geese present between the peaks and later in the winter.

Table V-1. Mid-winter inventories (MWIs), Christmas Bird Counts (CBCs), and other winter counts of Canada Geese in the Port Joli area, Nova Scotia, additional to those reported earlier (see Tables II-5, III-4 and III-6).

Winter	Number of geese estimated on MWI[1]	CBC[2]	Comments
1945–46		2000–3000	
1952–53	5750		Evidently the (aerial) count by Boyer shown in Table III-4; all these were in Port Joli area.
1953–54		6512	
1969–70	2593		Aerial.
1970–71	3743		Ground; by E. Turner (?)
1971–72	5566		Ground; by E. Turner (?)
1972–73	2565		Sutherland; 1818 on aerial survey 12 Dec.
1973–74	6440		Aerial; another 3000 geese were in Lockeport and Jordan areas.
	4404		Aerial (15 Feb.); another 2900 were farther west.
1974–75	905		Aerial; very low count, compare 1055 found 1 Dec. & 1140 on 12 Feb.
1975–76	2796	700	MWI: Aerial CBC: 1 observer only.
1976–77	1691	3500	MWI: Aerial (3 Feb.).
1977–78	1735	2612	MWI: Aerial.
1978–79	1230	5886	MWI: Aerial.
1979–80	1290	1537	MWI: Aerial
1980–81		3822	
1981–82	2170	490	MWI: Aerial (18 Feb.).
1982–83		3610	
1983–84		1252	
1984–85	2735	3489	MWI: Aerial (11 Feb.); compare 760 air survey 19 Feb.
1985–86	1635	3859	MWI: Aerial (4 Feb.).
1986–87	1135	2205	MWI: Aerial.
1987–88		2691	
1988–89		4029	
1989–90	1550	3510	MWI: Aerial.
1990–91	4871	1522[3]	MWI: Ground (CWS).
1991–92	2547	829[3]	MWI: Aerial.

[1] MWIs in January unless noted otherwise.
[2] CBCs all 15–28 December.
[3] CBC area was shifted 4 km SW in 1990, no longer including the Port Joli inlet where at least half the geese were to be expected at that season.

4.3 Canada Geese in other South Shore areas of Nova Scotia

NSB reports included sightings of a few geese farther east, mainly near Green Bay (50 km northeast of Port Joli) where several observers had seasonal residences (Figure V-1). Reported observations there provided a few early arrival dates, and the Broad Cove CBCs produced numbers that varied erratically from 0 to 356, only 6 of 22 counts reporting over 100 geese. No aerial surveys between Halifax and Port Joli reported as many as 100 geese in any local area. That stretch of largely rocky coastline includes few areas of salt-marsh and almost no mud flats, although white sand beaches are more frequent.

Farther to the southwest, geese occurred more frequently and sometimes in large numbers. The aerial surveys occasionally found many geese near Lockeport or Jordan Bay, 5–15 km west of Matthews Lake (the western limit of the Port Joli area as here defined) (Figure V-1). Numbers there were especially high (2000–3000 geese) in January to February 1974. Probably those birds had been forced out of the sanctuary area by ice cover or hunting pressure. Those inlets are generally similar to the sanctuary area, but with smaller areas of salt-marsh and eelgrass flats. Jordan Bay was suggested as an additional sanctuary area in the 1950s, so geese may have occurred there more regularly in the past.

Barrington Bay, 40 km west of Matthews Lake, also had goose flocks on some surveys (Fig. V-1). Only sporadic sightings were made through fall and winter, and CBCs sampled the area in only a few winters, with the peak count 300 on 3 January 1987. More frequent occurrence

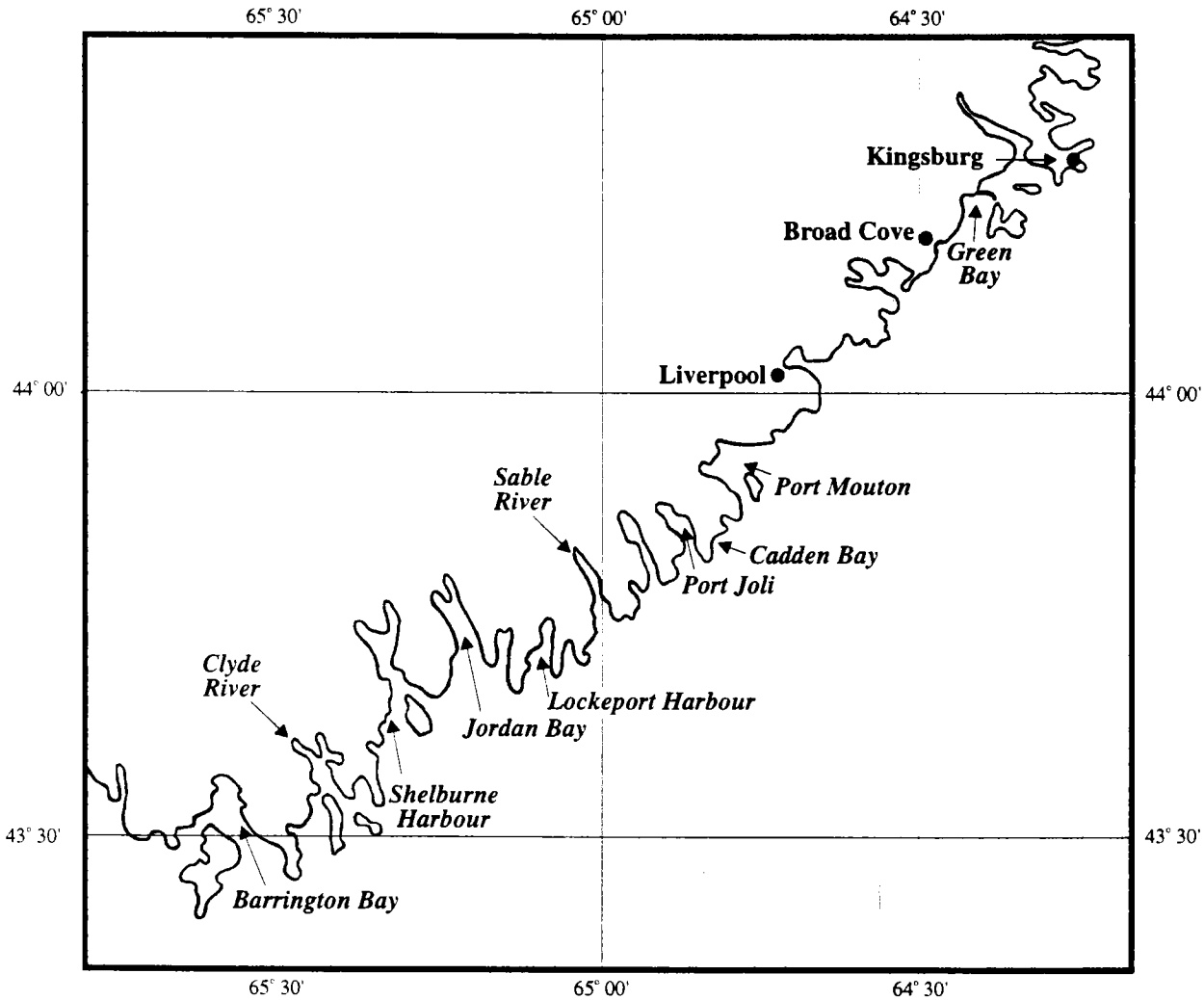

Figure V-1 Canada Goose staging and wintering areas along the South Shore of Nova Scotia (Lunenburg to Pubnico).

Table V-2. Canada Goose estimates, Port Joli area, Nova Scotia, 1961–62 through 1971–72 (not including counts reported elsewhere in this volume—see Tables III-4,5,6, V-1). When 2 estimates were available for a period, the higher was used.

	Geese estimated in winter[1]					
Count period	61–62	62–63	66–67	69–70	70–71	71–72
01–15 September			1000		1435	1873
16–30 September		458	2000		2150	
01–15 October				2737	4350	2728
16–31 October	1540	5362				7140
01–15 November						7410
16–30 November	3186			4250	5971	3046
01–15 December				1500	4424	2051
16–31 December				560		1990
01–15 January				4638		1955
16–31 January				7020		
01–15 February				7262	3435	4208
16–29 February				3765	3518	
01–15 March				3479		6640
16–31 March				2189	244	

[1] No additional data available for winters not shown.

Table V-3. Summary of mid-winter goose numbers in the Port Joli area, to show trends, from data in Tables II-5, III-4, and V-1. January counts (MWIs) used when available, with late December counts (CBCs) for years with no January data; only the highest pertinent count in a year was used.

	No. of years in period with maximum counts in range				
Period	<2000	2000–3000	3000–4000	4000–5000	>5000
1914–31[1]		1	1	1	2
1945–49[1]		2		1	1
1950–54			1	1	3
1955–59	1	1			3
1960–64		1		3	1
1965–69	1		2	1	1
1970–74		2	1		2
1975–79	4	1			
1980–84	2	1	2		
1985–89	2	2	1		
1990–92	1	1	1		

[1] Data available for only 5 winters in 1914–31 and for 4 winters in 1945–49; all other winters had relevant counts.

and greater numbers were noted there in spring, e.g. 1500 12 March 1966, a few 100s in late March 1970, 211 24 March 1973, 700 2 April 1975.

5. Discussion

The more extensive and detailed data now available confirmed that the Port Joli area, west to Matthews Lake and irregularly to Jordan Bay, continued to support most of the geese staging or wintering west of Halifax on the South Shore of Nova Scotia. The use of that area evidently arose from its production of eelgrass, the principal winter food of geese in this region, as the existence of a sanctuary alone could not hold geese there through the winter without sufficient food.

The numbers of geese frequenting the Port Joli area in winter declined in recent decades. Table V-3 summarized the MWI and CBC data set out in Tables II-5, III-4, and V-1. No single type of survey was conducted annually, and wide variations occurred between years, but the lower numbers—roughly 2500 compared to 4500 earlier—starting around 1975 were obvious.

It is unlikely to be a coincidence that an increase of similar scale in numbers of geese wintering in Halifax County, 200 km to the northeast, was detected, starting around 1975. The combination of milder winters in the 1970s, combined with the formal declaration of the Martinique Game Sanctuary there in 1974, encouraged more regular use of the Eastern Shore area by geese in recent years. The occurrence of geese in that area is treated in the following chapter.

VI. CANADA GEESE ON THE ATLANTIC COAST EAST OF HALIFAX, NOVA SCOTIA

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1. Abstract

Canada Geese visit Nova Scotia's eastern Atlantic coasts mainly in the extreme west (Cole Harbour, Chezzetcook Inlet, Musquodoboit Harbour; 44°40'N, 63°05–25'W) and the extreme east (Bridgeport Basin, Big Glace Bay Lake, Port Morien, Mira Bay; 46°00–10'N, 59°55'W). Before 1970, these were mainly staging areas where geese stopped during the migrations. A few hundred geese stayed into the winter at each site, but they were driven out by ice cover in many years, with overwintering occurring mainly in mild seasons. With fewer cold winters since 1975, wintering in these areas has become regular. The Martinique (provincial) sanctuary at Musquodoboit Harbour now harbours the largest winter flock in the Maritimes, at 3000 to 4000 birds exceeding present numbers in the long-used Port Joli area 200 km to the southwest.

2. Introduction

Almost nothing has been published about the Canada Goose situation in southeastern Nova Scotia, and systematic studies other than counts of numbers have not yet been undertaken there. Geese have long been known to frequent several inlets east of Halifax (Fig. VI-1; 44°40'N, 63°05–25'W)(see Macpherson and Allen 1957). Use by geese of another group of inlets southeast of Sydney (Fig. VI-2; 46°00-10'N, 59°55'W) was less well-known. The numbers in these areas before 1975 were not large, and overwintering occurred mainly in mild years. Recent climatic amelioration has allowed wintering to increase to the point where the Halifax County areas now hold more geese in winter than any other part of the Maritimes. This chapter summarizes the recent historical data on numbers and occurrence of geese on the Atlantic coasts of Nova Scotia east of Halifax.

3. Description of area

Most of the Atlantic coast of Nova Scotia from Halifax to the eastern tip of Cape Breton Island is low-lying, a drowned rocky shore underlain by greywacke/quartzite and granite. Gravel and boulder spits partly enclose some inlets, and there are occasional fine sand beaches, but mud flats are restricted to the heads of a few inlets. The Lingan–Mira area on Cape Breton Island is geologically distinct, based on Carboniferous sandstones, with sandy muds in the inlets behind gravel or sand spits. Its climate is generally similar to that of the eastern Atlantic coast with which it is combined for this presentation. (based on Simmons *et al.* 1984, which see for more detailed descriptions)

Sea ice occurred around eastern Cape Breton Island, mainly in March and April, in years when east winds pressed onto the shores the ice then flowing out of the Gulf of St. Lawrence. At other times, the sea there is open, as it always is farther southwest. The upper reaches of inlets and barrier-beach lagoons usually begin to freeze in mid- to late December, and only a few inlets remain open during January in most years.

4. Materials and methods

Canada Goose data were extracted from *Nova Scotia Birds* (NSB; formerly *Nova Scotia Bird Society Newsletter*) 1955–present, with a few supplementary records from *Nova Scotia Museum of Science Newsletter* in the first years. Data from personal files (AJE) were also used, mainly for Cape Breton County. Ground surveys by provincial Wildlife Division personnel were available for October through January, 1962–63 to 1977–8.

Aerial survey data for Halifax County, mainly in mid-winter 1964–92, from Wildlife Division, Nova Scotia Department of Natural Resources (formerly Lands and Forests), were summarized by Randy Milton, supplementing similar but less extensive data in CWS computer files. Only one aerial survey (11 April 1975) extended east of Jeddore Harbour (63°W).

5. Results

5.1 Annual chronology and numbers, from NSB and AJE data

5.1.1 Halifax County

The annual cycle of arrival, build-up, wintering, and departure was readily discernible when data from blocks of years were pooled (Table VI-1). Only small numbers of geese were seen in September, with the first substantial movements occurring towards mid-October. The first wave apparently continued farther southwest, for example 900+ departed from Cole Harbour 7 November 1967. Numbers seen resting averaged lower in November, though this was *not* apparent from the peak counts summarized in Table VI-1. December estimates (largely from Christmas Bird Counts [CBCs], with more extensive coverage than in other months; Fig. VI-3) were the highest of all, perhaps partly reflecting a second migratory "wave". There was some decrease in January in the earlier years, but since 1975 the midwinter numbers were maintained through February.

Spring migration became evident in further increases before mid-March in many years, e.g. at least 1400 geese arrived from the southwest in 14 flocks in late afternoon 13 March 1967 at Cole Harbour (NSB). Peak numbers usually had passed before the end of that month, e.g. 3500 to 4000 seen leaving Cole Harbour 26 March 1968. There were few reports in April, usually featuring much lower numbers, and all except a few stragglers were gone before May.

There was a major increase in the goose numbers reported in recent years, in all seasons. The pattern was most obvious from the Halifax East (originally called "Cole Harbour-Chezzetcook") CBC, for which annual data were available from 1956 to the present (Fig. VI-3). Despite wide fluctuations between years, the increase from near or below 1000 geese annually through 1970, to 3000 to 6000 (once over 10 000) geese in the last decade, was obvious. A comparable increase was evident from the records in most months (Table VI-1). Numbers during the migrations after 1975 averaged twice those before that time, from under 1000 to near 2000 in fall, and from 3000–5000 to 4000–10 000 in spring. Winter estimates increased even more, from under 1000 in the early years to 3000 to 5000 recently.

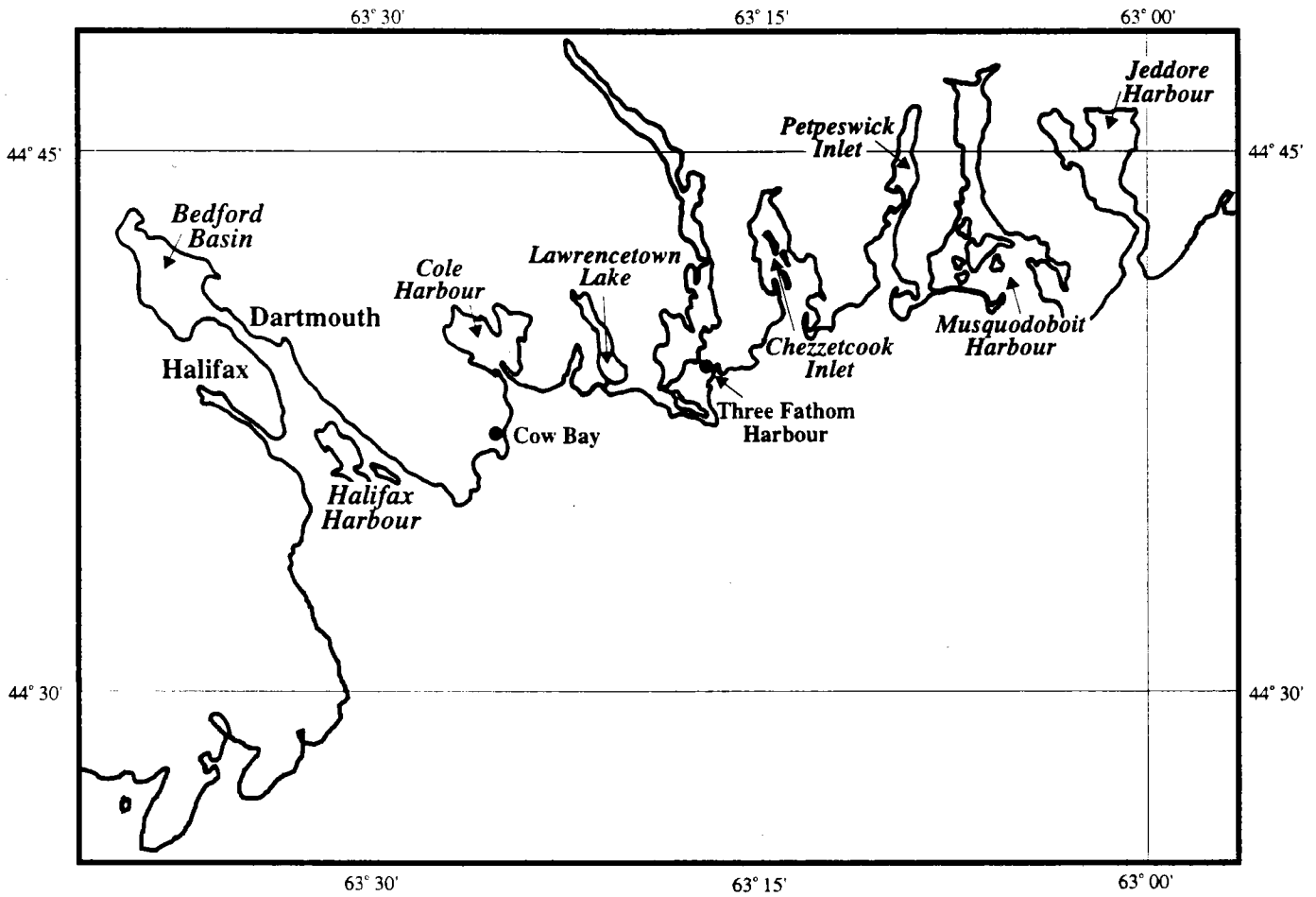

Figure VI-1 Canada Goose staging and wintering areas in Halifax County, Nova Scotia.

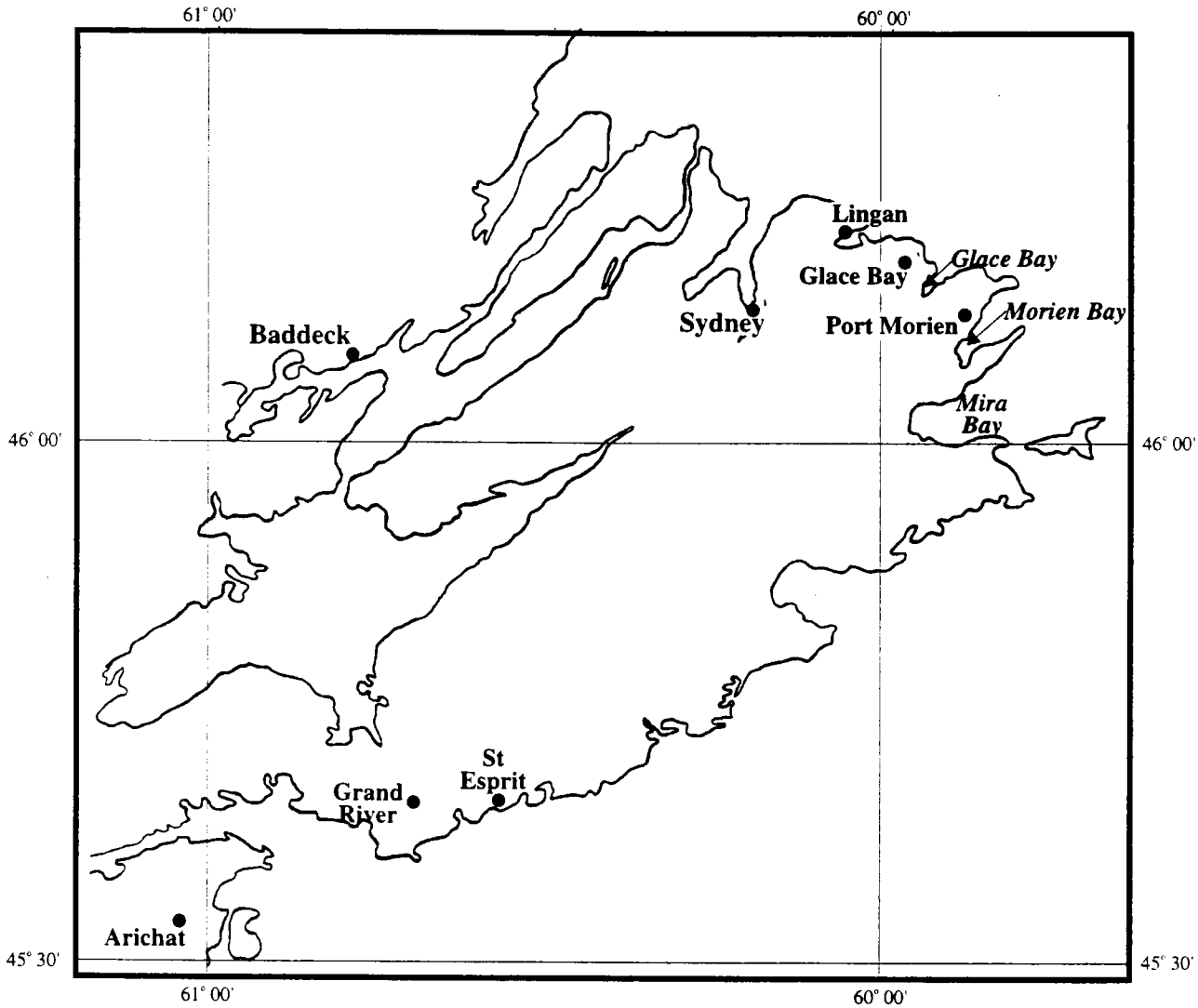

Figure VI-2 Canada Goose staging and wintering areas in southern Cape Breton Island, Nova Scotia.

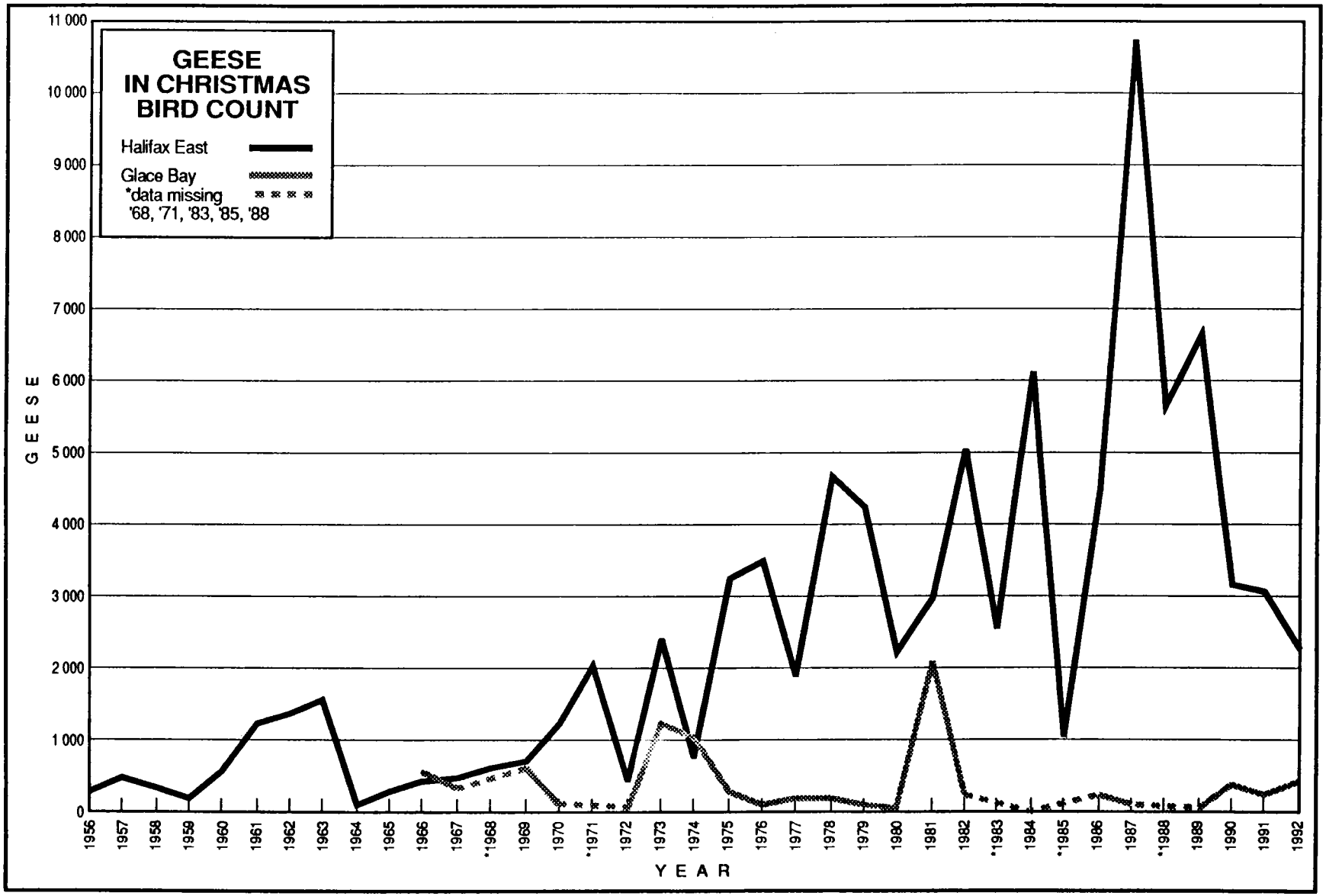

Figure VI-3 Numbers of Canada Geese seen on the Halifax East and Glace Bay Christmas Bird Counts, from *Nova Scotia Birds* (and earlier publications).

Table VI-1. Chronology and numbers of Canada Geese in coastal Halifax County, Nova Scotia, summarized from *N.S. Bird Society Newsletter* and *Nova Scotia Birds*, 1955–1992.

Month	Summary of occurrence records[1] 1955–1975			1976–1992		
September	50	125	150		n.d.[2]	
October	150	240	700	1500	1800	2500
November	600	900	1000	1000	2000	2150
December	2000	2350	3220	6063	6606	10 666
January	200	200	1500	4050	5000	5000
February	250	650		3500	4000	5000
March	4000	4000	5500	7000	8000	9850
April	300	1000			3000	

[1] The three highest estimates in different years (records were not always available for three years) were listed.
[2] n.d. = no data reported.

Table VI-2. Summary of winter (December–February) aerial goose surveys in coastal Halifax County, from Nova Scotia Wildlife Division (mostly) and CWS data, 1953–1992.

Year(s) (No. of surveys)	Mean number of geese at Cole Hbr	Chezzetcook	Petpeswick	Musquodoboit	Total[1]
1953 (1)	220				220
1964 (1)[2]					500
1965–69 (2)[2]					3650
1970–74 (3)[2]	125		435	352	1775
1977–79 (3)	45	225	438	1282	2322
1980–83 (5)	513	441	91	2582	3659
1985–89 (8)[2]	608	920	581	2249	4920
1990–92 (3)	482	0	621	2600	3774

[1] Totals included geese in other areas surveyed, viz. Cow Bay, Lawrencetown, Three-Fathom Harbour, Jeddore. Key to main survey areas: Cole Harbour, Chezzetcook Harbour, Petpeswick Harbour, Musquodoboit Harbour (including Martinique Sanctuary).
[2] In 1964, 1965, 1969, 1970 and 1985, only the combined total for all areas was available; those figures were included in the mean totals, but those years were excluded for individual areas.
When two or more surveys were made in one winter, these were averaged before combining with other years for overall mean values.

5.1.2 Cape Breton County

Data from Cape Breton Island were much sparser than near Halifax, and reporting was irregular in most years. First fall arrivals were reported as early as the last week of August. September and October numbers were small, mostly 100–200 and only twice exceeding 250 geese. November showed some increase, with usual reports of 250 to 450 and occasional counts of 1,000 birds. December was similar, with few counts above 700, CBCs (Fig. VI-3) seldom producing larger numbers than the casual counts. Numbers fell off later, only one January count exceeding 450, and no data were available for February. Counts in March were much larger, from 1000 to 5000, and peak spring numbers were reached in early April when 3000–6000 were present. The last geese were seen in late April or the first days of May. There was no clear trend in numbers over time, although the larger estimates in a month were more often after 1975 than before, especially during March.

5.2 Trends in numbers, and patterns in use, mostly from mid-winter aerial surveys

Data from CWS and N.S. (provincial) aerial surveys, summarized in Table VI-2, showed that totals of wintering geese increased dramatically but irregularly, from a few hundreds before 1965 to over 3500 since 1980. Estimates of 6500 geese 23 January 1969 and 3500 on 19 January 1970 seemed anomalous, as such large numbers

were not approached again until after 1980, and were never exceeded. However, provincial Wildlife Division ground counts (Table VI-3) confirmed that geese were exceptionally numerous in January in both 1969 and 1970, with much lower numbers thereafter through 1977-78. Atypically low estimates from aerial surveys in 1986 (1615 geese) and 1992 (2525 geese) reduced the means for those periods below those in other recent years.

The largest numbers and most regular occurrence were in the seaward reaches of Musquodoboit Harbour (Table VI-2), where the provincial Martinique Game Sanctuary was established (unofficially ca. 1964, legislated 1974) to protect wintering Black Ducks, geese then being scarce there. Ground surveys (Table VI-3) showed that geese there usually occurred in the Sanctuary through December, but often were forced onto the outer harbour or to the sea outside in January when waters in the Sanctuary froze. Cole Harbour, 20 km farther west, was used nearly as frequently but by much smaller numbers, and these also rested on the bay outside when the almost landlocked harbour froze (compare Macpherson and Allen 1957). The other narrower inlets, including Lawrencetown Lake (freshwater, not shown separately in tables) were still more prone to freezing and to disturbance by hunting, and geese were found there irregularly, though sometimes in large numbers.

6. Discussion

Canada Geese are large, conspicuous birds that occur in flocks. Volunteers obtained estimates that were representative for these more easily than for less obvious species. Absurdly high counts of geese by bird-watchers were no more frequent than among estimates by hunters. Low figures were reported more often, partly through the misconception that a "conservative" estimate is preferable to a "best guess", and partly when the observers didn't attempt careful estimates. Most of the larger estimates of goose numbers by birdwatchers are useful indices to the actual numbers in an area.

First arrivals in fall mostly involved small numbers, and we ignored most reports of 5 to 10 geese in August unless these were followed quickly by larger groups. Early sightings might have involved (feral) goose families that had bred in Nova Scotia (see Chapter XVI, this volume). Fall arrivals averaged one to two weeks earlier on Cape Breton Island than in Halifax County, where they preceded those near Port Joli by similar intervals. Migrating geese, flying at 60 to 70 km/h, could travel from Glace Bay to Chezzetcook in five hours, and onward to Port Joli in three hours more, so the later first arrivals farther southwest evidently involved stopovers between the summer range and Nova Scotia staging/wintering areas. Intuitively, it seems unlikely that any one flock regularly stops at all the known staging areas in each migration. Probably each local breeding stock has a distinct tradition of stopping at suitably spaced areas (compare Hochbaum 1955), with adverse conditions forcing its use of alternate areas in some years.

The southward migration pattern seen at Port Joli (Chapters II-IV, this volume) of one major movement during October followed by a pause before a second and larger movement in December and early January, was discernible also in the NSB data from Halifax County. No early peak was apparent from the provincial Wildlife Division ground surveys there, nor in the sparse data from Cape Breton Island, both of which showed the fall passage peaking later, between late November and late January in different years. Wintering numbers, after mid-January, were generally lower than those present during December. Evidently some geese of these stocks continued onward to winter farther southwest. Through the 1960s, geese were forced out of wintering areas in both Cape Breton and Halifax Counties several times each decade, in winters that were colder than average (pers. comms. from hunters and local residents), the Port Joli area apparently being the northernmost that held geese all winter in every year. The effect of temperature, acting through ice-cover, was detectable in the CBC data (Fig. VI-1): the three unusually high goose counts at Glace Bay (1973, 1974, 1981, none of which also had high counts at Halifax East) were in years with mild late fall weather, whereas years with very low counts at both Glace Bay and Halifax East (1972, 1980) were considered very cold in late fall. [Ed. Note: Temperature data for Halifax and Sydney could be obtained, if required, the general statements above being based on summaries of impressions by persons reporting to Nova Scotia Birds.]

The erratic over-wintering of geese in Halifax County changed markedly after 1975-80, becoming regular and involving larger numbers. From 1000 - 1500 geese, often fewer and sometimes none, using traditional areas at Cole Harbour and Martinique Beach in the 1950s and 1960s, the numbers built to 3000 - 5000 birds annually since 1980. Nearby areas became used more regularly, near Lawrencetown and Chezzetcook. There was a concurrent decline in wintering numbers in the Port Joli area (Chapter V, this volume), the combined total for the Port Joli and Halifax County regions showing no overall change. Thus, geese may be wintering farther north(east) in recent years, in consequence of less severe winters and with the establishment in Halifax County of another refuge from hunting, the provincial Martinique Game Sanctuary. No parallel increase in over-wintering or at other seasons was detected in Cape Breton County, where the Glace Bay Migratory Bird Sanctuary existed since 1939.

The spring movement occurred mainly during March in Halifax County, and few large flocks were reported there after the end of March. Peak numbers in Cape Breton County were usually in April, and little increase in March occurred there until 1979. The final departures from Halifax County and Cape Breton were usually in April, with a few stragglers into early May in Cape Breton. Spring reports showed higher numbers than in fall, peaking at 10000 in Halifax County and 6000 in Cape Breton. Apparently some geese that move north along Nova Scotia's Atlantic coasts follow a different route in fall.

Table VI-3. Summary of goose data from weekly ground surveys in coastal Halifax County, Nova Scotia, October through January, 1962–63 to 1977–78, from N.S. Wildlife Division files.

Year	Month	Mean numbers of geese at Cole Harbour	Martinique Sanctuary	Other[1]
62–63	October	100	0	0
	November	125	0	6
	December	300	775	0
	January	50	500	620
63–64	October	0	125	0
	November	50	25	700
	December	0	520	300
	January	100	50	950
64–65	October	0	6	38
	November	325	800	538
	December	560	1201	1400
	January	125	500	1550
65–66	October	25	185	201
	November	500	660	680
	December	700	900	1275
	January	125	500	1575
66–67	October	13	286	0
	November	350	900	200
	December	140	1680	540
	January	260	500	2120
67–68	October	277	208	5
	November	500	700	250
	December	1000	1500	1000
	January	500	0	1000
68–69	October	154	500	75
	November	300	1275	500
	December	325	1625	875
	January	608	2200	840
69–70	October	183	1900	0
	November	850	1500	1525
	December	300	2800	340
	January	400	1000	2000
70–71	October	188	1000	250
	November	675	648	1300
	December	185	1980	340
	January	290	700	575

Table VI-3. Summary of goose data from weekly ground surveys in coastal Halifax County, Nova Scotia, October through January, 1962–63 to 1977–78, from N.S. Wildlife Division files. (Continued)

Year	Month	Mean numbers of geese at Cole Harbour	Martinique Sanctuary	Other[1]
71–72	October	334	791	0
	November	388	1475	1425
	December	660	840	200
	January	412	650	700
72–73	October	250	367	0
	November	520	860	680
	December	550	1300	394
	January	200	420	760
73–74	October	100	432	125
	November	220	495	200
	December	225	300	400
	January	325	306	625
74–75	October	21	66	51
	November	188	404	594
	December	290	400	180
	January	140	105	450
75–76	October	54	92	112
	November	234	700	103
	December	406	750	44
	January	31	850	544
	— no data collected in 1976 -77 —			
77–78	October	0	150	0
	November	300	250	0
	December	750	850	250
	January	850	400	50
	February	250	500	1400

[1] "Other" included Musquodoboit Harbour outside of Martinique Game Sanctuary, but information was lacking on whether other areas used by geese were surveyed regularly. The observer passed near (often within sight of) several other areas used by geese while driving between Cole Harbour and Martinique Sanctuary, and it seems likely that any geese seen there were included in the totals.

Surveys were made weekly except in 1977 to 1978 (bimonthly), but 1 or 2 surveys were missed in a few months.

The increase in wintering geese in later years was evident also in the spring passage in Halifax County.

7. Literature cited

Hochbaum, H.A. 1955. Travels and traditions of waterfowl. Univ. Minnesota Press, Minneapolis. 301 pp.

Macpherson, L.B., Allen, C.R.K. 1957. Birds of the Cole Harbour–Chezzetcook area. N.S. Mus. Sci. Newsletter, 2(1): 7–9.

Simmons, M., Davis, D., Griffiths, L., Muecke, A. 1984. Natural history of Nova Scotia. Nova Scotia Department of Education and Department of Lands and Forests, Halifax. 2 vols., 807 pp.

B. THE CANADA GOOSE SITUATION IN THE SOUTHERN GULF OF ST. LAWRENCE: A GENERAL INTRODUCTION

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1. Introduction

This section provides background information general to the next four chapters (VII–X). Its content was assembled from general sources, and from Martin and Guignon (1983a,b), the only published studies on Canada Geese in the entire region.

2. Geology, climate, and land-use

The lands bordering the southern Gulf of St. Lawrence are underlain by sedimentary sandstones of Carboniferous (mainland) or Permian (Prince Edward Island) age, except in eastern Nova Scotia. There, the Cape George peninsula and the Cape Breton Island shores feature harder rocks and steeper coastlines that are generally unattractive to and little used by geese, except around Antigonish (see preceding chapter). Elsewhere the soft sandstones erode rapidly, leaving flats of sandy mud, the coarser sediments being left to form barrier bars enclosing many of the bays. The inner reaches of bays and estuaries have developed salt-marshes of cord-grasses *Spartina* spp., whereas the flats near and below the low-tide mark feature extensive beds of eelgrass *Zostera marina*.

Landward, except where raised peat bogs blanket the landscape in eastern New Brunswick and western Prince Edward Island, most of the (originally forested) area was farmed in the recent past, and remains open at present. The regional climate in winter and spring is influenced by sea-ice, which sometimes persists into May, so the growing seasons are short, and few crops are economical. Much land is still cultivated on Prince Edward Island, mostly for potatoes or oats. Both the shallow sub-tidal and inter-tidal areas of bays and the nearby farmlands are used by geese in season (Fig. B-1), except when those areas are covered by ice or snow, or when disturbance by hunting drives the birds away. The colder winters (compare Table A-1) in this region preclude most wintering by geese, which are forced out by ice on the inlets and snow on the fields, beginning in early December and extending through late March or early April.

3. Historical and social background

Canada Geese occurred prominently in the southern Gulf of St. Lawrence throughout historic times, probably having appeared there soon after the ice-sheets of the last glaciation retreated about 10 000 years ago. Formerly they bred in some numbers, most recently on Miscou Island, N.B. (Squires 1976), but numbers of migrants probably far exceeded the local breeding population once the Maritimes became a generally forested region. As elsewhere in eastern North America, overall numbers of Canada Geese here declined from early settlement into the 1900s when the last indigenous breeding birds disappeared. Since 1920 they increased, at first gradually and later more strikingly. There are only anecdotal indications of numerical trends before 1960, but the patterns described above were general though much influenced by local variations in hunting pressure.

The southern Gulf of St. Lawrence (Fig. B-1) is now the northernmost major spring staging area for geese on the Atlantic coast of North America. Farther north, the birds are spread out across the breeding range from insular Newfoundland and Labrador through Ungava, but major parts of those stocks assemble each spring and fall in the southern Gulf. With as many as 50 000 geese present at one time in spring on Prince Edward Island (R. Dibblee, P.E.I. Fish & Wildlife Division, pers. comm.), plus several thousands more on the mainland shores, this is the Atlantic coastal counterpart to major spring staging areas farther west in Québec (Lehoux *et al.* 1985), Ontario (Ross 1984), and New York (AJE, pers. obs.). All of these are agricultural areas where geese, over the last century, established traditions of staging on the northernmost major farmlands before departing to the boreal and subarctic wilderness to breed. All these farming areas were largely covered by forests four hundred years ago, but the wetlands adjoining them probably provided suitable foraging areas for substantial numbers of staging geese over several thousands of years since the ice-sheets of the last glaciation retreated from those regions.

Geese also assemble in the southern Gulf of St. Lawrence in autumn, when hunting greatly influences their distribution and numbers. Geese are desired game nearly everywhere, and on Prince Edward Island, in the absence of deer, moose, and bear, geese are literally the only "big game" species. Human exploitation eliminated former breeding geese from the southern Gulf region by 1905. The many broad, shallow bays and coastal lagoons there provided adequate refuge from the relatively low legal hunting pressure exerted by the sparse human population, after the much more harmful practice of spring hunting was banned around 1915. More recently, with hunting restricted to mornings at Tabusintac Lagoon, N.B. (a provincial management zone), and largely closed in waters adjoining coastal national parks near Kouchibouguac, N.B., and Cavendish/Dalvay, P.E.I., geese can ride out daytime hunting by much larger numbers of hunters, returning inshore at night to feed. Migratory Bird Sanctuaries to

provide undisturbed resting and feeding areas have not proved necessary for maintaining staging goose numbers in the southern Gulf of St. Lawrence, in contrast to the situation on the Atlantic coasts of Nova Scotia, where wintering as well as staging occurs (compare A. and Chapters I–VI, this volume).

4. Literature cited

Lehoux, D., Bourget, A., Dupuis, P., Rosa, J. 1985. La sauvagine dans le système du Saint-Laurent. Environnement Canada, Service canadien de la faune, Région du Québec. 76 pp + annexe 72 pp.

Martin, K., Guignon, D. 1983a. Canada Goose numbers, daily movements and foraging patterns on Prince Edward Island. Proc. N.S. Inst. Sci., 33: 107–114.

Martin, K., Guignon, D. 1983b. Canada Goose hunter profile, success and expenses on Prince Edward Island. Proc. N.S. Inst. Sci., 33: 137–144.

Ross, R.K. 1984. Migrant waterfowl use of the major shorelines of eastern Ontario. pp. 53–62 *in* Waterfowl studies in Ontario, 1973–81. Ed. by Curtis, S.G., Dennis, D.G., Boyd, H. Can. Wildl. Serv. Occas. Paper no. 54. 69 pp.

Squires, W.A. 1976. The birds of New Brunswick. 2nd ed. New Brunswick Museum, Monogr. Ser. no. 7. 221 pp.

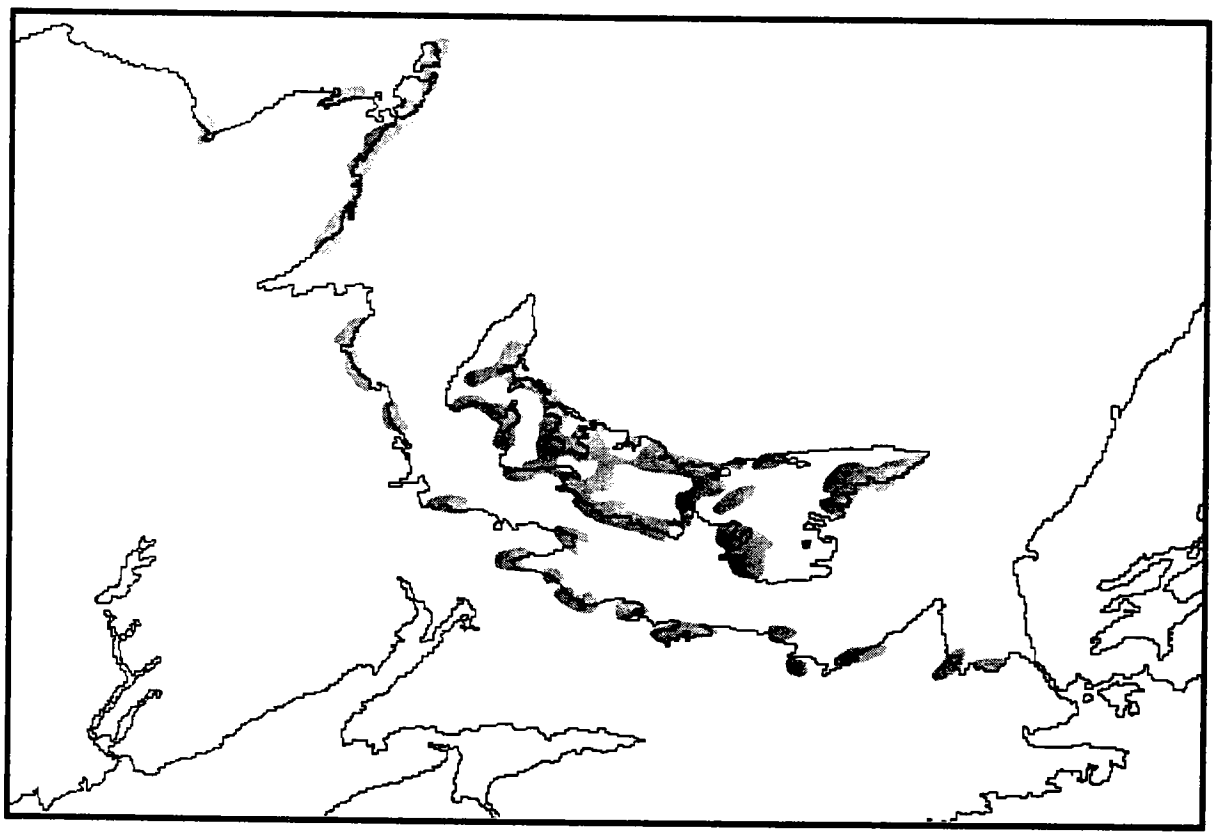

Figure B-1 The southern part of the Gulf of St. Lawrence, with Northumberland Strait, showing areas with Canada Goose staging (shaded).

VII. DISTRIBUTION, ABUNDANCE AND ACTIVITY OF MIGRANT CANADA GEESE IN ANTIGONISH HARBOUR, NOVA SCOTIA

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1. Abstract

The distribution, abundance and activity of migrant Canada Geese were studied in Antigonish Harbour in northeastern Nova Scotia during the period 1972–1992. Flock size increased during the autumn, reaching a maximum in December, and peak abundance occurred during 1982 to 1986. Geese roosted and foraged at very specific sites and most foraging occurred in water, primarily over eelgrass stands. Tide and wind were the main factors influencing when and where geese foraged. At night, geese usually roosted en masse at sites which were sometimes also used as daytime roosts. Movements were usually between foraging and roosting sites or between foraging sites. Most geese used two main flight lines between the upper and lower harbour. Disturbance was low but activity was sometimes interrupted by Bald Eagles and boaters. Disturbance rarely prevented geese from foraging or roosting for long. Geese usually departed from the harbour sometime in the last two weeks of December.

2. Introduction

Staging and wintering Canada Geese (*Branta canadensis*) along the Atlantic coast of Canada traditionally foraged and roosted in coastal bays, harbours and estuaries. Foraging on agricultural lands has become a widely established tradition in migrating and wintering geese of several species and may result in enhanced reproductive fitness of some goose populations (Reed 1976). Martin and Guignion (1983) reported an approximate doubling of the migrant flock of Canada Geese in Prince Edward Island during the 1970s, when the birds made extensive use of cropland available for foraging in both autumn and spring. Although roosting frequently occurs over water, some coastal populations of geese now forage on cropland almost exclusively. However, many migrant and wintering goose flocks in Nova Scotia continue to use coastal habitat for all of their requirements, and some of these coastal flocks remain in Nova Scotia throughout the winter (F. Payne, pers. comm.).

Raveling (1969, 1979) reported that Canada Geese regularly use highly specific foraging and roosting sites, and disturbance at these sites may result in decreased fitness of individuals. Korschgen *et al.* (1985) investigated disturbance in staging waterfowl, and Zicus (1981) and Bartlett (1987) studied the influence of hunting on staging and wintering Canada Geese. Bélanger and Bédard (1989) also investigated the influence of hunting and other human disturbance on Greater Snow Geese (*Chen caerulescens*), but pointed out that the effects of disturbance on waterfowl activity are still poorly documented. Staging and particularly wintering geese in Nova Scotia are potentially vulnerable to human disturbance, especially when ice restricts their foraging options.

The objectives of this study were to investigate seasonal changes in abundance, distribution and patterns of use of a harbour in northeastern Nova Scotia by migrant Canada Geese. Specific focus was on foraging and roosting activity, and on movements between foraging and roosting sites.

3. Study Area

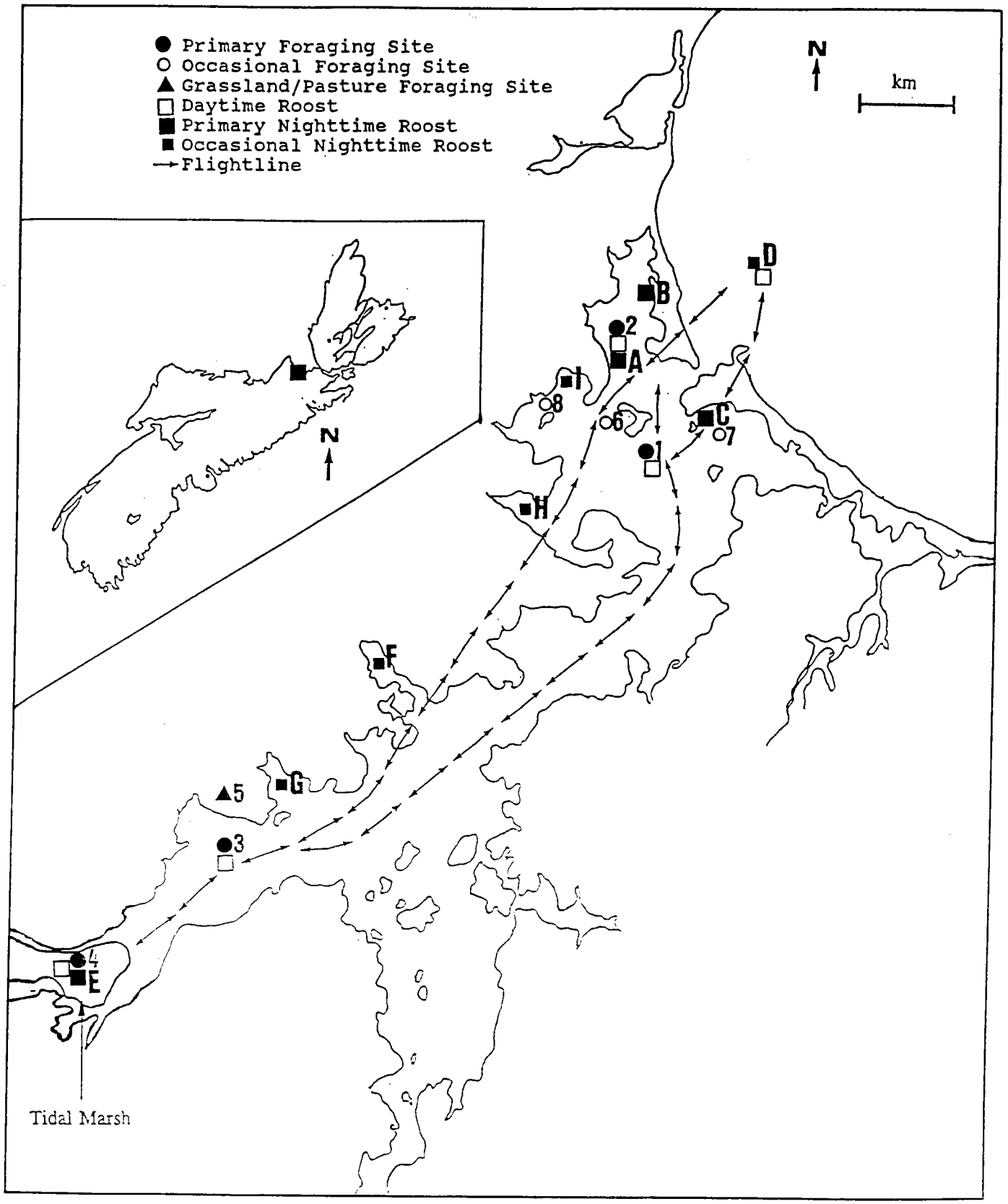
Northeastern Nova Scotia is characterized by numerous small drainage basins that discharge into brackish, tidal areas that are separated from the sea by barrier beaches (Fig. VII-1). Eelgrass *Zostera marina* is the dominant submerged vegetation in open harbours during summer and autumn, but it is sparse during the late winter and spring. A complex of submerged and emergent vegetation dominated by cordgrasses *Spartina* spp. comprises the marshes that develop where the fresh water outflow from streams and small rivers forms tidal deltas.

Antigonish Harbour has NE/SW orientation and occupies approximately 20 km^2 (Fig. VII-1). Discontinuous stands of eelgrass cover almost 70% of the bottom, and are most dense in the coves on the northwest side and in the central part of the upper harbour. Tidal amplitude is generally < 1 m; water depth over eelgrass is seldom less than 0.5 m, and stands are rarely completely exposed. Two tidal marshes (0.5 and 1.5 km^2) occur at the upper end of the harbour where small rivers form deltas. The larger and more intensively used marsh is a wildlife sanctuary and is also the deposition site of nutrient-rich effluent from the sewage treatment facility that serves the town of Antigonish. There is little human activity in the harbour and hunting is only an occasional disturbance factor.

Agricultural land occurs adjacent to the harbour and in discontinuous patches inland. During most years, there is 9 km^2 of mixed grasses and pasture and 1.25 to 2.0 km^2 of grain stubble within a radius of 10 km of the main tidal marsh.

4. Methods

Ground surveys were conducted at least once/wk along the coast from Pictou in the west to the Strait of Canso. These began in early September and continued to early May, when most migrants had left. These surveys determined only abundance and distribution of waterfowl. From mid-September to the end of December, intensive surveys were conducted in Antigonish Harbour at least 3



Figire VII-1 Location of roosts, foraging sites and flight lines of Canada Geese using Antigonish Harbour during autumn staging (September to January); based on 412 surveys, 1972-1992. Inset map of Nova Scotia, with Antigonish Harbour shown.

days/wk (1247 days and 1309 surveys, 1972–1992) at all hours from dawn until dark. Surveys by boat along the length of Antigonish Harbour supplemented ground surveys, and additional data were obtained from 8 helicopter surveys of the harbour.

The regular ground surveys included visits by car to a series of observation points from which observation of the entire Antigonish Harbour was possible. The entire margin and surface of Antigonish Harbour could be surveyed within one hour, with precise counts of all geese in the harbour. Complete surveys (N = 127) of the main wetlands in the drainage basin lasted 3–4 h. In addition, observation of birds for longer periods (30 min to 2 h) was sometimes made. Continuous observations (734 h) allowed patterns of activity to be determined. Reference markers were driven into the substrate at most sites, and these enabled me to define locations of birds in the habitat and depth of water. A sample of 77 hunter-shot geese provided qualitative information about diets. Temperatures and wind direction were recorded at noon on days when surveys were conducted. In addition, wind direction was recorded on those occasions when specific observations were made.

5. Results

5.1 Abundance and Distribution

Although there were usually Canada Geese in the Harbour by the last week of September, large numbers did not arrive until mid-October (Table VII-1). Starting about 1980, flock size increased further during the late autumn, reaching its maximum in December. The mean size of the flock during the 10-day period when it was at peak abundance for the autumn increased from 357 (range 345–382) during the period 1972–76 to 946 (range 792–1225) in 1982-86; it decreased to 706 in 1990-92 (range 690–725).

Virtually all of the geese remained together in one flock, but groups regularly arrived in and left the harbour throughout the fall. Counts were conducted almost daily during 1986 and 1987 when peak numbers in November were 670 and 604, respectively. However, the mean flock sizes were 483 and 454. In late December 1986, 350–400 newly arrived migrants roosted at sea overnight, and stayed for only 3 days before they continued on migration. This group never joined the main flock. In some years, brief stop-overs such as this occurred throughout the autumn but particularly late in the season. Departure of geese usually occurred sometime in the last 2 weeks of December (Table VII-2). Exodus most frequently coincided with the presence of a high-pressure system, clear skies and moderate westerly winds following a period of high northerly winds, cold temperatures (to −15°C) and extensive freezing of the lower harbour (the upper harbour was always frozen earlier). Birds moved out in flocks of 12 to 30 individuals and gained altitude as they flew directly up the harbour and disappeared from view in a westerly direction.

5.2 Foraging

Canada Geese used very specific foraging and roosting sites while in the harbour (Fig. VII-1). Virtually all of their autumn foraging occurred at four aquatic sites (sites 1–4) which encompassed approximately 14 ha (and one on grassland/pasture—site 5) (Table VII-3). The two sites (1 and 2) in the lower harbour consisted of eelgrass stands as did the site (3) in the upper harbour and the infrequently used sites 6–8. At the tidal marsh (site 4), the birds foraged within an area of approximately 4 ha along the vegetation/water interface, which consisted of a variety of emergent and submerged vegetation.

Activity was usually synchronized within the flock, and the geese usually remained at foraging sites throughout the day, alternating between bouts of foraging and resting. Foraging was the more frequent activity at the main foraging sites, except the tidal marsh (Table VII-4). The relative frequency increased in November and December when most of the day was spent foraging (Table VII-5). There was usually a peak in the morning with a smaller peak in the evening.

Most foraging occurred in water (Table VII-3), primarily over eelgrass stands (sites 1, 2, 3). Foraging in fields occurred more frequently in some years than others, but only 8 ha (approx.) of mixed grasses/pasture adjacent to the harbour were ever used. Geese rarely rested in the field, particularly early November (Table VII-5).

Eelgrass was the principal item in the diet. A sample of 22 geese, collected over the open harbour after birds had foraged, contained eelgrass in their digestive tracts. Even when birds used fields, this only provided a small part of their daily diet. Small flocks of birds sometimes alternated between foraging on eelgrass and in fields during the day, and 14 such birds collected over grassland/pasture had eelgrass in their digestive tracts.

Geese foraged at all times of day, but tide and wind were the main factors influencing where geese foraged in the harbour. When the depth of water was suitable at a site, they might attempt to forage there regardless of weather. However, birds usually flew to or remained in the relatively protected tidal marsh to forage or roost when winds were high. When winds created turbulence in the lower harbour, birds deserted foraging sites there and flew to the tidal marsh, although the tidal marsh was rarely used (4 of 83 days) for foraging during calm weather.

Tidal conditions appeared to be the most important factor in determining when geese began to forage (Table VII-6). Although a few small flocks usually moved in the morning and evening, there was no significant early morning flight to foraging sites on an additional 83 occasions when the tide remained high during the 3 h after first light. Similarly there was no evening foraging flight on 109 additional occasions when the tide remained high for 3 h before dark. The onset of foraging on eelgrass usually began on a falling tide, most frequently when the depth of water was approximately one m above the substrate (Table VII-6).

Table VII-1. Peak number of Canada Geese using Antigonish Harbour during ten-day intervals throughout the annual cycle, 1972–1992.

Period	1972 –73	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92
1–10 Sept	0[1]	0	0	0	12	0	0	0	0	19	0	0	0	0	0	0	0	0	0	0	0
11–20 Sept	0	0	0	8	0	0	20	0	0	0	0	0	0	0	16	0	0	0	0	0	0
21–30 Sept	19	0	39	52	9	0	66	32	32	37	9	28	64	27	63	47	72	12	59	40	36
1–10 Oct	124	102	73	58	103	67	68	111	34	70	34	105	84	84	83	102	72	47	50	45	47
11–20 Oct	160	282	209	246	202	311	219	308	362	307	326	309	218	281	247	305	298	300	271	318	394
21–30 Oct	320	342	361	303	298	370	347	297	429	443	472	328	450	400	382	457	404	520	526	411	457
1–10 Nov	346	327	309	382	350	411	318	303	460	429	605	520	548	492	670	600	598	670	625	615	598
11–20 Nov	329	340	298	299	340	385	360	340	465	398	648	659	600	672	580	578	670	646	600	600	570
21–30 Nov	328	345	300	265	265	401	368	319	549	507	647	650	645	681	624	604	604	672	590	602	603
1–10 Dec	300	302	289	304	290	87	109	309	487	612	599	819	1200	919	894	700	826	900	700	725	690
11–20 Dec	310	310	304	341	286	82	80	312	485	800	792	782	1225	999	870	1205	825	830	702	698	640
21–31 Dec	212	208	106	88	201	29	64	242	302	612	568	492	864	602	712	609	478	600	390	209	304
1–10 Jan	20	0	13	47	0	0	24	14	0	43	0	0	18	81	41	38	0	86	29	42	14
11–20 Jan	20	0	0	29	0	0	0	0	0	8	0	0	18	8	35	42	6	54	0	20	0
21–30 Jan	16	0	0	0	0	0	8	0	0	8	0	0	16	11	32	30	0	0	0	0	0
1–10 Feb	14	0	0	0	0	0	0	0	0	0	0	0	16	0	12	8	0	0	0	0	0
11–20 Feb	14	0	0	0	0	0	0	0	0	0	0	0	15	0	0	9	0	0	0	0	0
21–28 Feb	14	0	0	0	0	0	0	0	0	0	0	0	13	0	0	7	0	0	0	0	0
1–10 Mar	14	0	0	0	0	0	0	10	0	0	0	0	12	0	0	0	0	0	0	0	0
11–20 Mar	29	34	0	47	112	0	0	0	96	27	0	0	32	0	0	19	0	0	0	0	0
21–31 Mar	96	82	38	26	129	40	0	0	126	126	0	0	37	0	0	14	0	0	0	0	0
1–10 Apr	20	12	0	0	0	43	0	0	122	98	0	0	0	0	0	0	0	0	0	0	0
11–20 Apr	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21–30 Apr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[1] No geese seen during surveys which occurred in all intervals

Table VII-2. Departure dates and weather conditions prior to and at departure of Canada Geese from Antigonish Harbour

Year	Departure Date(s)	No. of Birds	% Frozen ( )[1]	Temp (°C) Prior[2]	Temp (°C) Day	Wind Direction Prior[3]	Wind Direction Day	Wind Velocity[4] (km/h) Prior	Wind Velocity[4] (km/h) Day
1973	18–21 Dec	187	65(80)	-3	4	NW	SW	45	15
1978	26 Dec	62	80(90)	-12	-13	N	NW	60	12
1980	28 Nov–3 Dec	244	60(70)	-9	-3	NW	W	35	12
1981	19,23,25 Dec	592	70(60)	-11	2 to 5	NE	W	65	25
1985	27 Dec	387	65(70)	-15	-5	NW	W	55	10
1987	28–29 Dec	419	50(55)	-4	-6	NE	NW	40	20
1989	17 Dec	81	50(60)	-6	-1	NW	W	45	5
	23–24 Dec	302	70(70)	-9	-2	NW	NW	50	20
1990	26 Dec	209	80(90)	-15	-4	NW	W	45	5
1991	21–24 Dec	147	60(70)	-9	-2	NE	SW	35	15
1992	18–21 Dec	152	45(30)	-14	-9	NW	W	25	10
	28–29 Dec	109	65(60)	-12	2	NW	SW	45	15

[1] Approximate % of harbour frozen (approximate % of eelgrass stands covered with ice) at departure
[2] Noon temperature on the day prior to the onset of departure
[3] Wind direction at noon on the day prior to the onset of departure
[4] Maximum velocity in gusts

Table VII-3. Location and relative occurrence of Canada Geese at foraging sites in Antigonish Harbour throughout the autumn.

Site	Location	Area (Ha)	Year 1975 (48/59)[2]	1978 (63/112)	1986 (42/72)	1987 (57/109)	1988 (52/100)	1991 (63/109)
1	Lower harbour	3	13%[3]	16	19	10	15	18
2	Lower harbour	4	38	36	30	41	34	31
3	Upper harbour	3	26	31	30	31	31	26
4	Tidal marsh	4	19	12	11	13	9	15
5	Field	8	3	2	8	3	6	5
6/7/8	Various[1]	2	1	3	2	2	5	5

[1] Three aquatic sites in the lower harbour
[2] Number of survey days/Number of surveys
[3] % of total geese in the harbour at that site

Table VII-4. Number of daylight hours spent foraging (vs resting) during the autumn at the four main aquatic foraging sites

Site	Location	Year 1977	1982	1987	1991	Total (%)
1	Lower harbour	6.25[1]/8h[2]	3.5/6	8.5/12	6.25/9	23.5/35 (67.1)[3]
2	Lower harbour	4.25/6	7/9	7.5/9	8/12	26.75/36 (74.3)
3	Upper harbour	5.5/7	8.5/11	10.75/14	7.5/9	32.25/41 (78.7)
4	Tidal marsh	5.25/12	3.75/9	5.25/10	3.75/10	18/41 (43.9)

[1] Number of hours spent foraging
[2] Total number of hours observed
[3] Percentage time spent foraging

Table VII-5. Number of daylight hours spent foraging (vs resting) during the autumn while at major foraging[1] sites; 1977, 82, 87, 91.

Site	Period October 06:00 - 10:00	October 10:00 - 14:00	October 14:00 - 18:00	October Total	November 06:00 - 10:00	November 10:00 - 14:00	November 14:00 18:00	November Total	December 06:00 - 10:00	December 10:00 - 14:00	December 14:00 - 18:00	December Total
Aquatic	12.5[2]/15h[3] (83.3%)[4]	10.25/28 (36.6%)	8/19 (42.1%)	30.75/62 (49.6%)	14.25/15 (95.0%)	14/21 (66.7%)	17/23 (73.9%)	45.25/59 (76.7%)	9.5/11 (86.4%)	13/20 (65.0%)	13.5/17 (79.4%)	36/48 (75%)
Field	7.25/8h (90.6%)	3.0/4.25 (70.6%)	5.75/6 (95.8%)	16.0/18.25 (87.7%)	6.5/7 (92.9%)	4/4 (100%)	4/4 (100%)	14.5/15 (96.7%)	4/4 (100%)	5/5 (100%)	2/2 (100%)	11/11 (100%)

[1] Corresponds to 7 aquatic and one grassland/pasture site in Table VII-3 and Figure VII-1
[2] Amount of time spent foraging
[3] Total time birds observed
[4] Percentage time birds spent foraging

Table VII-6. Onset[1] of foraging related to tidal conditions in Antigonish Harbour

Condition	N[2]	Depth[3] of water (m) 0.5	1.0	1.5	2.0	2.5
Tide Rising	31	6	23	2	0	0
Tide Falling	141	5	87	40	8	0

[1] Geese flew from nighttime roost to foraging site, or began foraging after a period without foraging
[2] Number of occasions when onset of foraging was known
[3] Depth of water (above the substrate) at foraging site when foraging began

Birds foraged in fields at all times of day (Table VII-5). The onset of most (65% of 82 flights) field-feeding occurred when the tide was falling. Birds flew to fields on 16 occasions when tides were low but turbulence due to high winds prevented them from continuing to forage on eelgrass.

Geese occasionally foraged at night, when high tides during the day restricted foraging opportunities and light from the moon and low night-time tides made nocturnal foraging possible. Night-time sites were the same as those used during the day (19 observations), and 23 birds collected en route to day-time roosts, after apparent night-time foraging, had eelgrass in their digestive tracts.

After widespread freezing of the upper harbour in early to mid-December, aquatic foraging was restricted to the two regularly used sites (1 and 2) in the lower harbour. All 18 birds collected then contained eelgrass. Regardless of tide or weather, in November and December birds spent most (80.7% and 79.6% of 74 and 59 h of observation, respectively) of the diurnal period foraging, compared with 58.3% of 80.25 h of observation in October (Table VII-5).

During spring, small numbers of geese regularly used the harbour for 2 to 3 wk until 1981 after which this became rare. Spring migrants used the same sites as were used in the autumn, but they foraged more widely within these sites then. Geese never foraged on grassland/pasture in spring and always remained within Antigonish Harbour.

5.3 Roosting

There were few regularly used night and day-time roosts. The main aquatic foraging sites (sites 1, 2, 3, 4, Fig. VII-1) were also used as day-time roosts with the entire flock frequently remaining at one site (site 1) throughout the day, particularly after mid-November; on 43 occasions the flock remained there for 24 h or more. Three main sites (site A, B, C) in the lower harbour and the tidal marsh (site E) were used as night-time roosts by the flock (Table VII-7). Occasionally, groups of 15 to 35 birds roosted in four protected coves (sites F, G, H, I) but usually geese roosted en masse at one location. One roost (D), 0.25–0.5 km out from the barrier beach on the open sea, was used as a night-time roost by newly arrived migrants, and occasionally as a day-time roost when the main flock was disturbed.

Until mid-November, birds used the tidal marsh as a nocturnal roost more than the sites in the lower harbour (Table VII-8). Later in the season, and when ice did not restrict their options, the choice of sites by undisturbed birds correlated with direction and velocity of wind (Table VII-9). Site A in the lower harbour was used almost every night, unless E and ENE winds of >75 km/h caused extreme turbulence. Then birds sometimes used site B, but more usually (11 of 14 observations) they used the tidal marsh. Coves on the northwest side of the harbour (sites F, G, H, I) were used by small flocks when there were N and NW winds of >50 km/h. The southeast side of the harbour was never used by even small flocks of geese.

On seven occasions when day-time winds were >120 km/h, geese roosted on two inland lakes. Under similar conditions (11 occasions), they flew to the field-foraging site adjacent to the harbour. While there they were inactive, foraging only occasionally and then for only a few minutes duration.

5.4 Movements and Disturbance

Movement usually involved flights between foraging and roosting sites, or between foraging sites. Most geese used two main flight lines between the upper and lower harbour (92% of 492 observations) (Fig. VII-1) and when they crossed the barrier beach to and from the marine roost. Newly arrived migrants sometimes (N = 18 occasions) used other flight lines. These birds sometimes landed in rarely used parts of the harbour, but after only one or two days they joined the main flock.

Geese flew between foraging and roosting sites in groups of 5 to 20 individuals. Frequently birds flew 8 to 10 km from night-time roosts to foraging sites.

Strong winds appeared responsible for birds leaving night-time roosts earlier than usual. On 16 occasions when there were NNE winds of >90 km/h, birds that roosted in the lower harbour left roosts an average of 95 min earlier than in the preceding 7–10 days. Also, on 12 occasions when birds were known to have foraged at night, they roosted at the foraging site throughout the following day.

Undisturbed birds rarely left foraging sites, and little time was spent in flight (Table VII-10). The usual response of foraging geese to the rare disturbances was to fly up or down the harbour to another foraging site and resume foraging (26 of 33 observations). Birds that were disturbed while foraging sometimes (16 of 33 observations) attempted to return to the site of disturbance. The usual pattern was for groups of 5 to 20 birds to begin returning within 20 min of the disruption. Flocks did not resume foraging for >2 h on nine occasions when prolonged disturbance occurred. Flocks that were repeatedly flushed usually flew either to the tidal marsh, or to the offshore roost where foraging was impossible (14 occasions). The only time the marine roost was used in the day-time was when the flock was repeatedly disturbed, and only then did they fly there en masse. When birds were disturbed while roosting they simply flew to another roost, often the marine one, and remained there for 20 min to 2 h in one large flock.

Disturbance sometimes prevented birds from foraging at sites within 50 m of the shore. On seven occasions birds had foraged at sites 7 and 8 for 3 to 5 days prior to disturbance, but they left these sites and did not return for a minimum of seven days after the disturbance.

Table VII-7. Relative occurrence of Canada Geese at night-time roosts in Antigonish Harbour throughout the autumn.

Site	Location	Area(ha)	Year 1975 (32/60)[1]	1978 (29/32)	1986 (40/52)	1987 (30/31)	1988 (28/50)	1991 (41/50)
A	Lower harbour	3	31%[2]	30	33	20	37	23
B	Lower harbour	3	22	20	12	16	21	24
C	Lower harbour	2	14	14	16	16	8	13
D	At sea	3	6	5	12	8	7	7
E	Tidal marsh	2	22	28	18	31	19	27
F/G/H/I	Various[3]	2	5	3	9	9	8	6

[1] Number of survey days/Number of surveys
[2] % of total geese in the harbour at that site
[3] Four aquatic sites in the harbour

Table VII-8. Relative occurrence of Canada Geese at major nocturnal roosts in Antigonish Harbour throughout the autumn.

Date	N[1]	Location Site A	Site B	Site C	Site E
15–30 September	33	8	3	1	21
01–15 October	47	13	5	3	26
16–30 October	44	7	6	2	29
01–15 November	47	11	6	2	28
16–30 November	42	20	7	5	10
11–15 December	28	12	6	4	6

[1] Number of surveys (1975, 78, 86, 87, 88, 91, 93)
Sites A, B, C in lower harbour, site E is tidal marsh (as in Table VII-7)

Table VII-9. Use of specific nocturnal roosts during different wind directions in Antigonish Harbour.

Site	Number of surveys[1] when geese (>=5) present with winds from W, WNW, WSW	with winds from E, ENE
A	68[2]	21
B	27	39
C	12	14
D	8	3
E	29	43
F	11	6
G	6	2
H	7	2
I	14	3

[1] Surveys ($\sum$ = 93) in which all roosts were investigated when wind velocity was 30 km/h or greater (1973, 75, 78, 80, 86–88, 90–93)
[2] Indicates occasions when there were 5 or more roosting geese at that site

Table VII-10. Amount of time spent on versus off[1] foraging sites by Canada Geese during days of no/light[2]/moderate[3] disturbance; 1977, 1982, 1987, 1989, 1991, 1992.

Intensity of Disturbance	No. Days[4]	Hours Observation	Frequency of Disturbance[5]	Hours On Foraging Site	Time in Flight (h)
None	30	236	0	217 (91.9%)[6]	12 (5.1%)[6]
Light	24	189	112	161 (85.2%)	18 (9.5%)
Moderate	13	116	63	73 (62.9%)	17.5 (15.1%)

[1] In flight, on marine roost or on parts of the harbour used rarely and temporarily
[2] Occasional boat traffic
[3] More intense disturbances or of longer duration (not always more disturbance events per day than for "light" days)
[4] Most of daylight hours spent observing main flock
[5] Observations of disturbance
[6] % of hours observed

Table VII-11. Response of Canada Geese to disturbance by humans and Bald Eagles in Antigonish Harbour

Source of Disturbance	No. of Observations	Duration[1](min) Mean	Range
Human	42 (36)[2]	37	8–122
Bald Eagle	78 (67)	12	3–14

[1] Period before birds resumed activity engaged in prior to disturbance
[2] Most or all of flock were foraging

Disturbance was potentially more serious after ice restricted birds to foraging in the lower harbour. In the days immediately after the upper harbour froze in early December, foraging geese that were disrupted flew (19 occasions) to the specific site where they had foraged prior to freezing, and sat there on the ice for 1 to 3 h before returning to the lower harbour.

Prior to 1989 the main source of disturbance was hunters in small boats. Since then, there has been increased disturbance by aboriginal people who fish eels from boats until freeze-up. Birds always flew (32 observations) when boats approached within 500 m. Bald Eagles (*Haliaeetus leucocephalus*) were the only other source of disruption. Flocks always suspended foraging when eagles approached, and all (N = 16) or part (N = 27) of the flock flew when eagles got to within 300 m of them (69 occasions). Geese then did not resume foraging until departing eagles were at least 500 m away from them. Human disturbance resulted in geese suspending the activity they were engaged in prior to disturbance for longer than when eagles disturbed them (Table VII-11).

Geese were more vulnerable to hunting late in the season. Each year, 15–25 birds were shot, >90% (N = 215) in the lower harbour after ice restricted movements of birds. In fact, >75% of the birds were shot in the 10 d preceding the exodus of the main flock from the harbour.

There was no evidence that disturbance seriously affected flock integrity. Group size remained remarkably stable, and few single birds were observed at any time.

6. Discussion

Craighead and Stockstad (1956) and Raveling (1969, 1979) reported that Canada Geese were strongly attached to specific foraging and night-time roosting sites and consistently used the same flight patterns. Raveling (1969) reported this behaviour in family groups, and noted that geese in Illinois avoided strong winds by roosting in sheltered bays, sometimes leaving the water to roost in fields. He also found geese roosting on water closest to the cropland food source being used. Martin and Guignion (1983) reported that geese frequently roosted en masse at one location, and they noted no regular daily movement to foraging sites.

Similar patterns of activity and behaviour occurred during this study. Geese used highly specific foraging sites of relatively restricted area and there was no variation in key foraging and roosting sites through the 21 years. There was a high level of stability within the flock. Raveling (1969, 1979) suggested that consistent use of the same night roost, as occurred in this study, enables separated family members to reunite, limits aggression, and promotes stability within the flock.

Although flock size varied, indicating turnover in the flock, this varied from year to year. In most years a relatively large flock remained until general freeze-up occurred. At least in some years, reduced foraging options, rather than cold temperatures *per se*, appeared to be the impetus for departure late in the season.

Birds spent relatively more time foraging later in the season when they had fewer foraging options available to them and, presumably, higher energy demands. Disturbance early in the season did not disrupt foraging to the extent that it did after ice restricted birds to the lower harbour. When initially disturbed, birds changed their pattern of use of foraging and roosting sites. Disturbance was infrequent and rarely prolonged. However, coastal habitat in northeastern Nova Scotia is important for autumn-staging Canada Geese, and autumn flock size doubled since the 1970s, as Martin and Guignion (1983) reported for geese in P.E.I. Although human disturbance is currently relatively low, foraging options are probably restricted for these birds, making them vulnerable to disturbance and human activity which seem likely to increase along this coast.

Weller and Batt (1988) defined habitat selection as differential use relative to availability. Geese predominantly selected eelgrass stands for foraging, and they used very specific sites within these stands. Few Canada Geese foraged on grassland/pasture in northeastern Nova Scotia, despite its availability and the relative lack of disturbance there. Geese predominantly used traditional aquatic habitat for all of their requirements, and some of these birds may move to and remain in coastal habitat on the Atlantic coast of Nova Scotia when they leave northeastern Nova Scotia in early winter (F. Payne, pers. comm.). This is in contrast to P.E.I., approximately 125 km away, where geese have shifted to extensive use of cropland for foraging, although they still forage and roost in coastal habitat (Martin and Guignion 1983), as has generally occurred throughout the U.S. Atlantic coastal region.

Reed (1976) has suggested that foraging on cropland during spring may result in enhanced reproductive fitness of some goose populations. This may explain the small number of birds during spring in Antigonish and elsewhere in northeastern Nova Scotia, where cropland is less available, and why numbers on Prince Edward Island are 40% higher in spring than in autumn (Martin and Guignion 1983). Spring density and abundance of eelgrass is low in northeastern Nova Scotia.

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8. Literature cited

Bartlett, G.A. 1987. Effects of disturbance and hunting on the behaviour of Canada goose family groups in eastcentral Wisconsin. Journal of Wildlife Management 51: 517–522.

Bélanger, L. and J. Bédard. 1989. Response of staging snow geese to human disturbance. Journal of Wildlife Management 53: 713–719.

Craighead, J.J. and D.S. Stockstad. 1956. Measuring hunting pressure on Canada Geese in the Flathead Valley. Transactions North American Wildlife Conference 21: 210–238.

Korschgen, C.E., L.S. George and W.L. Green. 1985. Disturbance of diving ducks by boaters on a migrational staging area. Wildlife Society Bulletin 13: 290–296.

Martin, K. and D. Guignion. 1983. Canada goose numbers, daily movements and foraging patterns on Prince Edward Island. Proceeding Nova Scotia Institute of Science 33: 107–114.

Raveling, D.G. 1969. Roost sites and flight patterns of Canada geese in winter. Journal of Wildlife Management 33: 319–330.

Raveling, D.G. 1979. Traditional use of migration and winter roost sites by Canada geese. Journal of Wildlife Management 43: 229–235.

Reed, A. 1976. Geese, nutrition and farmland. Wildfowl 27: 153–156.

Weller, M.W. and B.D.J. Batt. 1988. Waterfowl in Winter: Past, Present, and Future. Pages 3–8 *in* Waterfowl in Winter. *Edited by* M.W. Weller. University of Minnesota Press, Minneapolis.

Zicus, M.C. 1981. Flock behaviour and vulnerability to hunting of Canada geese nesting at Crex Meadows, Wisconsin. Journal of Wildlife Management 45: 830–841.

VIII. CANADA GOOSE STAGING ALONG NORTHUMBERLAND STRAIT IN NOVA SCOTIA AND NEW BRUNSWICK

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1. Abstract

Staging by Canada Geese along the south shore of Northumberland Strait (45°40'–46°20'N, 62°20'–64°20'W) in Nova Scotia and southeast New Brunswick involves only a few thousands and never over 10 000 birds, far fewer than stop off on Prince Edward Island. The largest numbers in fall (1000–2000) occur at Tatamagouche Bay and Wallace/Fox Harbours, and flocks of 100 or more stop annually on many bays and coastal marshes with nearby fields from Merigomish, N.S., to Baie Verte, N.B.. Spring occurrence is less regular and involves much smaller numbers (<1000 on any survey). Total numbers using this area have not changed obviously over the last 30 years, when numbers in P.E.I. increased greatly. Owing to the smaller agricultural areas and the lesser numbers of geese using them, local hunting pressure is less than in P.E.I., but geese leave both sides of the Strait promptly once ice and snow cover begin to encroach on foraging areas in early December.

2. Introduction

The most detailed accounts of geese using the south shores of Northumberland Strait were published in earlier times when spring hunting of waterfowl was still legal (e.g. Pattillo 1903). Brant (*Branta bernicla*), then much more numerous than recently (compare Erskine 1988), were the principal quarry of hunters, but Canada Geese were also present in numbers at Wallace Harbour and elsewhere. On this low coast, the flocks often fed and rested in shallow waters far out from shore, so they often were less conspicuous than in some other parts of the Maritimes where numbers were no larger. There is no convincing evidence of changes in overall numbers during the last 30 years. This chapter summarizes the scattered information on Canada Geese on the north shore of Nova Scotia and adjacent parts of southeastern New Brunswick.

3. Sources

Data on Canada Geese were obtained from computerized aerial survey data in CWS files, from aerial and ground survey data in Nova Scotia Wildlife Division files (NSW), and from my personal files (AJE), with a few records from *Nova Scotia Birds* (formerly *N.S. Bird Society Newsletter*). Coverage varied in extent and timing in all kinds of surveys, and usually was sporadic and incomplete.

4. Results

4.1 Fall

Occasionally small groups of geese were seen in late August or early September. Possibly some of these were derived from Maritimes breeding stocks, originally of captive or introduced birds (see Chapter XVI, this volume), rather than all being migrants from the north. Larger flocks were occasionally seen in late September, e.g. 150 at River John 29 September 1960 (AJE); 350 at Tatamagouche Bay 16 September 1970 (CWS). Geese were still infrequent in early October, and first became regular around mid-October in most years (Table VIII-1). Peak numbers were noted in mid-November, e.g. 5271 on an aerial survey from Shediac, N.B., to Merigomish, N.S. (Fig. VIII-1), 17 November 1972 (CWS), compared with October peaks of 2164 Shediac to Merigomish 16 October 1969, and 2840 19 October 1989 (NSW). Numbers sometimes changed rapidly with the arrival of migrants, for example over 1800 geese were seen in two compact flocks on Wallace Harbour 19 October 1984 (AJE). Goose numbers seemed not to have increased here in recent decades, when major increases in fall staging populations were noted in Prince Edward Island (Martin and Guignon 1983).

Departures usually occurred in early to mid-December; for example, over 1500 geese were counted between Northport and Tatamagouche, N.S., 9 December 1960 (C.O. Bartlett, CWS, pers. comm.), but all bays there were frozen and the geese had departed by 14 December (AJE). In some years, geese remained later, with 1566 seen Northport to River John on 24 December 1969 (NSW). Freeze-up begins in December at much the same time as on Prince Edward Island, and the geese that staged in P.E.I. cross the Strait as they continue southward. A substantial exodus from the Island in 1984 occurred 15 December, when flocks totalling at least 1370 geese were seen flying southwest across the Cape Tormentine peninsula all through the day (Christmas Bird Count data).

4.2 Winter

No Canada Geese occurred regularly in winter, without human assistance, along the southern shores of Northumberland Strait. Starting in 1988-89, a flock of 200 to 300 stayed along East River at Trenton, N.S. (NSB), on water kept open by effluent from a new thermal power station (M. Pulsifer, NSW, pers. comm.), perhaps also encouraged by food provided by people.

4.3 Spring

The spring migration usually began in the last week of March, when snow and ice began to clear from the fields and shores of the Strait. Geese were then seen flying north over Sackville, N.B., towards the Strait or P.E.I. (e.g. 26 March 1982, 250; 31 March 1986, 140), but few observations were reported from Northumberland Strait before April. Aerial surveys showed 8 Canada Geese near

Table VIII-1. Summary of Canada Goose data from autumn surveys along Northumberland Strait shores of Nova Scotia and New Brunswick, all years 1960–89 combined. Number of surveys in parentheses (not all areas were covered every time).

Period		No. of geese seen in area (1)	(2)	(3)	(4)	(5)[1]
(a) CWS and NSW (marked*) aerial surveys						
01–15 October		–	–	–	–	–
16–31 October		335(5)	144(2)	380(2)	4(1)	95(1)
	*	–	215(2)	272(2)	752(2)	78(2)
01–15 November		407(3)	370(1)	858(1)	2076(1)	–
16–30 November		665(7)	397(5)	755(5)	1626(5)	275(5)
	*	–	260(1)	665(1)	1513(1)	400(1)
01–24 December	*	–	340(2)	362(2)	814(2)	–
(b) AJE and NSW (marked*) ground surveys						
01–15 October		200(1)	0	150(1)	340(2)	0
	*	–	0	690(1)	575(1)	0
16–31 October		100(1)	365(1)	1925(1)	0	0
	*	–	400(1)	1460(1)	980(1)	88(1)
01–15 November		0	282(4)	220(1)	0	0
	*	–	–	–	–	195(4)
16–30 November		330(2)	350(1)	235(1)	50(1)	–
	*	–	–	–	–	227(3)
01–15 December		300(1)	111(3)	145(5)	100(2)	–

[1] Key to areas surveyed (1) Baie Verte – Cape Jourimain, N.B.
(2) Northport – Pugwash, N.S.
(3) Wallace Harbour – Fox Harbour, N.S.
(4) Malagash – River John, N.S.
(5) Caribou Harbour – Merigomish, N.S.

Cape Tormentine, N.B., 24 March 1969, and 240 near Baie Verte and Cape Tormentine, N.B., 31 March 1970 (CWS). Probably most geese overfly the area in spring. Some move early, directly to Prince Edward Island where open water may be more often available early in the season. Others staged in the upper Bay of Fundy (compare C, Chapters XI-XIV, this volume), and move north later in April and in May. The highest counts along the south shore of Northumberland Strait were on the few aerial surveys at that season, all in mid-April, e.g. 843 at Baie Verte, N.B. to Merigomish, N.S., 19 April 1973 (CWS). Largest numbers staged at Baie Verte, N.B., Linden to Port Philip, N.S., and near Wallace, N.S., but no really large groups were noted; repeated aerial surveys at Baie Verte in 1970 peaked at 632 birds on 20 April (CWS). The rather sparse data gave no suggestion of increased numbers in recent years. By the end of April all but occasional stragglers had moved away.

4.4 Habitats and feeding

Along the south shore of Northumberland Strait, geese were seen mainly on the shallow waters of bays and harbours, often far out from shore. Fields, usually within sight of salt water, seemed to be used rather infrequently, even in spring or before the fall hunting season, compared to such use in P.E.I. (Martin and Guignon 1983). Geese used fields chiefly for roosting during daylight hours, e.g. 300 resting on a field west of Port Philip, N.S., in late morning 25 April 1992 (AJE). During April, little new growth was evident in most fields in most years, so feeding presumably was mainly in aquatic habitats. No studies focussed on feeding have been made there.

5. Discussion

This area was of minor significance for migrating Canada Geese compared to nearby Prince Edward Island. It was generally similar in habitat, land-uses, and human population density to P.E.I., and seasonal phenology also was comparable to that on the Island. Thus, geese would gain little obvious benefit by staging south of the Strait rather than in P.E.I. where the areas of suitable habitat were larger and the interdigitation of agricultural fields and shallow inlets more extensive than on the mainland. The accessibility of geese along Northumberland Strait in late October and November, when little goose hunting opportunity exists in the Atlantic coast staging areas, makes this area attractive to Nova Scotia hunters unable or unwilling to travel outside the province. The occurrence of goose flocks here is not sufficiently predictable to attract mainland bird-watchers from any distance, as the Atlantic

coast flocks are readily viewed throughout their seasonal occurrence.

6. Literature cited

Erskine, A.J. 1988. The changing patterns of Brant migration in eastern North America. J. Field Ornithol. 59: 110–119.

Martin, K., Guignon, D. 1983. Canada Goose numbers, daily movements and foraging patterns on Prince Edward Island. Proc. N.S. Inst. Sci., 33: 107–114.

Pattillo, T.R. 1903. Moose-hunting, salmon-fishing and other sketches of sport; being the record of personal experiences of hunting wild game in Canada. William Briggs, Toronto. [see Chapt. XI, pp. 175–228].

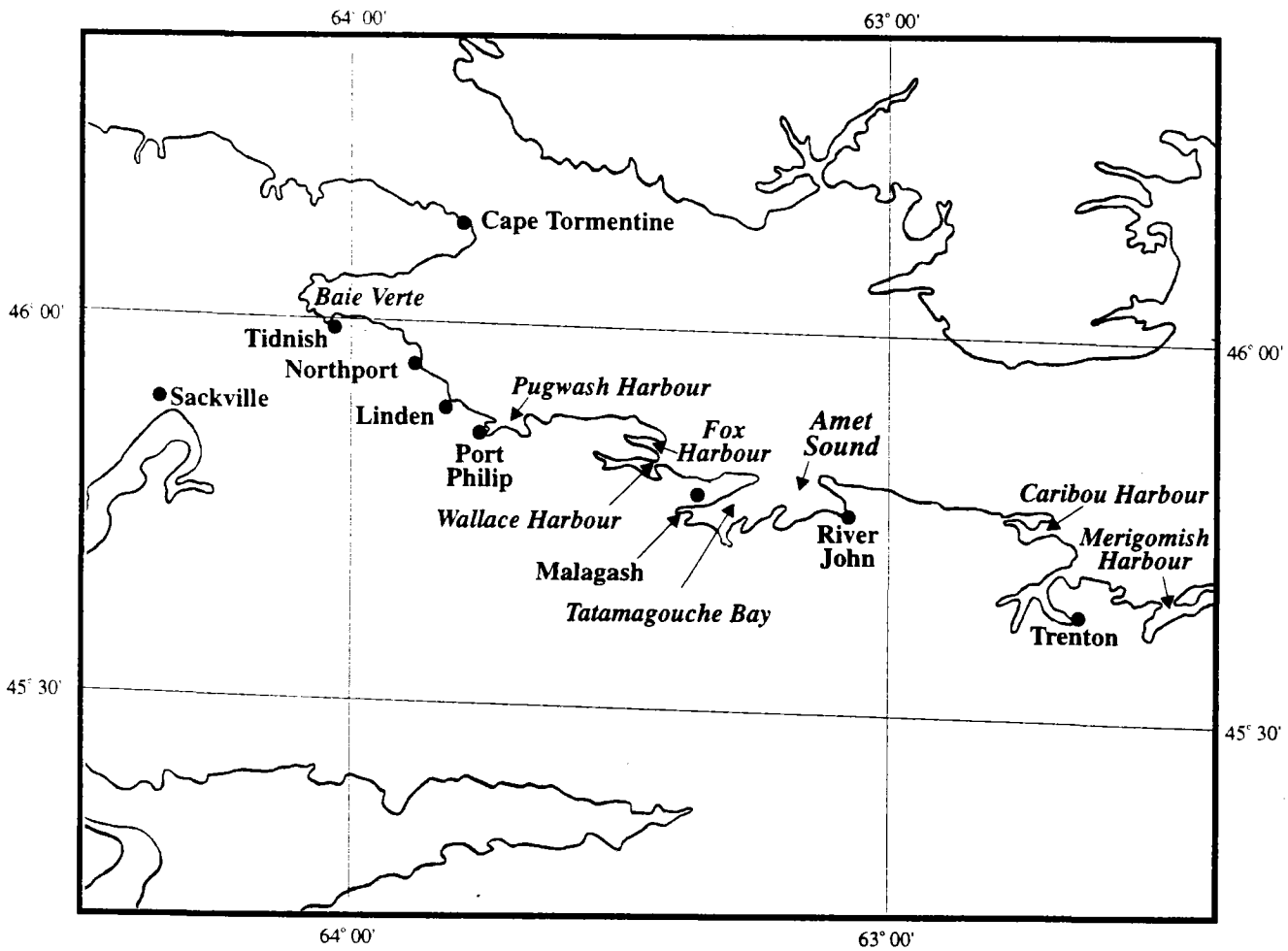

Figure VIII-1 Northumberland Strait, northern Nova Scotia and southeastern New Brunswick, showing Canada Goose staging areas.

IX. CANADA GEESE IN PRINCE EDWARD ISLAND

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1. Abstract

On Prince Edward Island are found the largest continuous farmland areas in the Maritimes, and also the largest numbers of staging Canada Geese. Nearly all the farmland in P.E.I. lies within 20 km of tidal waters. Peak goose numbers in both spring and fall exceed 30 000 at one time, and probably two to three times as many pass through in a migration, comprising two-thirds of all geese found in the Maritimes. Goose numbers during the migrations increased up to about 1977 and then stabilized. Very few geese over-wintered in P.E.I. earlier, but since 1987 several hundreds have lingered into early January. The increasing numbers at all seasons may reflect both changing land-use and climatic warming. Snow- and ice-cover now develop later in fall and clear earlier in the spring than was usual before 1970, and geese since then appeared earlier in spring as well as in greater numbers. Larger field-size recently allowed foraging inland more safely, and this occurs regularly, but most geese on both spring and fall surveys still frequented the shallow waters of bays and estuaries.

2. Introduction

The general introduction to the goose situation in the southern Gulf of St. Lawrence (B, this volume) applies to Prince Edward Island as well as the nearby coasts of northern Nova Scotia and eastern New Brunswick. Of these, P.E.I. is now by far the most important area to Canada Geese, accommodating at least two-thirds of those birds that stage in the Maritime Provinces each spring and fall. The island province includes the largest and most continuous agricultural areas in the Maritimes, most of which lie close to the shores of shallow bays and estuaries, thus satisfying most habitat requirements for migrating geese. The only previously published studies of Canada Geese and goose hunting in the Maritime Provinces were conducted in the Dunk River and Wilmot River watersheds east of Summerside, P.E.I., in 1974 to 1976 (Martin & Guignon 1983a,b).

3. Study area

Elsewhere in the Maritime Provinces, only localized areas provide favourable conditions for staging Canada Geese, which otherwise are seen mainly in flight between suitable areas. In contrast, geese occurred in almost all the larger bays and estuaries around the coasts of Prince Edward Island. The only extensive and consistently unused areas were the unbroken and often cliffy coastlines in the northwest (West Point around North Point to Kildare Capes), northeast (St. Peters Bay to East Point), and southeast (Murray Harbour to Pinette River) (Fig. IX-1). Because of the extent of potential goose habitat, aerial surveys extending over most or all suitable areas were the only source that provided adequate perspective on the migrations, and the area treated in this chapter thus comprised about two-thirds of the Island.

Most of the area (see Fig. B-1) is underlain by Permian sandstone, eroded to produce moderately fertile sandy loam soils inland and sand to sandy mud shores in the inlets. Most farmlands lie within 20 km of a coastline, many much closer, and the most extensive farming areas are in the central part of the island, between Summerside, Borden, Charlottetown, and the Prince Edward Island National Park. Peatlands are extensive only northwest from Summerside, reaching the coast east of Cascumpec Bay.

The western part of the north coast includes the vast shallow expanses of Cascumpec and Malpeque Bays, separated from the Gulf of St. Lawrence by a 50-km chain of sand-dune islands. Elsewhere, the inlets are smaller, more in the nature of drowned river-valleys. Barrier beaches partly close the mouths of the north shore inlets from New London Bay to St. Peter's Bay, but many bays on the east and south shores are open to the sea. The south shore areas frequented by geese divide naturally into three adjoining groups:

(a) the rolling farmlands and the Charlottetown urbanization around Hillsborough Bay and Hillsborough River,
(b) the flatter and more open farming country from Argyle Shore to Summerside, and
(c) the low shore of sand flats and salt-marsh backing on less fertile farmlands around Egmont Bay.

4. Sources

The CWS computerized aerial survey files, comprising mainly surveys by P.E.I. Fish & Wildlife Division with a smaller number by CWS, mostly in 1960 to 1979 with a few later, were the main source. Data from earlier midwinter aerial surveys were available only as totals rather than broken down by sector or survey block, and only total numbers were on file also for aerial surveys in May. Usually, very few geese were present at those seasons, so we made no effort to search farther for more detail. The files of sightings of Canada Geese marked with neck-collars (Chapter XVII, this volume) provided estimates of numbers of geese present in the vicinity at the times of sightings (1987–93). The newsletters of the P.E.I. Natural History Society, later called *Island Naturalist*, in 1977 to

1992, included many records of Canada Geese, and personal files of C. Ellingwood and A.J. Erskine added a few more. Some earlier perspective was obtained from unpublished reports by Harold S. Peters, of U.S. Fish and Wildlife Service, in 1939 to 1946 (copies in CWS files), and from observations summarized by Godfrey (1954).

5. Results

5.1 Fall

Detection of early fall arrivals was obscured by the presence of feral Canada Geese breeding around the introduced but free-flying flocks at Moore's Sanctuary (Milltown Cross) and P.E.I. Wildlife Park (North Rustico), which probably totalled 400–500 birds in late summer (Chapter XVI, this volume). Most reports in late August and September involved fewer than 100 geese that may all have been local breeders and their offspring. In 1983, 500 geese were reported near Orwell, a major staging area, on 4 and 11 September, but widespread reports and flocks totalling in the hundreds usually did not appear until later, e.g. 350 off Tryon 3 October 1981, 1700 at Lake Verde 17 September 1990, 2500 off Hog Island in Malpeque Bay 29 September 1984.

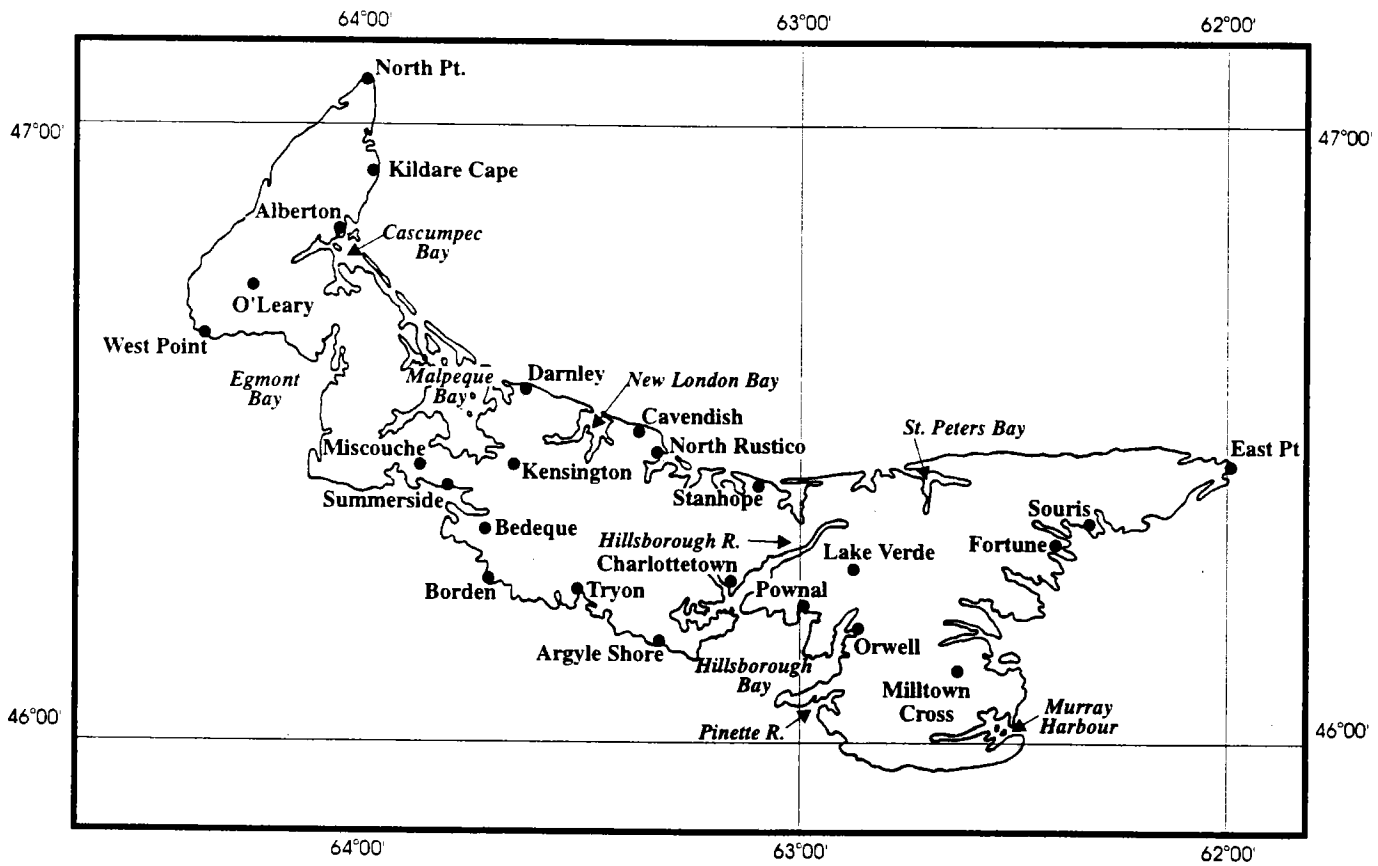

Figure IX-1 Prince Edward Island, to locate areas with Canada Goose staging and surveys.

Aerial surveys in late September (Table IX-1(a)) found 403 (1965) to 1625 (1966) geese, but the birds then were less widely distributed than later, with most birds on each survey seen in only two or three survey blocks, e.g. 86% of the total in 1966 were at Pownal–Orwell and at New London Bay, whereas the latter area had none in 1965. Geese became more numerous and widespread during October, with surveys in 1966 to 1972 (Table IX-1(b)) noting totals of 4444 to 7608 birds. Numbers in October 1965, as in September, were much lower (1181 geese) than in later years, perhaps reflecting poor reproduction or a late migration. The late October survey in 1987 gave totals more comparable to those obtained in November, perhaps indicating an early movement that year. Repeated ground surveys (for neck-collared geese) in the Souris–Rollo Bay area in 1992 suggested stable numbers there from late October until departure began late in November (Table IX-2).

November surveys provided the most continuous series (16 years; Table IX-1(c)), with two counts each in 1973 and 1976. Numbers generally increased up until 1977 and then stabilized. Counts after 25 November (in 1967 and 1973) were well below the trend line, with numbers on 27 November 1973 far fewer than ten days earlier (2239 vs. 8492 geese). Conversely, in 1976 the numbers increased through late November, the 1 December count that year (26 005) being the largest in fall up to that time.

Geese continued onward from the Island's staging areas through the fall, as shown by flocks seen migrating through northern Nova Scotia and southern New Brunswick (Chapters VIII, XII, XIII, XV, this volume). Major departures began in late November in some years (Table IX-2; H.S. Peters, unpubl. rpt. 1944; see also 1967 and 1973 above), but more usually occurred in December. The only aerial surveys in mid-December (16th in 1969, 15th in 1987) found over 4000 and nearly 9000 geese, respectively, both down from at least twice those numbers a month earlier. The Christmas Bird Counts (CBCs) often found geese in late December. Few CBCs had more than 100 geese until 1987, but counts since then often totalled several hundreds. By early January in most years nearly all geese had moved away from Prince Edward Island.

5.2 Winter

The midwinter waterfowl inventories (MWIs), conducted usually in early to mid-January (data available for 24 years, 1951–87), confirmed that very few geese wintered in P.E.I. in most years. Only nine MWIs showed more than 50 geese, and only in 1953 to 1955 were over 200 reported, with the maximum of 1,657 geese in January 1955. In contrast to the situation in fall, the most frequent and largest numbers in winter were in the east coast inlets, especially at Rollo Bay and Fortune near Souris (Godfrey 1954).

5.3 Spring

The PEINHS records showed first arrivals during early to mid-March in all years with data published from 1978 to 1992, similar to the pattern found in 1974 (Martin and Guignon 1983a). First reports of over 200 geese were usually 25 March to 5 April, but larger numbers appeared earlier recently. Over 2500 geese were seen near Orwell 17 March 1985, 2000 near Tryon 22 March 1991, and 10000 at Wilmot River 21 March 1991. In recent years, upwards of 20 000 geese usually had reached the Island by the end of March (W.R. Barrow, CWS, pers. comm.). Anecdotal reports suggested that arrivals were later in the past, when snow and ice covered the fields and marshes well into April; for example, in 1966, the earliest spring of that decade, there was extensive ice and snow in marshes along the south shore of P.E.I. on 14 April (AJE, pers. obs.) when goose flocks were still passing over from the southwest.

Peak numbers occurred during April, when data were available from only five complete aerial surveys (Table IX-3). The increase on the 1983 survey was especially prominent in the northwest and south-central sectors, with fewer along the Hillsborough River. However, the 1988 and 1989 surveys gave sector totals more similar to those in 1974 except for the increase in the eastern sector. Overland transects during the 1983 survey found no substantial numbers of geese more than one kilometre from the water, although geese were commonly seen on large fields closer to the shores. This contrasted with the use of stubble fields well inland, in both spring and fall, reported by Martin and Guignon (1983a), and with the widespread use of harvested fields inland by both geese and goose hunters in fall. In 1992, mass pre-departure staging of Canada Geese occurred near Freetown east of Kensington, where over 20 000 geese assembled in an area of ca. 2 square km. on 24 April; only about 2 000 were found there 28 April (W.R. Barrow, pers. comm.).

Goose numbers decreased rapidly after late April, with few recent reports exceeding 300 birds after the first week of May, compared to 675 near Summerside 3 May 1990, 1500 near Malpeque 2 May 1991, 2000 at Hamilton (N of Kensington) 5 May 1992, 900 at Cape Traverse (E of Borden) 3 May 1993. Evidently geese sometimes stayed later in the past. Peters (unpubl. rpts.) noted 400–1500 at Dunk River on 9 to 12 May each year in 1941 to 1944. An aerial waterfowl survey 4–6 May in 1957, a very cold spring when 25 cm snow fell 2–3 May, noted 12 962 geese, which departed soon afterwards. In 1955 also, 1860 geese were found on an aerial survey around 5 May. Spring aerial surveys in nine other years were after mid-May, and noted

Table IX-1. Canada Goose numbers on fall aerial surveys in Prince Edward Island, 1953–92, data for coastal survey blocks summarized into major "sectors" (see footnote).

Year-date	Number of geese in sector[1]						
	NW	NC	E	SCE	SCW	SW	TOTAL
(a) September surveys							
1965-29	15	3	0	350	35	0	403
1966-29	75	700	0	850	0	0	1625
1970-17	89	314	0	502	88	156	1149
1974-23	55	0	0	978	222	90	1345
(b) October surveys							
1953-9	69	185	0	183			437
1965-14	531	75	0	500	0	75	1181
1966-18	1675	2935	25	1000	444	450	6604
1967-27	1449	1607	80	755		553	4444
1968-28	3267	725	45		679	745	5461
1969-16		(2886)[2]			(2318)[2]		5204
1970-21	2017	1494	109	1796	1314	733	7463
1972-10	2418	1938		2518	350	384	7608
1987-27	6933	3004	3456	3763	6383	2797	26 336
(c) November surveys							
1967-27	996	841	105	685	140	415	3182
1969-19	2065	1301	250	1775	1801	1030	8737
1970-18	3131	2115	276	1911	2346	841	10 620
1971-19	1572	843	125	519	301	246	3506
1972-19	4268	1114	180	1201	1077	1059	9014
1973-17	4065	841	318	1543	1278	222	8492
1973-27	688	696			790	65	2239
1975-18	4881	2295	0		2060	460	9721
1976-17	4065	841	80	1740	1351	222	8299
1976-19	4268	1106	95	1316	1077	1053	8915
1977-23	5342	1889	167	3903	2792	1037	15 130
1978-21	5600	2842	1145	2673	2640	2541	17 411
1979-20	5647	2172	1417	4290	2091	2568	18 260
1982-19	4791	2219	3358	3852	1951	2243	18 414
1987-15	3333	1796	3684	3008	3590	1783	17 296
1988-24	5223	1526	2336	2955	3857	1466	17 066
1990-15	3422	1811	495	2313	1404	761	10 206
1992-10	3074	1755	2731	1943	4017	1600	15 120
(d) December surveys							
1969-16		(825)[2]			(3300)[2]		4125
1976- 1	9989	2980	789	5351	5855	1091	26 005
1987-15	3645	1159	893	573	1437	1145	8852

[1]Key to sectors (survey block numbers in parentheses):
NW - Alberton to Darnley (blocks 382–385);
NC - New London to St. Peter's bays (386–390);
E - East Point to Murray Harbour (395–404);
SCE - Pinette River to Charlottetown (406–410);
SCW - Charlottetown to Summerside (411–413);
SW - Miscouche to West Point (414–416).

Note: a. Totals included a few records in other coastal blocks where geese were noted too seldom to warrant tabulation.
b. "0" entries mean no geese seen on survey; blank means that sector not surveyed.

[2] Numbers available only as totals for north and south (the latter including east) shores.

Table IX-2. Canada Geese seen near Souris and Rollo Bay during neck-collar surveys, fall 1992.

Date	Number of geese Rollo Bay	Souris	Total
22 October	2500	n.d.[1]	2500+
26 October	2000	n.d.	2000+
28 October	1800	n.d.	1800+
03 November	2000	350	2350
09 November	2000	n.d.	2000+
16 November	800	n.d.	800+
19 November	1200	1000	2200
24 November	n.d.	600	600+
27 November	1000	500	1500
01 December	220	1000	1220
07 December	n.d.	450	450+
09 December	n.d.	550	550+

[1] n.d. = no data.

Table IX-3. Canada Goose numbers on April aerial surveys in Prince Edward Island, 1960–83, data for coastal survey blocks summarized into major "sectors" (see footnote to Table IX-1).

Year	– date	Number of geese in sector[1] NW	NC	E	SCE	SCW	SW	Total
1960	– 20–22	1494	1886	210	5981	5090	310	14 996
1974	– 18	6577	1809	1861	5383	6717	109	22 436
1983	– 19–21	14 851	472	0	1750	13 927	1133	32 128
1988	– 14	6415	1317	3844	3150	7758	910	23 740
1989	– 14	9111	2044	3344	4453	5613	287	24 852

[1] See Table IX-1.

fewer than 60 geese in any year, probably mostly local breeding birds.

6. Discussion

Prince Edward Island differs from most other areas used by geese in the Maritimes in its greater area and more continuous extent of suitable (farmland) habitat. Elsewhere, geese are found regularly in only a few areas in each region, and are noteworthy anywhere else unless seen in flight. Estimates by bird-watchers provided useful indices to seasonal and annual variations in numbers in many other parts of the Maritimes. In P.E.I., geese occurred so widely that only the first appearances in migration were reported systematically by volunteer observers who each covered only a small part of the potential habitat. Also, many geese used areas far out from shore or near shores not easily reached by roads. Thus, the aerial surveys covering most or all goose concentration areas on the Island provided the most useful indices to numbers there over time.

The fall aerial surveys suggested that goose numbers increased substantially from the 1960s up to about 1977. Only the mid-November surveys (and the midwinter counts, which found few geese) were continued regularly in later years, and those suggested no major change after 1977. Martin and Guignon (1983a) studied goose staging in the Dunk and Wilmot Rivers area east of Summerside in 1974 and 1975 when numbers were still increasing. They concluded that changes in farming practices, particularly larger field sizes, were making inland farms more attractive to geese than formerly. Extensive dumping on fields of potatoes surplus to marketing board quotas also increased the available food there (W.R. Barrow, CWS, pers. comm.). A tradition of field-feeding in Prince Edward Island probably took several years to develop, and this would not have begun until geese settling inland in spring were no longer disturbed by illegal hunting, which may have persisted locally until after World War II.

The spring surveys also suggested an upward trend in staging geese since 1960, but too few complete surveys were available to indicate when the increase occurred. The spring trend also may have been linked to climatic warming, which allowed geese to occupy P.E.I. staging areas earlier and in larger numbers than was possible in the 1960s, when geese stopped off on the Saint

John River and around the upper Bay of Fundy for longer periods (see Chapters XII–XIII and XV, this volume).

The larger numbers of geese staying in P.E.I. into January since 1987 probably reflected delayed onset of ice cover then, another result of climatic warming. It is too early to conclude that a wintering tradition has been established, as few sightings were reported after mid-January.

The larger overall numbers after the mid-1970s involved increased numbers in two sectors where geese were scarce earlier, on the east coast and in the southwest (Table IX-1(c)). Those sectors also were the last to be occupied during the fall migration (compare Table IX-1(a),(b),(c)). This suggests that those sectors offered less desirable habitat than the areas occupied earlier, and that the other sectors were nearing their maximum carrying capacity. Increased use in the east was correlated in time with the creation of a wildlife management area (closed to hunting) at Rollo Bay in 1978, so the availability of undisturbed rest areas may have been a limiting factor earlier (compare wintering areas in Nova Scotia).

If P.E.I. staging habitats were among the best in the Atlantic Flyway, we would predict that numbers should increase there throughout the fall, peaking in early winter just before the geese were driven away by increasing snow- and ice-cover. Under that scenario, the latest fall count should provide the best index to numbers passing through the region. The three surveys in 1976 lent some support to that hypothesis, but the continued passage of geese onward from P.E.I. through the fall in most years argued against it. An alternate hypothesis seems more plausible, that P.E.I. goose habitat is good compared to that elsewhere in the Maritimes but no better than, if as good as, much habitat farther south along the Flyway. In that case, peak numbers would give a much less accurate index to total population size, owing to continuing but variable turnover in the numbers present in P.E.I. Prince Edward Island harbours more geese during the migrations than all other areas in the Maritimes combined, but we can only make informed guesses as to the total numbers involved.

7. Literature cited

Godfrey, W.E. 1954. Birds of Prince Edward Island. Nat. Mus. Canada Bull., 132: 155–213.

Martin, K., Guignon, D. 1983a. Canada Goose numbers, daily movements and foraging patterns on Prince Edward Island. Proc. N.S. Inst. Sci., 33: 107–114.

Martin, K., Guignon, D. 1983b. Canada Goose hunter profile, success and expenses on Prince Edward Island. Proc. N.S. Inst. Sci., 33: 137–144.

X. STAGING OF CANADA GEESE ALONG THE EAST AND NORTH COASTS OF NEW BRUNSWICK

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1. Abstract

Canada Geese paused in migration along the coasts of northeastern New Brunswick, numbers there in fall far exceeding those in spring. The main areas of fall concentrations included coastal lagoons from Tabusintac to Kouchibouguac on the east coast, plus the Bathurst area, each holding 3000–5000 geese during November and early December. Peak spring numbers were less than 1000 birds. Feeding was mostly in shallow waters of bays and lagoons, presumably on eelgrass, with some minor use of fields near Bathurst in fall.

2. Introduction

Eastern New Brunswick (Fig. X-1) shares its geological history and climatic regime with the southern shores of the Gulf of St. Lawrence, for which the general introduction (C, this volume) also applies. It stands apart from other areas in the Maritimes frequented by geese most distinctively in cultural ways, including the persistence of an illegal "spring shoot" of waterfowl, long after similar traditions had ended elsewhere. This, combined with the unproductive nature of farmlands backing on the coastal lagoons, may have reduced spring use of the area by geese. The region being settled largely by French-speaking people, among whom watching birds other than while hunting is a very recent form of recreation, resulted in few observations having been recorded before the 1980s. In total, we know little more than the bare patterns in goose use in northeastern New Brunswick.

3. Study area

The east coast of New Brunswick is included in the "sedimentary triangle" that dominates the geology of that part of the province. Underlain by sandstones of Carboniferous age, the land is low-lying, sloping upwards very gradually inland, with vast lagoons bounded by sandspits offshore. Peatlands, presumably formed when fresh water was impounded inland soon after the Wisconsin (glacial) ice-sheets receded, cover large areas. They extend out to the coast from Kouchibouguac to Point Escuminac, and especially from Tabusintac north along the mainland and Shippegan (Lameque) and Miscou islands, with breaks for sand beaches, to the northeast tip of the province. The huge saltwater lagoons at Kouchibouguac, Neguac, Tabusintac, and Inkerman are the major goose areas, with eelgrass growing profusely in sheltered waters behind the long sand beaches.

Although farther north, the spring break-up of sea-ice here averages little later than around the north shores of Prince Edward Island. Of the rivers discharging on the eastern New Brunswick coast, only the Miramichi system is large enough to contribute sufficient fresh water to affect sea-ice cover appreciably. Similarly, freezing of the coastal marshes in fall occurs on a schedule resembling that in Prince Edward Island, with late November to early December the usual time for the start of continuing snow cover.

The southern shore of the Baie des Chaleurs differs from eastern New Brunswick in its nearly unbroken coastline, although also underlain largely by sedimentary rocks nearly to the head of the bay. The estuaries of the Nepisiguit and Tetagouche rivers at Bathurst, with adjoining farmlands, 60 km west from the Tracadie shore, provide the only important goose habitat on the north shore of New Brunswick. Data from that area were too sparse to warrant a separate chapter, and thus are included here.

4. Sources

Little information on this region had accumulated in any form, with the CWS aerial survey files providing the most comprehensive coverage. Distribution files at the New Brunswick Museum, only partly summarized by Squires (1952, 1976) and in pages of *Nature News* and *N.B. Naturalist*, provided records scattered over the entire coast and over 100 years in time. H.S. Peters (of U.S. Fish & Wildlife Service) summarized anecdotal evidence from long-time residents around Tabusintac in 1938 to 1946 (unpubl. rpts. in CWS files). The avifaunal surveys of Kouchibouguac National Park (Tull 1974) provided localized details for 1973. Reports of waterfowl banding crews at Bathurst Harbour (1986–92) provided the most extensive data for that area.

5. Results

5.1 Fall migration

Wishart (quoted by Peters, MSS) reported that first arrivals of Canada Geese at Tabusintac up to 1938 were usually in late September. More recent data (7-yr mean arrival 1965–78 was 23 September) agreed with that schedule, but the Museum files suggested that arrivals were earlier in the past (4-yr mean 1885–90 was 12 September). The earliest recorded dates (excluded from above means) were 15 August 1890 and 31 August 1975,

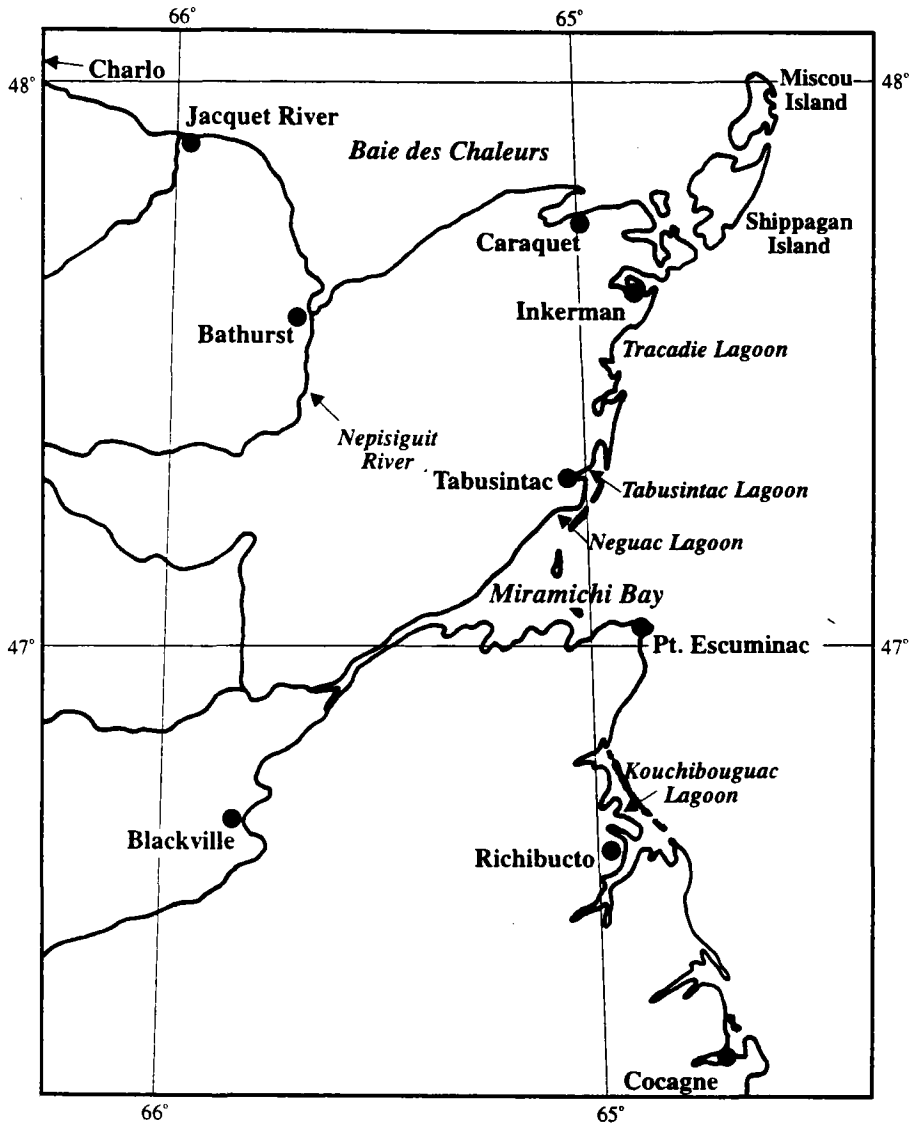

Figure X-1 Northeastern New Brunswick, to locate areas with Canada Goose staging and surveys.

both at Miscou Island; a few geese were seen on surveys in the first week of September in various years, and the absence of records before October in many years probably reflected a lack of reporting. Four aerial surveys (Shediac to Tracadie or Miscou) on dates between 8 and 18 September in 1965 to 1970 found only 14 to 54 geese on the entire coast, but two of three aerial surveys on 27 to 30 September (Table X-1) showed over 600 birds, as was usual in early October.

Thereafter, numbers increased gradually to peaks of 3000 to 4000 geese by early to mid-November, on the east coast. The few aerial surveys from the same period (1966–75) that included the Bathurst area showed an additional 1000–1200 birds in November, but recent (1988–92) ground counts there consistently reported 300–500 geese by 20 September, and 3000–5000 during October (Table X-2), indicating a marked increase. Wishart's peak figure of 6000 at Tabusintac in 1927 (Peters MS) was not approached again until the 1960s, recent high figures including several thousands 11–13 November 1961, 6000 geese 13 December 1969, 5810 17 October 1987, and 5000 geese, 15 October 1991.

Latest departures reported in the past ranged between late November and late December, and similar dates still apply. The two aerial surveys in December (Table X-1) found over 1000 geese each, substantially fewer than on late November surveys in the same period, and ground observations also showed large flocks up to 20 December in some years. Usually all geese were gone before the Christmas Bird Counts (CBCs, starting ca. 17 December). The Kouchibouguac CBCs noted 1217 and 2000, respectively, in 1981 and 1984, but all these left soon afterwards. The latest sizable flock was 120 near Shediac 9 January 1983.

Visible migration was documented mainly inland near Blackville in 1969 and 1970. Fifteen flocks for which flight directions were noted included six (totalling 1011 birds) headed west, seven (total 443) headed southwest, and two (total 256) headed south-southwest or south. Geese also were seen leaving Bathurst southeastward (i.e. towards Tabusintac) 13 December 1969.

No directed studies of habitat use or feeding have been made. Most feeding geese were seen in the shallow waters of bays and lagoons, which suggested that eelgrass was the main food. The only use of fields reported was near Bathurst, in part because hunting often precluded such use elsewhere.

5.2 Spring migration

At Tabusintac, Wishart (Peters MS) reported passage of geese from early April to early May. Peters quoted first sightings on 13, 8, and 1 April, with a few still present 20–21 May, in 1943 to 1945. Early records in N.B. Museum files showed a 30-yr mean arrival (1884–1920) of 23 March, considerably earlier than the recent 10-yr mean (1965–78) of 5 April. Few large numbers of Canada Geese were reported in spring, no ground counts exceeding the 208 at Charlo bar 25 April 1971. Three aerial surveys in April (20th in 1970 & 1974, 15–16th in 1975) noted totals of 381, 689, and 438 geese, respectively. None were found 17 May 1974, but 210 were seen 16 May 1977, and 45 on 15 May 1975, the last at Bathurst. Similarly, the last ground observations were mostly in late May, with a few flocks in early June. Six flocks seen migrating near Blackville in early May 1969 and 1970 were headed east (2), northeast (3), and north (1).

6. Discussion

As in Prince Edward Island, the extensive shallow waters in and to seaward of the lagoons and bays of eastern New Brunswick were rarely surveyed effectively except from the air. Ground survey data provided arrival and departure dates but gave only vague suggestions of timing of the main passage.

The data suggested that migration, both in spring and fall, began earlier a century ago (1885–1920) than recently. Reports from the intervening period, summarized by Peters (MSS), suggested that the numbers of geese frequenting northeastern New Brunswick in the 1920s and 1930s were far fewer than in earlier times. Lower total numbers might tend to pass through in shorter periods, and the recent large numbers around Bathurst seemed to arrive earlier than the general pattern for 1960 to 1980.

The overall picture showed that numbers of geese staging along the east and north coasts of New Brunswick in fall were much less than in Prince Edward Island, totalling a few thousands only, although numbers passing through the Bathurst area probably increased since 1986. Timing of the movements seemed typical of the southern Gulf of St. Lawrence. The scarcity of large concentrations (only two reports >200 geese) near Shediac, where the coast turns sharply eastward into Northumberland Strait, suggested that fall migration did not follow the coastline south and west to New England. Most departures from the New Brunswick east coast during the fall were directly overland from more northern staging areas, Tracadie to Kouchibouguac. The west to southwest headings of most flocks seen migrating near Blackville in October and early December, if continued, would bring such birds to coastal staging areas only in southwestern Maine (e.g. Merrymeeting Bay) or Massachusetts. It remains unclear whether regular interchange occurs between the geese staging at Bathurst and those on the east coast of New Brunswick, as suggested by the southeastward departure seen in December 1969; the Bathurst birds probably often proceed directly southwest overland (as suggested also by neck-collar sightings (Chapter XVIII, this volume).

Few geese stop along New Brunswick's east and north coasts in spring, partly because of persistent shooting at waterfowl there in that season. The few hundred geese seen then were inconsequential in the regional picture.

Table X-1. Canada Geese numbers on fall aerial surveys in eastern New Brunswick, 1965–77, data for coastal survey blocks as in footnote.

Year – date	Number of geese in block[1] 342	343	345	348	349	350	353	Total
(a) Late September (S) and October surveys								
1966 – 13	0	45	0	65	240	130	162	704
1967 – 6	0	142	510	12	562	120	157	1503
1968 – 30S	0	0	0	25	415	12	150	602
– 31	116	60	721	28	661	225	200	2165
1969 – 17	0	278	212	62	625	434	276	1898
1970 – 19	0	191	215	215	373	23	535	1637
1971 – 22	6	210	400	300	16	15	–	1247
1972 – 29S	0	110	65	0	730	14	725	1644
– 11	373	150	318	285	539	617	0	2390
– 27	959	340	590	280	56	120	–	2742
(b) November and early December (D) surveys								
1966 – 7	0	725	200	1025	1150	0	30	3175
– 12D	0	775	0	200	750	120	–	1845
1967 – 7	0	0	329	400	82	38	70	979
1968 – 18	181	570	391	25	210	0	506	1883
1969 – 18	50	560	254	225	787	200	600	3147
1970 – 20	24	375	252	462	1207	11	503	3072
1971 – 18	49	154	104	0	30	118	–	650
1972 – 17	125	964	237	–	988	398	6	3178
1973 – 15	131	992	514	495	784	217	260	3393
1974 – 30	0	527	44	0	585	203	80	1769
1975 – 2D	15	0	0	0	966	0	0	1131
1977 – 15	1650	625	0	112	44	25	0	2494

Key to blocks: 342 - Richibucto; 343 - Kouchibouguac; 345 - outer Miramichi Bay; 348 - Neguac; 349 - Tabusintac; 350 - Tracadie; 353 - Miscou Island east shore;

Note: Totals also include the few records in other blocks from Cocagne to Caraquet.
0 = no birds; - = not surveyed.

Table X-2. Canada Geese at Bathurst Harbour, N.B., from waterfowl banding crew notes (1986–92) and CWS aerial surveys (1969–75, marked*), by half-months (E: 1–15th, L: 16–31st); when two (or more) surveys were made in one half-month, the range of counts was shown.

	Number of geese noted					
Year	E - Sep.	L - Sep.	E - Oct.	L - Oct.	E - Nov.	L - Nov.
1969						1100*
1972				1000*		
1975					1244*	
1986	0	500	900–1500	2500		
1987		1490	2785–4500	5810		
1988	8	355–442	1402–1966	2700		
1989	38–119	400–600	2500–3300			
1990	15–80	300–3000	3500–3800	4000		
1991	15–200	500–2000	3200–5000			
1992	60	180–1500	3000–4000			

7. References

Squires, W.A. 1952. The birds of New Brunswick. Monogr. Ser. no. 2. The New Brunswick Museum, Saint John. 164 pp.

Squires, W.A. 1976. The birds of New Brunswick. 2nd ed. New Brunswick Museum, Monogr. Ser. no. 7. 221 pp.

Tull, C.E. 1974. Avifaunal survey, Kouchibouguac National Park. Contract rep. 72–174 and 73–17. Nat. & Hist. Parks Br., Dept. Ind. & Nor. Aff., Ottawa. 210 pp.

C. THE CANADA GOOSE SITUATION AROUND THE UPPER BAY OF FUNDY: A GENERAL INTRODUCTION

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1. Introduction

This section provides background information general to the next four chapters (XI–XIV]. Its content was based upon Boyer (1951), Van Zoost (1970), and more general sources.

2. Physiography, climate, and land-use

Geologically, the upper Bay of Fundy region is very complex, comprising parts of several parallel ridges, either formed of ancient rocks or capped with resistant basalt of more recent origin. Most areas between the ridges are underlain by much softer rocks, mostly sandstones of Carboniferous to Triassic age. The upper reaches of the Bay of Fundy, including Chignecto Bay with its two arms Shepody Bay and Cumberland Basin (Fig. C-1), and Minas Channel leading to Minas Basin and Cobequid Bay (Fig. XIV-1), now occupy the intervening sedimentary basins (Simmons *et al.* 1984).

After glaciers of the Wisconsin period retreated from the region about 10 000 years ago, but while much water was still contained in more northern ice-sheets, the sea-level was generally much (perhaps as much as 100 m) lower than at present. Much of the continental shelf including Georges Bank was dry land, and the present Bay of Fundy was a vast forested lowland containing shallow lakes through which the precursors of present-day rivers discharged. Subfossil remains of those forests, destroyed when sea-water returned to these areas about 3500 years ago (Ramsay 1963), persist on the sea-bottom, visible at extreme low tides, near the heads of Cumberland Basin and Minas Basin. Erosion of the soft sedimentary rocks that form the basins by tidal currents, of which velocities approach 4 m/s in some areas, produced the vast quantities of sediments that have been deposited in the basins. The rivers entering the upper Bay of Fundy are all relatively small, so almost all the sediments in the basins, to depths of 25 metres or more, were produced and brought there by action of tidal currents.

The deposition process, described by Ganong (1903), resulted from reduction in velocity of tidal currents after these overflow the river channels, thus reducing their ability to transport sediment. The heaviest particles were deposited first, near the river banks, building the marsh higher there than elsewhere, and forming salt-marshes to landward. Farther inland, there was a gradual transition through brackish marsh to the freshwater marshes and peat bogs which had persisted from earlier times.

European settlements around these vast open areas, the only natural grasslands in this region, grew up first near the upper limits of tidal influence in the late 1600s. Drawing on earlier experience with tidal areas in northwestern Europe, the settlers gradually enclosed with dykes all of the major salt-marsh tracts around the upper Bay of Fundy within the next 100–150 years. During the first two centuries of dyking, salt water was re-admitted to the dykelands every few years to stimulate the growth of marsh hay, an important commercial product locally. Intensive drainage and subsequent cultivation of dyked lands became widespread only in the last 50 years, and many dyked lands are still used only for hay or pasturage.

The waters of the Bay of Fundy are some of the coolest on earth in equivalent latitudes, with temperatures of well-mixed waters scarcely exceeding +10°C in July. However, in the upper arms of the Bay where the rising tides flow across vast mud-flats warmed by the sun, water temperatures at high tide in summer locally approach +20°C. Where cool Fundy waters approach the shores, onshore winds are cool and damp. However, fog reaches inland to the tidal salt-marshes and dykelands regularly only at the head of Cumberland Basin, where the prevailing wind blows directly up the bay. That area averages somewhat cooler in summer than the other marsh areas at the head of the Bay of Fundy, but differs little in other climatic parameters.

3. Historical and social background

Canada Geese presumably frequented the upper Bay of Fundy since pre-historic times. Before the extensive salt-marshes were dyked and drained by European settlers, some breeding by geese may have occurred on islets in upper reaches of the marsh, but the evidence for this is anecdotal and inconclusive. Given the relatively fertile nature and abundant wildlife in these marshes, it seems likely that both predatory animals and native peoples found it worth hunting there in summer, which would have precluded geese from breeding in large numbers. Probably, geese always occurred here mainly as migrants in both spring and fall.

Before agriculture came to the Maritimes with European settlers in the 1600s, the Fundy salt-marshes were the largest open areas, as well as some of the largest marshes, in the region. As goose staging areas, especially in spring, they may have rivalled the southern Gulf of St. Lawrence, which then had no farmlands. In March, the

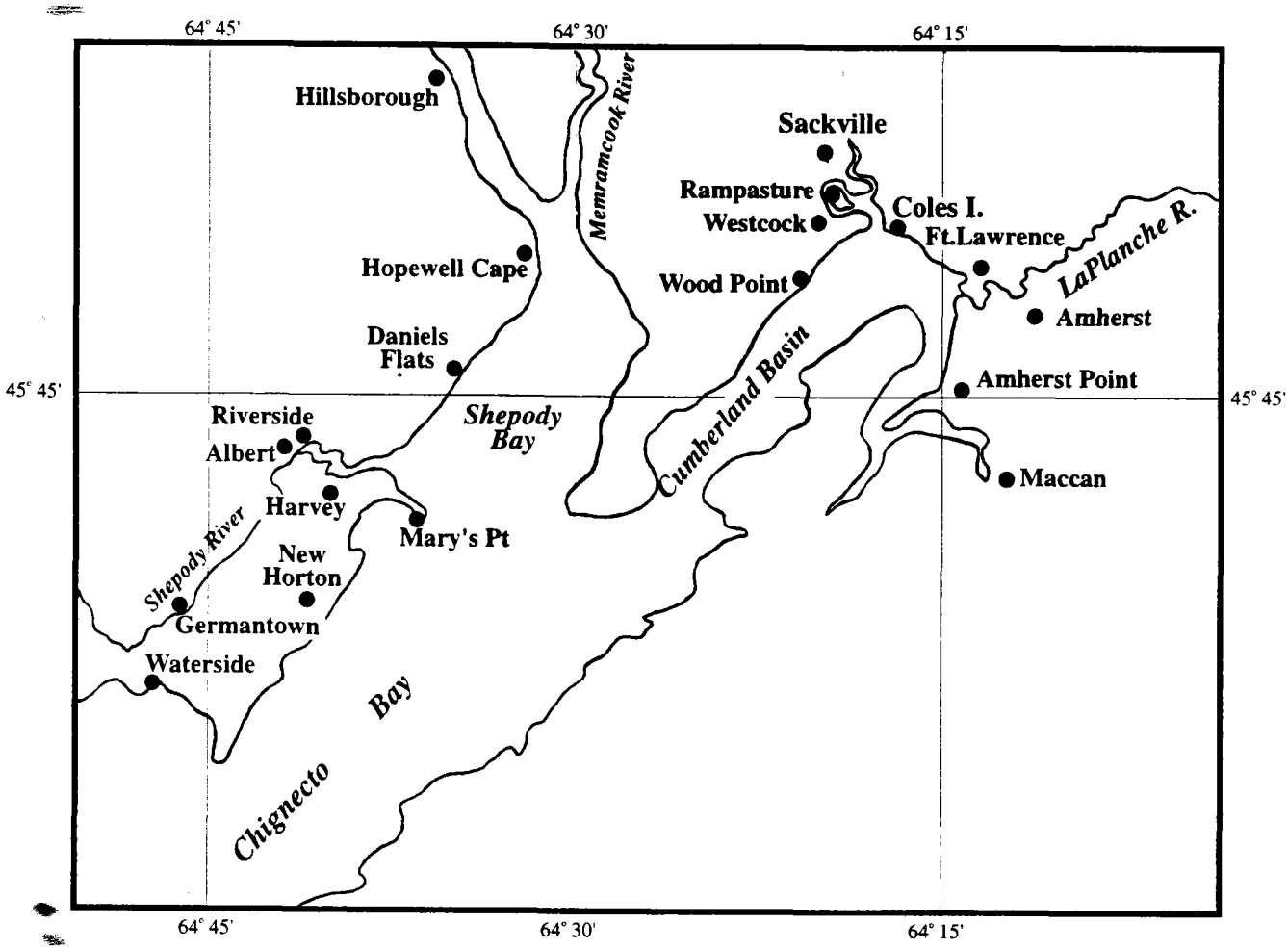

Figure C-1 The upper part of Chignecto Bay, with Shepody Bay and Cumberland Basin, in New Brunswick and Nova Scotia, to locate areas with Canada Goose staging and surveys.

high tides in Fundy still clear ice from the local salt-marshes earlier than this occurs along Northumberland Strait, where the tidal range is much smaller. Presumably the situation was different before 4000 years ago as, with lowered sea levels then, Georges Bank probably excluded tidal influence from the Bay of Fundy. The tidal regimes prevailing at the start of European settlement had been in place for about three thousand years, amply long enough for traditions in goose migration pathways and staging areas to have developed.

After settlement came to the upper Fundy region in the late 17th Century, dyking and draining gradually reduced the area of marshes, both salt and fresh, by as much as 70 per cent overall. The numbers of geese using the region also declined, as was occurring all over eastern North America in response to unregulated hunting and concurrent loss of habitats. Overall, goose numbers reached a minimum in the early 20th Century and have been increasing since then. In the Fundy region, however, the decline in numbers of staging geese continued to the present, reflecting increased drainage and cultivation of dykelands there and development of more suitable areas elsewhere. With milder winters and earlier springs in the last 20 years, most geese now pass by the Fundy marshes without stopping, en route to Northumberland Strait, where the marshes now become ice-free earlier than formerly. In fall, the smaller areas of stubble fields around the Fundy marshes also are less attractive to geese than staging in Prince Edward Island. It seems doubtful that more than 3000–5000 geese stop around Fundy in spring now, compared to 10 000 to 15 000 thirty years ago, and fall numbers are even lower.

4. Literature cited

Boyer, G.F. 1951. An ecological study of the marshes of the New Brunswick–Nova Scotia border region with special reference to waterfowl. Unpubl. M.S. thesis, Univ. Ill., Champaign.

Ganong, W.F. 1903. The vegetation of the Bay of Fundy salt and diked marshes: an ecological study. Botan. Gaz., 36(3): 161–186; 280–302; 349–367; 429–455.

Ramsay, E.A. 1963. The composition of the submerged forest at Fort Lawrence, Nova Scotia. Unpubl. B.Sc. (Hons.) thesis, Dept. of Biology, Mount Allison U., Sackville, N.B.

Simmons, M., Davis, D., Griffiths, L., Muecke, A. 1984. Natural history of Nova Scotia. Nova Scotia Department of Education and Department of Lands and Forests, Halifax. 2 vols., 807 pp.

Van Zoost, J.R. 1970. The ecology and waterfowl utilization of the John Lusby National Wildlife area. Unpubl. M.Sc. thesis, Dept. of Biology, Acadia Univ., Wolfville, N.S. 183 pp.

XI. THE ECOLOGY AND CANADA GOOSE UTILIZATION OF THE JOHN LUSBY SALT-MARSH, CHIGNECTO NATIONAL WILDLIFE AREA, NOVA SCOTIA, IN 1969–70 1/

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1. Abstract

A study from February 1969 to May 1970 provided an ecological description of the John Lusby salt-marsh at Amherst Point, Nova Scotia, with an assessment of use of available foods by waterfowl. The existing marsh developed through tidal sedimentation, before dyking in the 18th century and after the dykes were breached in 1947. About 30 salt pans (shallow ponds) are scattered throughout the marsh. The major plant species in the marsh are the cord-grasses (*Spartina alterniflora* and *S. patens*), alkali-grass (goose-grass of some authors) *Puccinellia americana*, and widgeon-grass (ditch-grass of many authors) (*Ruppia maritima*).

The principal food of Canada Geese on the marsh in spring was the leaves of alkali-grass. Some use was also made of introduced forage plants on upland pastures adjoining the salt-marsh. In fall, geese fed mostly in areas dominated by alkali-grass, but also in freshwater ponds in the Amherst Point Migratory Bird Sanctuary (apparently using pondweeds *Potamogeton* spp.) and on grain stubble fields on the uplands. Feeding in most areas in fall was restricted by hunting activity.

Geese were present in the area from late March until early May, with peak numbers around 1 April. Peak numbers in spring varied greatly between years, with near 10 000 birds in 1968 vs. 2200 in 1969 and 4400 in 1970. Fall numbers were much lower, with a maximum of 240 geese noted in October and November 1969.

All foods used by geese were readily available in the study area. Limited sampling suggested that goose numbers in the area were not limited by food availability, and that goose grazing had no detectable impact on the grass production on the marsh and on agricultural fields nearby. Management recommendations included efforts to convince local farmers that goose-grazing of their fields does not affect the grass crop adversely.

2. Introduction

Federal Migratory Bird Sanctuaries to protect the birds from disturbance by people have been established in various places since soon after the Migratory Birds Convention and its enabling Act were put in place in 1916 and 1917, respectively. Protection of habitats needed by the birds was not covered under the M.B.C. Act, with land management for wildlife remaining under provincial jurisdiction. A ministerial statement dated 6 April 1966 and titled *Canada's National Wildlife Policy and Program* (Laing 1966) set the stage for habitat protection through the federal government, later given formal legislation under the Canada Wildlife Act in 1973. One of the first areas acquired by the Canadian Wildlife Service (CWS) under the national program for land acquisition and wildlife habitat protection was the John Lusby salt-marsh near Amherst, Nova Scotia (see Fig. C-1).

A study (Van Zoost 1970) was conducted in 1969-70 to (a) provide an ecological description of the area, including soil characteristics, vegetation and zonation, and invertebrates;
(b) assess the foods available to waterfowl on the area, and the use made of them; and
(c) recommend approaches to solving problems in the management of the area identified during the study. Only those aspects of the study bearing on use of the area by Canada Geese were considered in this volume.

3. Study area

3.1 Location and topography

The John Lusby salt-marsh, about 600 ha in area, is located on the east shore of Cumberland Basin, about 3 km west of Amherst, Nova Scotia (see Fig. C-1). The name came from a former resident whose descendants still farm in the vicinity. The area acquired by CWS is roughly triangular, bounded by the Laplanche River estuary on the north, Cumberland Basin on the west, and the lower edge of the upland of Amherst Point on the east (Fig. XI-1).

Elevation at the "toe of the upland" is about 7.3 m (24 ft) above Chart Datum (= mean sea level). The salt-marsh is relatively flat, with elevations around 6.5 m above Chart Datum except in the creek channels (lower) and on the one small wooded island (elevation 7.6 m). Ponds in the salt-marsh usually are frozen from mid-November to late March or early April, clearing depending on timing of the highest (spring) tides.

3.2 History of the marshes

Ganong's (1903) account of marsh formation in the Cumberland Basin area was the principal source, modified by recognition that it was rising sea levels rather than subsiding land that led to tidal flooding of the basin 3500 years ago. Ramsay (1963) established, through radio-carbon dating, the timing of the destruction of the submerged forest near the Missaguash River mouth. Much of the information on land-use was compiled from traditions of local residents.

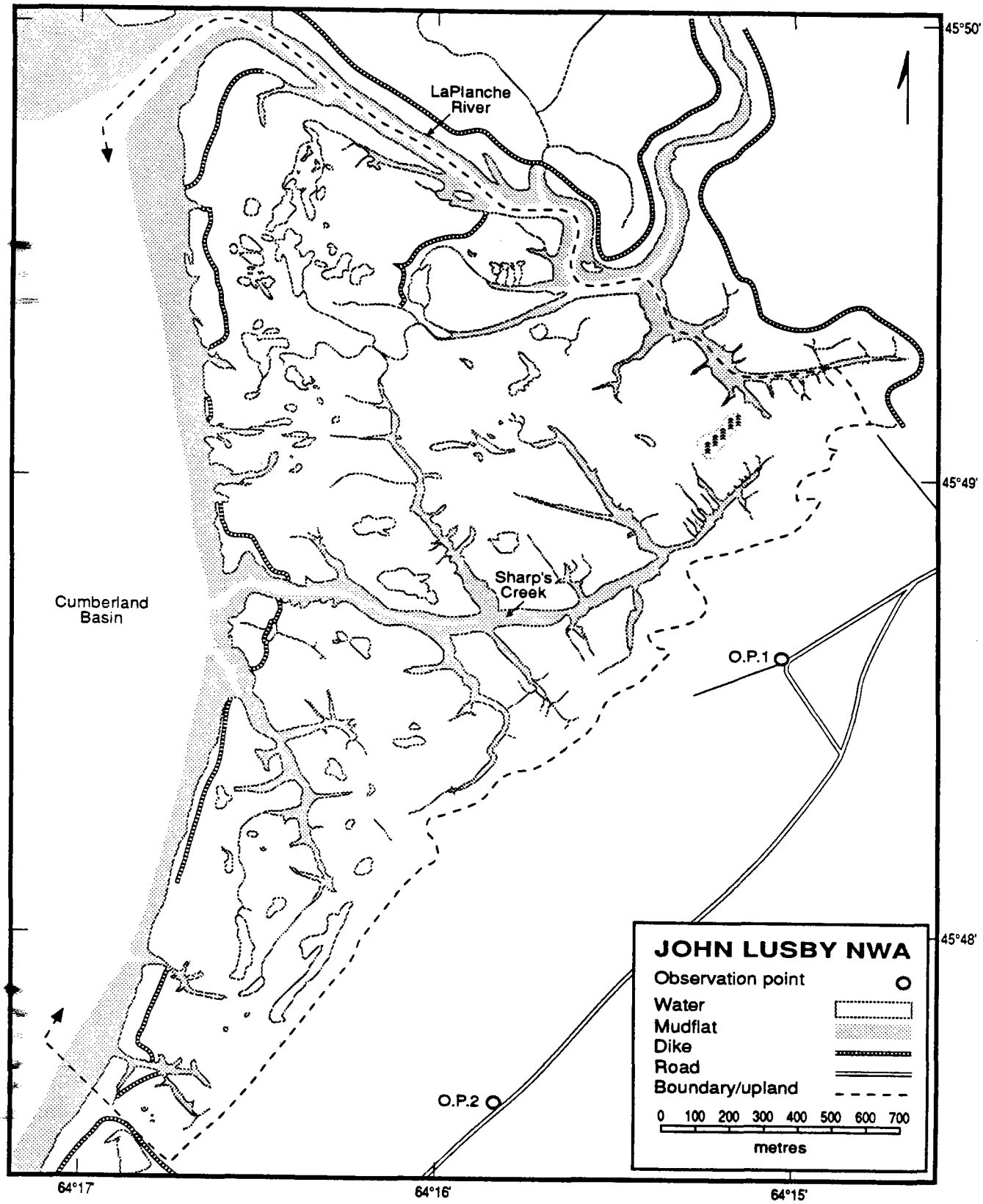

Figure XI-1 The John Lusby saltmarsh, Amherst Point, Nova Scotia, showing tidal creeks, dykes, salt-ponds and boundaries of the John Lusby unit of Chignecto National Wildlife Area.

The first European settlement in the area was in 1672, at Beaubassin near Fort Lawrence, N.S. (Bird 1928). Dyking and draining of salt-marshes continued to expand for 100 to 150 years (Trueman 1907). Tradition suggests that the John Lusby salt-marsh was first dyked by the French, i.e. before 1755, and later taken over by Yorkshire settlers (arrived 1774). Around 1880, wharves existed near the south end of the area, served by a narrow-gauge railway used for exporting gypsum from the Nappan area, and pilings of a wharf were still visible in 1931 aerial photographs. Hay was grown on the dyked area, including especially "English hay" (timothy and clover), with "broad-leaf" (= freshwater cord-grass *Spartina pectinata*) in damper areas. With the general decline in use of horse transport, the demand and price paid for hay fell after 1918. The Depression accelerated that decline, and maintenance of the dykes suffered.

High tides driven by strong winds breached the dykes on the John Lusby salt-marsh in spring 1937. Repairs were made that summer, but the marsh was again flooded by sea-water in spring 1938. By 1947 most dykes were still intact, but the two major aboiteaux (control structures on the larger creeks) were gone, allowing a limited amount of tidal flooding. Hay was still being cut on parts of the marsh in 1946, and a 1947 aerial photograph showed 32 marsh barns, a distinctive feature of local agriculture. The dykes continued to deteriorate, tidal creeks expanded along former drainage ditches, and salt-pans (ponds) formed in low-lying areas, as shown in 1954 and 1964 aerial photographs (Fig. XI-1). The vegetation changed from English hay and broad-leaf to salt-tolerant species. By 1969, the area was salt-marsh by standard definitions (Harries 1968, quoted in Van Zoost 1970).

4. Methods

Field work was conducted from February 1969 to May 1970. Waterfowl numbers were recorded each day. In fall 1969, emphasis was placed on waterfowl movements, food habits, and hunting pressure. Further waterfowl surveys, including observations on feeding, were conducted during March through May 1970.

Physical features were studied qualitatively. Water samples were collected for chemical analysis at intervals from June through August, always at approximately the same time of day. Each sample was analysed for pH, total alkalinity, chloride ion, and conductivity (A.P.H.A. 1936). Results were correlated with weather and tidal state at the times of collection. Soil samples were collected in various plant communities during September 1969, and the same parameters were measured as for the water samples (Jackson 1958).

During summer 1969, vegetative communities, defined by the dominant plant species present (Fernald 1950; Roland and Smith 1963–64, 1969) were outlined on a map of the area. An attempt was made to relate plant species and densities to water and soil characteristics. Invertebrates and fish were also collected in summer 1969 and identified (Bousfield 1960; Pimental 1967), and observations of all birds and mammals were recorded. Animal life of the area was not discussed further in this chapter, as it had little influence on the use of the area by geese.

Waterfowl population surveys were made by observations from aircraft, from viewpoints on the upland (Fig. XI-1), and by walking on the marsh. Observations of feeding, roosting, and movements were made mainly from the upland viewing stations. Waterfowl food habits were also studied by examination of digestive tracts, but only one Canada Goose was obtained locally by hunting in fall 1969. An attempt to assess goose food habits through faecal analysis was unsuccessful.

Goose use of the preferred plant community was assessed through sampling inside and outside of cylindrical wire cages (1.2 m diameter x 0.7 m high)(after Graves 1965). Unfortunately, 6 of the 10 cages were destroyed by tide-water during the period of goose passage through the area.

5. Results

5.1 Physical and chemical characteristics

Except for one wooded island with upland vegetation and one pond protected from the sea by a dyke, the area was all salt-marsh with numerous ponds (Fig. XI-1). [The two different areas noted above, not used by geese, are not discussed further herein.] Creeks and the former drainage ditches served as channels by which tide-waters flowed over the marsh. Elevation readings taken in spring 1970 ranged from 6.3 to 6.9 m above Chart Datum. Silt deposited by tide-water was only 1–2 mm in depth, whereas mounds of mud left by melted ice blocks were often 8–10 cm high. The frequency of tidal flooding depended on the height of the tide, and the strength and direction of wind. Generally, only tides of more than 7.9 m (at Saint John, N.B., Canadian Tide and Current Tables 1969, 1970) flooded the entire marsh.

The ponds varied in depth from 5 to 25 cm, and about equal numbers had soft vs. hard bottoms. Vegetation in ponds with soft bottoms was mostly the alga *Enteromorpha* and widgeon-grass (*Ruppia maritima*), whereas ponds with hard bottoms had mostly salt-water cord-grass (*Spartina alterniflora*). Water pH in the ponds varied from 7.4 to 9.6 (mean 8.2), vs. pH 7.8 for sea-water in the main creek. The algal bloom and hydrogen sulfide production in the ponds may have caused the higher pH there. Total alkalinity was high, averaging 211.4 ppm. Chloride ion values ranged from 8800 to 17 450 ppm, corresponding to 1.8 to 3.5% salts (mean 2.7%, vs. 3.3% in sea-water). Salinities increased over time after tidal flooding, owing to evaporation, but were reduced after rainfall.

The soil of the salt-marsh was uniform silt, with no stones or rocks. Its firmness varied, areas often flooded being softer than those seldom covered by the tide. The mud of tidal creeks was very soft, with a high water content, and should be avoided by anyone walking on the marsh. Soil samples contained a mean of 31.8% by weight of water. Soil pH values ranged from 3.2 to 7.9, with an

average of 6.5, and had no obvious correlation with the plant cover in an area. Soil salinity ranged from 0.01 to 0.41%, with a mean of 0.19% salts. Salt-water cord-grass grew in the most saline areas, but the other plants tolerated almost the same range of salinities.

5.2 Plant communities

The distribution of plant communities (Fig. XI-2) corresponded closely to the general zonation of local salt-marshes (Harries 1968, cited by Van Zoost 1970). The littoral zone was devoid of vegetation, and the tidal mud flats had only scattered plants of salt-water cord-grass. That plant also grew sparsely along the edges of tidal creeks, and commonly in the shallow ditches and around the more recently formed ponds. The older ponds were dominated by *Enteromorpha* and widgeon-grass. The lower salt-marsh was dominated by a dense growth of salt-water cord-grass. As the depositional salt-marsh was approached, that cord-grass was increasingly accompanied by scattered plants of sea-blite (*Sueda maritima*) and samphire (*Salicornia europaea*). Dense stands of alkali-grass dominated the upper levels of the depositional salt-marsh, which were only 10–20 cm higher but appreciably less saline, on average, than the lower areas dominated by salt-water cord-grass. The highest areas of salt-marsh were dominated by salt-meadow cord-grass (*Spartina patens*), with local patches of a rush (*Juncus gerardii*), seaside goldenrod (*Solidago sempervirens*), and fresh-water cord-grass (*Spartina pectinata*).

5.3 Use of the area by Canada Geese

Canada Geese were first observed in the area 21 March 1969 and 12 March 1970, when plant cover barely showed through the snow (3–8 cm depth). By the end of March and the first week of April the goose population reached maximum levels, and geese then used all feeding and resting areas identified during the study (Fig. XI-3). Observations showed that geese fed mainly near the banks of tidal creeks, which were dominated by alkali-grass (Fig. XI-2). During early April in both years, geese also fed in fields of the adjoining upland (areas IVa and Va, Fig. XI-3). To reduce concerns of the land-owners, geese were deterred from using the upland fields each day by use of bird-scare shells; after 3–4 days of scaring, the geese stopped feeding there. Up to 1,000 geese used upland fields at one time, especially in 1969 when clover growth there was more luxuriant than in 1970.

The geese usually rested on the marsh as well as feeding there. When disturbed, they flew out to Cumberland Basin and rested there, but overnight roosting was commonly observed on the marsh, around certain ponds. As numbers of geese using the marsh declined in late April, use became restricted to areas I and II (Fig. XI-3). The lower numbers of geese in fall were mostly seen in area II. In fall, all geese using the study area returned to Amherst Point Sanctuary at night, and they also fed on nearby stubble fields to a limited extent then, when not deterred by hunting.

5.4 Movements of Canada Geese

In spring, most geese approached the area from Cumberland Basin and landed near the centre of the marsh, later dispersing to other areas. Most arrivals seemed to occur during the night and early morning.

Grazing by geese was most intensive from about 08:00 to 12:00 or 13:00 and again from 16:00 until one-half hour before sunset. At the beginnings of those periods there was a large amount of movement, mostly in flocks of 4 to 10 birds (1 or 2 family groups). Flight from one area to another was usually direct, but geese often circled before landing on upland fields. There was very little movement during the afternoon rest period. Movement was at a maximum in the evening, including flights to feed, to the roosting areas, and departures to the north across the isthmus towards Northumberland Strait.

In fall, geese mostly arrived from the north, flying towards Cumberland Basin. Just before dark, geese resting on the Basin took flight towards the upland and over the ridge to Amherst Point Sanctuary. About one-half hour after sunrise geese left the Sanctuary and flew to the salt-marsh, landing in area II or continuing to the Basin. Geese that stopped off on the marsh remained for a half-hour and then continued to the Basin, where they remained during the day, returning to the Sanctuary in the evening to rest and feed. Illegal hunting in the Sanctuary sometimes disrupted that pattern.

5.5 Goose populations in the area

The largest numbers of Canada Geese occurred on the salt-marsh in early spring. In 1968 A.D. Smith (CWS, pers. comm.) reported that 10 000 geese were on the marsh at one time. In 1969 and 1970, peak spring numbers were much lower (Table XI-1). Geese were first seen on the marsh 21 March 1969 and 12 March 1970, the latter one of the earliest arrival dates on record but involving very few birds. Peak numbers were reached about two weeks after the first sizable flocks arrived, but were only sustained for a few days. Only 1000–1500 geese remained after the first week of April, and numbers dwindled rapidly after the end of that month, the latest record being on 15 May 1970.

Geese were first observed in fall on 8 October 1969. By 16 October, 240 geese were counted, but hunting pressure discouraged geese from using the study area regularly, so counts were terminated. F. Payne (N.S. Wildlife Division, pers. comm.) reported 200 geese on Cumberland Basin on 23 November 1969.

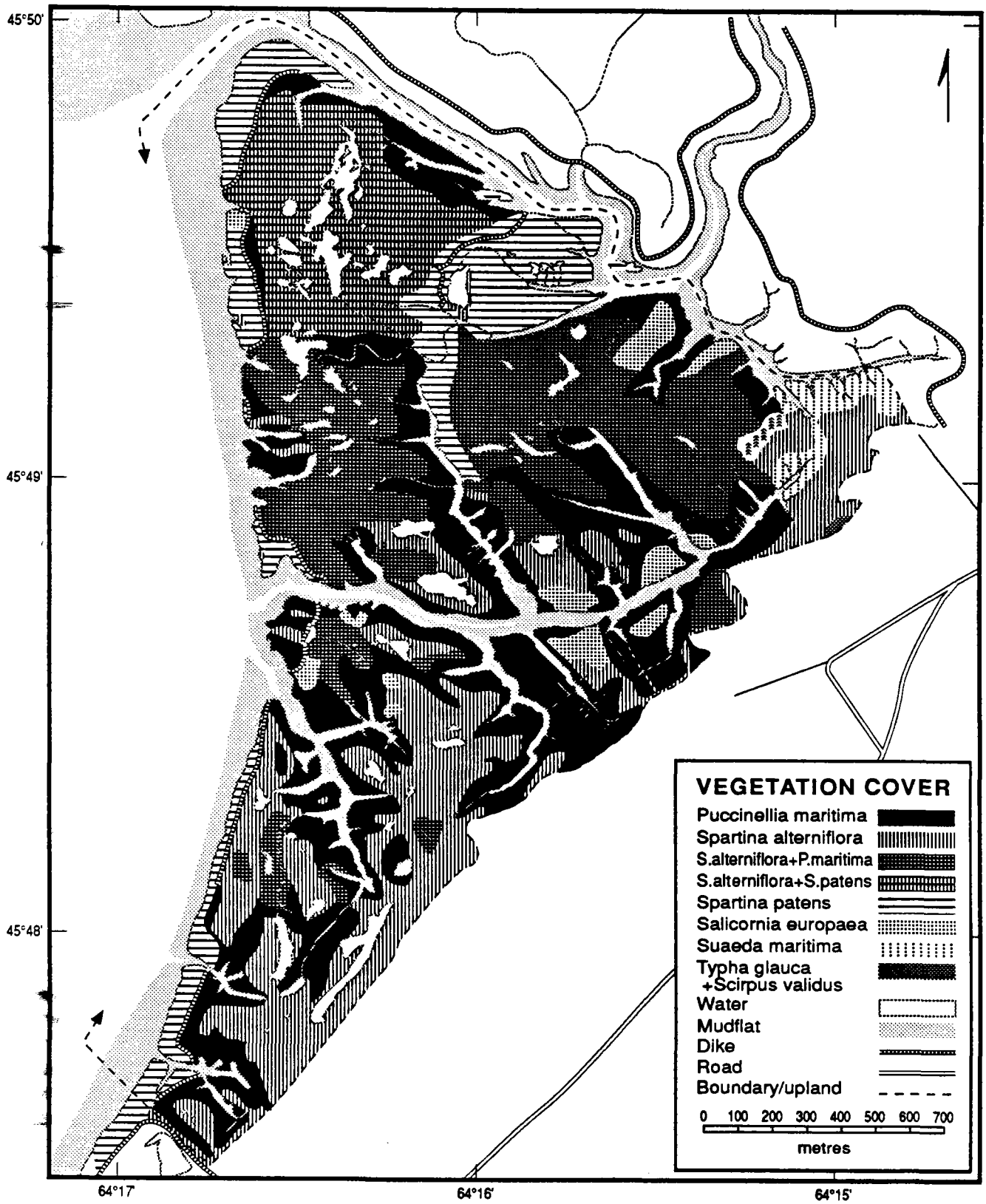

Figure XI-2 The John Lusby saltmarsh, Amherst Point, Nova Scotia, showing plant zonation pertinent to its use by Canada Geese.

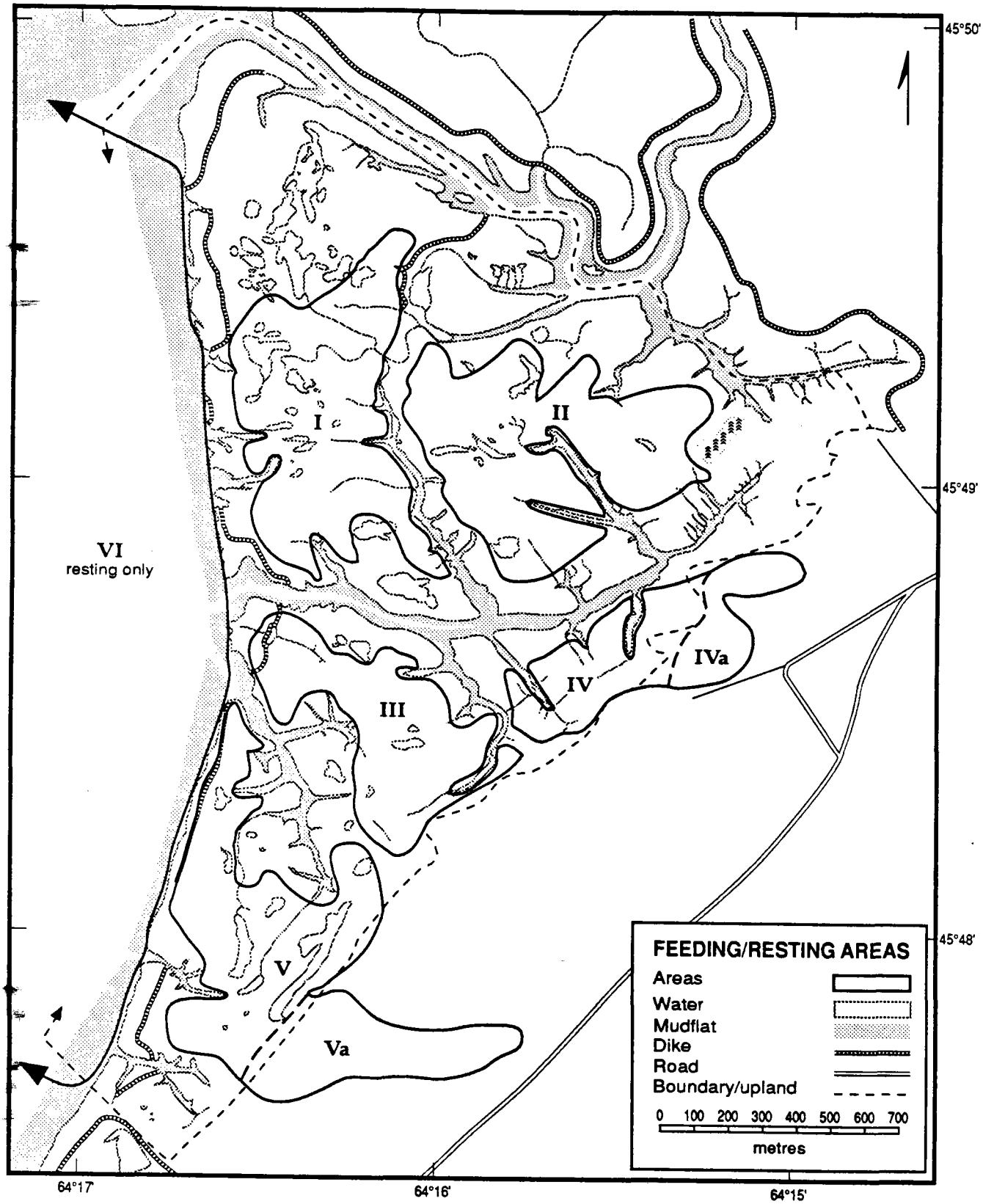

Figure XI-3 The John Lusby saltmarsh, Amherst Point, Nova Scotia, showing areas used for feeding by Canada Geese, 1968-69.

Table XI-1. Spring counts of Canada Geese, John Lusby salt-marsh, N.S., summarized by 5-day periods minimum and maximum counts, 1969–70. Highest counts of season in italics.

	Numbers of Canada Geese			
	1969		1970	
Period	Min.	Max.	Min.	Max.
March 12–16	–	–	26	35
17–21	300		40	51
22–26	455	800	691	3500
27–31	–	1500 (2x)	2410	*4430*
April 1–5	1200	*2200*	1094	1647
6–10	–	1879	1440	1630
11–15	–	–	–	1115
16–20	585	–	–	1062
21–25	500	1300	–	–
26–30	755	1313	614	707
May 1–5	715	817	–	–
6–10	145	311	–	–
11–15	0	34	18	156

5.6 Feeding and food habits of Canada Geese

Spring feeding by geese was assessed solely from field observations. Identified feeding areas were dominated mainly by alkali-grass. New growth of salt-water cord-grass was not readily available at the time of the goose migration, and the rhizomes and tubers of that plant species were inaccessible in the still-frozen ground. The geese selected new green blades of alkali-grass even in areas dominated by old growth of cord-grass. Geese feeding on upland fields took mainly new growth of red clover (*Trifolium pratense*) or timothy (*Phleum pratense*), mainly the blades and stems but occasionally also the roots.

In fall, feeding observations indicated that geese fed mainly in the alkali-grass zones. The terminal portions of plants of that species were then green and relatively succulent, and geese typically removed the top 2–3 cm of the plant. The one goose shot had been feeding on stubble fields. The gizzard contained only unidentifiable plant material, but the crop included leaves of red clover and oats (*Avena sativa*) and 3 seeds of a pondweed (*Potamogeton* sp.).

The attempt to measure differences between protected and grazed samples of alkali-grass marsh was ineffective owing to tidal destruction of 6 of 10 exclusion cages. The densities of plants apparently varied greatly between used areas and the four protected samples. However, there was no consistent difference in weights of dried samples from the different areas, all samples (from 30 x 30 cm samples) weighing between 0.9 and 1.0 gm.

6.0 Discussion

The John Lusby salt-marsh in 1969-70 was in a state of transition, reverting from dyked marsh with freshwater and terrestrial vegetation towards quasi-natural salt-marsh dominated by salt-tolerant plants. Silt deposited by the rising tides increased the general elevation of the marsh by 0.7 to 0.8 m during the 30 years since the map of J.W. Byers in 1939 showed marsh elevations ranging from 5.4 to 6.1 m above mean tide level. As noted by Ganong (1903) and Chapman (1960), sedimentation was greatest along the banks of tidal creeks and drainage ditches, areas now dominated by alkali-grass. As the marsh continues to build, the higher areas will be less frequently flooded.

In two older salt-marshes at Cumberland Basin (Coles Island and Rampasture; see Fig. C-1), salt-meadow cord-grass dominated the banks of the tidal creeks and other areas which were seldom flooded. It is possible that, as the John Lusby marsh increases in elevation, the higher parts of the depositional and central zones of the marsh will be taken over by salt-meadow cord-grass, and alkali-grass areas will become less extensive. As geese in spring fed almost exclusively in alkali-grass areas in 1969-70, reduction in extent of this plant would have some effect on the use of the area by geese. Boyer (1951) noted geese grazing mainly on salt-meadow cord-grass in spring in the Cumberland Basin area, even though this study found that new green growth of that species was largely covered by dense mats of dead vegetation during the spring goose migration. Presumably geese would use this less accessible food source in the absence of alternate feeding

areas in late March and early April. Their use locally of upland fields, when allowed to do so, indicated that they will seek out the best available feeding rather than continuing to use a traditional area that has become less attractive. Neely (1962) indicated that burning of *Spartina* zones in salt-marshes in late summer would make new growth of cord-grass more available in spring. Burning should be attempted experimentally in the salt-meadow cord-grass zone to improve spring feeding areas for geese.

Subjective assessment suggested that the study area was not used to capacity in the springs of 1969 and 1970. No adverse effects of grazing by geese were noted. In 1970, the spring peak numbers of geese (4000–4500) were in the area for less than one week. With larger numbers, as reported in 1968, or a longer stay, adverse effects might result. Further assessment of use of salt-marsh vegetation by geese is desirable. The enclosure technique should be feasible if the sampling stations were selected the previous fall so that stakes for anchoring the cages might be put in place before the ground froze. A wider range of plant density and species should be sampled. The major limit on use of that method was the time required for separating green plant material from dead plants.

Although most goose activity in the local area was on the salt-marsh and Cumberland Basin, geese also fed on upland clover fields. Local farmers asserted that goose grazing damaged clover fields, including uprooting of new growth. Although no measurements were made, superficial examination produced no evidence of major damage, with little uprooting of plants, as geese fed mainly on the leaves of the plants. Studies elsewhere (e.g. Kear 1965a,b, 1970) also indicated that grazing geese had little effect on agricultural production. Thus, the goose use of agricultural fields was more a problem in public relations than crop damage. Scaring geese from agricultural fields was often time-consuming, and should not be employed in ongoing management. A possible alternative might be to provide an area of upland grassland where geese could feed undisturbed on a "lure crop" planted for that purpose. One possible field existed within the Amherst Point Migratory Bird Sanctuary. That approach would require additional enforcement in the area, as violations of the Sanctuary at night or on weekends (as noted in fall 1969) would inhibit use of that area.

Geese and other waterfowl used the John Lusby salt-marsh mainly during spring and fall, when the area satisfied most of their requirements for feeding and resting. In fall, with hunting locally, the geese sought refuge overnight in the nearby Amherst Point Sanctuary, and total use of the area was much less than in spring.

[Other matters studied, such as use of salt-marsh ponds and suggested management activities, including construction of impoundments along the edge of the upland, were mainly focused on waterfowl other than geese, and are not treated here.]

7.0 Literature cited

American Public Health Association. 1936. Standard methods of water analysis. Lancaster Press.

Bird, W.R. 1928. A century at Chignecto: the key to old Acadia. Ryerson Press, Toronto. 245 pp.

Bousfield, E.L. 1960. Canadian Atlantic sea shells. Nat. Mus. Can., Ottawa. 72 pp.

Boyer, G.F. 1951. An ecological study on the marshes of the New Brunswick–Nova Scotia border region with special reference to waterfowl. Unpubl. M.S. thesis, U. Illinois, Champaign. 78 pp.

Canadian Tide and Current Tables. 1969. Can. Hydrogr. Serv., Ottawa. 70 pp.

Canadian Tide and Current Tables. 1970. Can. Hydrogr. Serv., Ottawa. 79 pp.

Chapman, V.J. 1960. Salt marshes and salt deserts of the world. Leonard Hill (Books) Ltd., London. 392 pp.

Fernald, M.L. 1950. Gray's manual of botany. 8th ed. Amer. Book Co., New York. 1632 pp.

Ganong, W.F. 1903. The vegetation of the Bay of Fundy salt and diked marshes: An ecological study. Botan. Gaz., 36(3): 161–186; 280–302; 349–367; 429–455.

Graves, W.L. 1965. Range analysis field guide. U.S. Dept. Agric. For. Serv., Southwest. Reg. FSH 2212.01 R 3. 153 pp.

Jackson, M.L. 1958. Soil chemical analysis. Prentice–Hall, Inc., Englewood Cliffs, N.J.

Kear, J. 1965a. The assessment of grazing trial of goose damage to grass. Wildl. Trust Ann. Rep. 16: 46–47.

Kear, J. 1965b. The assessment of goose damage by grazing trials. I.U.G.B. Congr. Trans. 6: 333–339.

Kear, J. 1970. The experimental assessment of goose damage to agricultural crops. Biol. Cons., 2: 206–212.

Laing, A. 1966. Canada's national wildlife policy and program. A statement made by the Minister of Northern Affairs and Natural Resources in the House of Commons on April 6, 1966. 12 pp.

Neely, W.W. 1962. Saline soils and brackish water in management of wildlife, fish and shrimp. Trans. N. Amer. Wildl. Nat. Res. Conf., 27: 321–335.

Pimental, R.A. 1967. Invertebrate identification manual. Reinhold Publ. Co. 151 pp.

Ramsay, E.A. 1963. The composition of the submerged forest at Fort Lawrence, Nova Scotia. Unpubl. B.Sc. (Hons.) thesis, Dept. of Biology, Mount Allison U., Sackville, N.B.

Roland, A.E., Smith, E.C. 1963–64. The flora of Nova Scotia. Part I. Proc. N.S. Inst. Sci., Truro, N.S. 244 pp.

Roland, A.E., Smith, E.C. 1969. The flora of Nova Scotia. Part II. Proc. N.S. Inst. Sci., Truro, N.S. 469 pp.

Trueman, H.T. 1907. Early agriculture in the Atlantic provinces. The Times Publ. Co., Moncton, N.B. 120 pp.

Van Zoost, J.R. 1970. The ecology and waterfowl utilization of the John Lusby National Wildlife area. Unpubl. M.Sc. thesis, Dept. of Biology, Acadia Univ., Wolfville, N.S. 183 pp.

XII. CANADA GOOSE MOVEMENTS IN THE N.B.–N.S. BORDER REGION

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1. Abstract

The use by Canada Geese of salt-marshes and nearby fields in the New Brunswick–Nova Scotia border region declined from the high levels noted in 1968 to 1975, apparently as a result of milder and less snowy springs in more recent years. Reduced use by geese of the largest salt-marsh (John Lusby) also reflected use of the nearby Amherst sod farm, which began operations in the 1970s. Geese still occur in the border area more regularly and in larger numbers in spring than in fall, and large overflights, to or from Prince Edward Island staging areas, are noted occasionally.

2. Introduction

A general summary of geological, physiographic, and recent land-use history of the upper Bay of Fundy region was set out earlier (C, this volume). This chapter reviews the situation around the head of Cumberland Basin (see Fig. C-1), including more recent data from the John Lusby salt-marsh area treated in Chapter XI (this volume). The picture is complicated only slightly by the few geese that breed locally (perhaps 20 pairs in all) following local introductions in newly impounded areas in 1966 to 1972 (Chapter XVI, this volume).

3. Study area

The New Brunswick–Nova Scotia Border area, at the start of European settlement, included the largest areas of salt and brackish marshes in the Maritimes. Subsequently, most of this marsh area was dyked and converted into agricultural fields. Unlike the situation around Minas Basin (Chapter XIV, this volume), the resulting fields in the Border area are still used mainly for pasture and haylands rather than being cultivated as croplands. Use by geese was mostly associated with remnant salt-marshes, the John Lusby marsh near Amherst, N.S., and Coles Island and Rampasture marshes near Sackville, N.B. (see Fig. C-1). All of these areas formerly were dyked, but all were abandoned and reverted to salt-marsh since 1920. Geese also appeared on nearby farm fields, but sporadically and in small numbers except on the fields of the Amherst Sod Company (began in 1970s; termed "sod farm" in this account).

4. Sources

Studies (Van Zoost 1970, this volume) of the John Lusby salt-marsh and its use by Canada Geese built upon earlier treatments of the whole Border marsh area as wetlands and waterfowl habitat (Ganong 1903; Boyer 1951, 1966). Systematic surveys of waterfowl use in spring of salt- and nearby fresh marshes around the head of Chignecto Bay were continued annually in 1971 to 1974, and less frequent counts of geese in the Amherst area in spring were made also in 1975 to 1986 (unpubl. data in CWS files). Data were extracted from the CWS aerial survey file (computerized). Sightings reported to *Nova Scotia Birds/Nova Scotia Bird Society Newsletter* (cited as NSB), in the New Brunswick Museum files, and in personal files (A.J. Erskine & C. Ellingwood), were also incorporated.

5. Results

5.1 Spring

Data assembled by Boyer (1951) included first arrivals ranging from 16 to 30 March in 6 years (1943–50). Data from personal files (AJE), also involving one observer, were similar: 24 March was the earliest in 7 years (1960–68), and 8 March in 1981 was the only sighting before 20 March in 1978 to 1988. Collected spring sightings from the Sackville CWS office, involving several observers and thus much wider coverage, averaged earlier; first dates in 1976 to 1984 ranged from 26 February 1978 (5) to 17 March 1980 (75). In some years substantial numbers followed closely after the first sightings, e.g. 500 at the John Lusby salt-marsh 11 March 1977, 400+ moving up Cumberland Basin near Wood Point 15 March 1983.

Data from the systematic spring ground surveys of the John Lusby salt-marsh and, in later years, nearby areas including the Amherst sod farm were summarized in Tables XII-1 and XII-2. Use by geese of the sod farm fields was first reported in 1976 (R. Hounsell, CWS, pers. comm.), when it was restricted to a few days in late March. Geese used the sod farm more frequently after 1980, but the situation in 1985, when sightings on that area comprised over 85% of the total reported (compare 23% in 1984, 42% in 1986), was unusual.

Geese were noted on those surveys first around the middle of March. Peak numbers occurred in late March or early April. However, substantial numbers were found in early May when surveys were continued later (Table XII-1). An aerial survey 5 May 1976 found 976 geese still in the John Lusby area, compared to 805 on 7 April that year. The latter was a low figure for the date, as other aerial surveys in the first half of April showed 2000 in 1967, 1879 in 1969, 1630 in 1970, and 4242 in 1975, but only 511 in 1974.

Table XII-1. Spring counts of Canada Geese, John Lusby salt-marsh, N.S., summarized by range of counts in 5-day periods, 1971–74 (no surveys in parentheses). Highest counts of season in italics.

Period	Numbers of Canada Geese 1971 (14)	1972 (23)	1973 (48)	1974 (49)
March				
06–11	–	–	–	122–150
12–16	–	–	170–350	160
17–21	2150–*3500*	140–400	500–1800	306–804
22–26	1900–*3455*	1197–2090	1500–*2050*	756–1889
27–31	2392	1933	800–*2112*	706–1399
April				
01–05	750–1930	1900	14–127	1150–2155
06–10	100	2201–*2305*	200–1248	1256–*3810*
11–15	410–1180	–	512–704	1309–3305
16–20	700	1500	122–1330	640–1699
21–25	690	1500–2000	545–1068	535–989
26–30	950	925	384–1026	566–1110
May				
01–05	–	420–860	422–618	380–626
06–10	–	–	110–461	159–709
11–15	–	575	12–82	111–300
16–20	–	320	–	10–25

Table XII-2. Spring counts of Canada Geese, John Lusby salt-marsh and nearby areas, N.S., by range of counts in 5-day periods, 1975–85 (no. surveys in parentheses). Highest count of season in italics.

	Numbers of Canada Geese													
	1975[1] (8)		1976[1] (11)		1978[1] (5)		1979[1] (5)		1984[2] (19)		1985[3] (22)		1986[4] (21)	
Period	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
March														
06–11	–	–	150	–	–	–	–	–	0	–	0	–	–	–
12–16	–	–	1500	–	–	–	18	87	40	–	21	568	0	–
17–21	–	–	100	2860	–	–	–	–	0	–	864	1116	0	640
22–26	–	–	2600	*3850*	–	–	–	–	190	359	1294	*1432*	1496	*1630*
27–31	–	–	1150	–	–	–	*900*	–	439	–	0	738	–	–
April														
01–05	960	3125	800	–	1500	–	250	–	165	360	190	316	41	1004
06–10	900	*6000*	1200	–	3000	–	305	–	143	–	157	174	94	134
11–15	–	–	–	–	*3200*	–	–	–	210	386	532	618	136	170
16–20	3650	–	–	–	300	2000	–	–	419	489	116	163	106	290
21–25	335	–	–	–	–	–	–	–	*997*	–	79	137	105	261
26–30	–	–	–	–	–	–	–	–	789	–	210	–	30	–

[1] Surveys by R.G. Hounsell (CWS).
[2] Surveys by W.R. Barrow (CWS).
[3] Surveys by D. Crocker (Canada Works Project)
[4] Surveys by R.J. Hicks (CWS)

Table XII-3. Spring counts of Canada Geese at Rampasture, Coles Island, and Westcock salt-marshes, N.B., by minimum and maximum counts in 5-day periods, 1971–74 (no. surveys in parentheses). Highest counts of season in italics.

	Numbers of Canada Geese							
	1971 (18)		1972 (8–9)		1973 (38)[1]		1974 (21)	
Period	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
March								
16–20	35	–	–	–	0	–	–	–
21–25	49	122	0	–	0	85	–	–
26–31	66	–	–	–	3	100	–	–
April								
01–05	36	261	12	–	0	*210*	–	–
06–10	147	196	–	–	175	184	–	–
11–15	21	312	6	–	6	18	88	120
16–20	140	306	5	*250*	38	146	63	*240*
21–25	246	–	3	–	0	6	78	–
26–30	353	*372*	–	–	2	–	6	86
May								
01–05	–	–	160	–	25	63	16	62
06–10	–	–	28	–	12	52	17	–
11–15	–	–	–	–	0	25	0	6

[1] Excluding 3 surveys with adverse weather.

Peak numbers on the spring ground surveys near Amherst were lower after 1978, declining from an earlier range of 2000 to 4000 (more in 1968 and 1975) to 1000 or less in recent years. Reports of *2500* to *4000+* at John Lusby in 1980 to 1983 (in NSB) were not substantiated by other observers in those years, nor subsequently. The remnant salt-marshes near Sackville are much smaller than the John Lusby marsh, and they never held more than 300–400 geese at one time. With the CWS–AR office located in Sackville since 1947, resident observers here provided casual observations over a longer period than elsewhere, and the local salt-marshes were surveyed regularly in spring 1971 to 1974 (Table XII-3).

5.2 Fall

As remarked by Boyer (1951, 1966) and Van Zoost (1970; this volume), numbers of geese seen in fall in the Border area were much lower than in spring. The few aerial surveys, which provided wider coverage including areas not sampled from the ground, showed fewer than 100 geese on any one day, e.g. 69 on 12 October 1971, 45 on 17 October 1973. Ground counts noted over 100 geese occasionally, e.g. 10 October 1965, 22 November 1991. The only substantial numbers involved birds passing over without stopping, with 1600 seen over John Lusby 14–17 December 1980, and 350 over Sackville 18 December 1971, presumably after staging areas along Northumberland Strait (in P.E.I. or N.S.) began to freeze. Geese were heard flying over Fenwick, N.S. (E. Coates, pers. comm.), at 21:15 on 12 December 1994, the first cold night of that winter; this was on a direct line from Orwell, P.E.I., to northern Massachusetts, and too far west to have come from north shore staging areas (except Baie Verte and Cape Tormentine, N.B.). The following day, between 15:00 and 17:00, K. Popma (pers. comm.) saw at least 1100 Canada Geese in 10 flocks flying southwest to west over the Tantramar marsh, N.B., 20 km farther west. Those geese also presumably came from P.E.I., as staging areas in southeastern N.B. were never known to hold that many birds. An anecdotal report of over 2000 geese passing over Sackville in early November 1992 lacked details, and cannot be correlated with freeze-up. Geese certainly move across the area throughout the fall, commonly in smaller flocks (30–70) which seldom arouse comment and thus frequently remain unrecorded.

6. Discussion

A distinctive feature of the Canada Goose migration in the N.B.–N.S. Border area, shared with other marsh areas around the upper Bay of Fundy, was the

much greater use of the area in spring than in fall. Another feature, shared with the Shepody marshes (Chapter XIII, this volume) but not those around Minas Basin and Cobequid Bay (Chapter XIV, this volume), was the lower numbers encountered here in recent years. A plausible hypothesis explaining those phenomena derives from the extremes of the tidal regime in the Bay of Fundy.

The highest tides ("spring tides", associated with full and new moon periods) in March regularly removed most of the snow and ice from the salt-marshes around the upper Bay of Fundy, even during periods when snow or ice persisted elsewhere. During the 1960s, when the occurrence of thousands of geese at the John Lusby salt-marsh in early spring gave the site recognition as an important staging area, coastal bays and marshes in Prince Edward Island, where tidal range is much smaller, often remained ice-covered well into April. With snow and ice cover in P.E.I. dispersing earlier in generally milder springs since 1970, it became possible for geese to move there directly, without a pause around Cumberland Basin and Shepody Bay as in the past. The farmlands adjoining Prince Edward Island marshes used by geese are more intensively worked and presumably more productive than those in the Border area, so geese may find better feeding as well as much more extensive fields in P.E.I., once the coastal marshes there, which provide refuges from disturbance, are ice-free.

Although the recent trend has been towards milder springs, there was great variation between years, sometimes to the point of affecting goose migration. In 1972, geese returned to the Border area as usual in late March, only to encounter frequent and heavy snows in early April. All natural food was covered by snow, and supplementary feeding (grain) was provided 9–11 April until a thaw cleared the feeding areas. Climatological data at Moncton, N.B., showed that 1972 had lower mean temperatures in both March and April (–6° and +1°C, respectively) than any year in recent decades except 1967, as well as the greatest snowfalls in both months (132 and 104 cm, respectively) excepting 1967 (March) and 1963 (April). The combination of cold temperatures and heavy late snowfalls occurred every few years before 1972, and evidently slowed the migration in some springs. The coldest and snowiest springs since then, in 1984 and 1992, ranked behind 1963, 1967, and 1972 both as to cold and snow, except for record total snowfall (accumulated over several small storms) in April 1984.

7. Literature cited

Boyer, G.F. 1951. An ecological study on the marshes of the New Brunswick–Nova Scotia border region with special reference to waterfowl. Unpubl. M.S. thesis, U. Illinois, Champaign. 78 pp.

Boyer, G.F. 1966. Birds of the Nova Scotia–New Brunswick border region. Can. Wildl. Serv. Occas. Papers no. 8. 52 pp. (2nd ed., 1971, with addendum).

Ganong, W.F. 1903. The vegetation of the Bay of Fundy salt and diked marshes: An ecological study. Botan. Gaz., 36(3): 161–186; 280–302; 349–367; 429–455.

Van Zoost, J.R. 1970. The ecology and waterfowl utilization of the John Lusby National Wildlife area. Unpubl. M.Sc. thesis, Dept. of Biology, Acadia Univ., Wolfville, N.S. 183 pp.

XIII. CANADA GOOSE STAGING AROUND SHEPODY BAY, SOUTHEASTERN NEW BRUNSWICK

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1. Abstract

Use by Canada Geese of the Shepody area in southeastern New Brunswick was not reported by bird students before 1960. Up to 8000 geese stopped there in spring in the 1960s, but numbers were smaller after 1970 and became insignificant after 1980. Few geese used the area in fall during the same period, although substantial numbers passed over, especially during December. Most staging geese frequented the dyked grasslands by the Shepody River near Harvey, with use of nearby salt-marshes being much less regular.

2. Introduction

The general introduction to the use by Canada Geese of areas around the upper Bay of Fundy (C, this volume) set out the topographical and land-use characteristics of the region. Like other similar macro-tidal areas (see Chapters XI, XII, XIV, this volume), the salt-marshes and dykelands of Shepody Bay, the northwestern arm of the Bay of Fundy (see Fig. C-1), probably have been used by migrating geese for many centuries, to varying degrees, but no traditions of such use were recorded by ornithologists. Squires (1952) cited no reports from this area, perhaps owing to an absence of observers, and useful records go back only to 1961. This chapter summarizes the available information up to 1993.

3. Study area

The history of dyking and drainage of salt-marshes in the Shepody area received little study (P. Kent & J. Steeves, unpubl. rep. in CWS files, 1970). Acadian settlement evidently was less extensive there than around the Border marshes and Minas Basin, and little dyking was done before English and German immigrants settled locally in 1775 to 1800. Attempts at drainage of Shepody (Germantown) Lake and associated inland bogs continued at intervals through the 19th Century, but that probably had rather little effect on use of the region by migrating geese. The dykes separating Shepody Bay salt-marshes from dyked haylands and pasture were established probably by the early 1800s. The major changes subsequently, there as elsewhere, were (a) the decline in drainage efforts that resulted from reduction in use of horses and thus in the market for marsh hay, mostly after World War I; and (b) the closing of the Shepody River by a tidal dam near Harvey in 1956, with subsidized drainage of grasslands in the protected area extending a few kilometres upriver. As in the Border marshes, little of the protected area there has been cultivated to date.

4. Sources

The largest data-set available was the species files of the Moncton Naturalists Club (MNC), from 1962 to 1978. Reports published in *Nature News* (of The New Brunswick Museum) and *N.B. Naturalist* provided only a few records additional to those from MNC, and the N.B. Museum species files added a few more. Systematic surveys were made each spring in 1971 to 1974 of several coastal marshes near the Shepody National Wildlife Area (along Shepody River downriver from Germantown; established 1975). The CWS (computerized) aerial survey files also provided some information.

5. Results

5.1 Spring

Geese usually arrived in the Shepody area in spring soon after the middle of March and departed in mid-May (Tables XIII-1,2,3). First sightings by MNC members usually involved small flocks in flight, but systematic surveys of staging areas showed several hundreds present within a few days after the first reports. Across the bay near Memramcook, first arrivals in 1929 to 1946 (6 years) averaged 30 March, whereas in 1963 to 1976 (5 years) the mean was 22 March (N.B. Museum data). Peak numbers in the region occurred between 16 March and 27 April, most often towards mid-April. Migration probably averaged a little earlier after 1970, when peak numbers were noted more frequently in March and first arrivals more often before mid-March.

Maximum numbers reported never exceeded 2500 and often were less than 1,000 geese after 1970, whereas reports of 4000 to 8000 were received in 1962 to 1964. No reports were published from this area after 1984, implying a further decline to insignificant levels. Coverage by ground surveys (Tables XIII-1,2) showed as many geese as were detected by aerial surveys in the same years (Table XIII-3), indicating that incomplete or variable coverage was unlikely to be the main explanation for the smaller numbers reported later.

Most of the geese reported were found on the dyked grasslands near Harvey, above the Shepody River dam. The other areas were used less regularly, although large assemblages were noted in many area on aerial surveys, e.g. 2027 at Germantown marsh (fresh) 15 April

Table XIII-1. Spring counts of Canada Geese, Shepody Bay area[1], N.B., summarized by span of dates with geese noted, plus date with highest number, from Moncton Naturalists Club files (1962–78), *N.B. Naturalist/Nature News*, and New Brunswick Museum files.

Year	No. of Dates	Span of dates with geese noted (no. seen)	Peak Count (number)	
1961	1		30 March	(1000)
1962	4	16 March – 15 April	15 April	(6–8000)
1963	8	26 March (244) – 18 May (7)	27 April	(5000+)
1964	8	18 March (30) – 15 May (6)	12 April	(3–4000)
1965	8	21 March (11) – 24 April (806)	16 April	(2000)
1966	19	13 March (19) – 18 May (10)	8 April	(1590)
1967	8	29 March (56) – 16 May (400)	23 April	(2222)
1968	22	17 March (few) – 16 May (2)	31 March	(3500)
1969	7	19 March (108) – 27 April (1012)	9 April	(1420)
1970	4	19 March (87) – 18 April (214)	27 March	(400)
1971	9	11 March (8) – 11 May (38)	12 April	(1100)
1972	2	18 March (few) –23 April	23 April	(1000)
1973	6	15 March (30) – 26 April (250)	1 April	(1000)
1974	5	16 March (32) – 21 April (650)	30 March	(850)
1975	4	24 March (21) – 12 April	12 April	(1000)
1976	3	7 March (80) – 23 March	23 March	(1100)
1977	1	15 March (55)		
1978	2	25 March (200) – 1 April	1 April	(350)
1983	3	11 March (few) – 27 April (250)	16 March	(2000)
1984	5	13 February (43) – 30 April (75)	15 April	(130)

[1] Including most areas in footnote to Table XIII-2; most observations were referred to Harvey, meaning the dyked fields above the Shepody River dam.

1975, 1270 at Daniels Flats (salt-marsh) and 506 at Waterside (brackish) 26 April 1972, 746 at New Horton (salt-marsh) 31 March 1970, 617 along Memramcook River (dyked and salt-marshes) 9 April 1969.

5.2 Fall

Geese used the Shepody area much less in fall than in spring. The few aerial surveys of this region in fall found no geese. MNC observers saw geese in many years but usually in small numbers (<100 birds) and often only as flocks passing over. First reports were mostly 25 September to mid-October, with last sightings in late November to mid-December. A few belated flocks passed after the New Year, e.g. near Salisbury (W of Moncton) 16 January 1955, at Moncton 23 January 1973 (50) and 4 January 1983 (75), and at Dover (E of Moncton) 12 January 1975 (11). The largest concentrations noted in the area used in spring included 1,000 near Riverside 5 October and 500 near Hillsborough 22 October in 1963, and 250 near Harvey 5 December 1970. Large flights were also seen passing over the city of Moncton (40 km north), e.g. 400 3 November 1974, 1,200 6 December 1977, 400 flying west 17 December 1980, and 550 at suburban Coverdale 20 October 1989. The large flights late in the season suggested winter-induced passage, probably from Prince Edward Island towards New England, as contrasted to the small movements into the local area.

6. Discussion

The pattern of much larger goose numbers in spring than in fall in the Shepody area was shared with other areas around the upper Bay of Fundy (Chapters XI, XII, XIV, this volume). Waterfowl hunting probably at times deterred geese from using the area in fall, as all large marshes there were open to hunting. The extreme tidal range, leaving wide mud-flats at low tide, and the exposure of adjacent salt waters to the full sweep of any wind and waves, makes the sea in this area unattractive as a refuge from which inshore foraging at night might be undertaken. Eelgrass, the main food of geese in most coastal areas in autumn, is scarce to absent in these silt-laden waters, and foraging was inland or on salt-marshes.

Table XIII-2. Spring counts of Canada Geese, Shepody area[1], N.B., by range of counts[2] in 5-day periods, 1971–74 (no. surveys in parentheses). Highest count of season in italics.

	Numbers of Canada Geese							
	1971 (9)		1972 (8)		1973 (12)		1974 (8)	
Period	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
March								
17–21	–	–	–	–	550	–	200	–
22–26	1078	–	724	–	–	–	–	–
27–31	1142	–	–	–	*622*	–	–	–
April								
01–05	1010	–	1753	–	–	–	–	–
06–10	1130	1472	–	–	–	–	–	–
11–15	*2010*	–	1868	–	543	–	525	–
16–20	1847	1886	2094	–	450	–	*1197*	–
21–25	–	–	*2142*	–	–	–	649	–
26–30	1349	–	1264	–	–	–	–	–
May								
01–05	–	–	1378	–	243	322	472	–
06–10	–	–	547	–	182	500	528	
11–15	–	–	–	–	23	–	–	–
16–20	–	–	–	–	109	–	10	–
21–25	–	–	–	–	0	–	0	–

[1] Areas surveyed (name used in original data-file, equated to name on current topographic maps) were:
Calhoun Flats = salt-marsh just S of Hopewell Cape;
Mountville Flats = salt-marsh at Daniels Flats;
Protected land above Shepody Dam = dykeland N of Harvey;
Saltmarsh below Shepody Dam = salt-marsh NW of Mary's Point;
Anderson Hollow = salt-marsh at Waterside;
Shepody National Wildlife Area = freshwater (impounded) marsh NE of Germantown.

[2] Minimum and Maximum counts were composites for all areas combined; original data-fields included data by individual areas, except in 1971.

Table XIII-3. Spring counts of Canada Geese, Shepody Bay area[1], N.B., from CWS aerial surveys, by minimum and maximum counts in each month, 1969–76 (no. surveys in parentheses). Highest count of season in italics.

		Range of goose counts					
		Shepody area			Memramcook Area		
Year	Span of Dates	Min.	Max.	No. Surveys	Min.	Max.	No. Surveys
1969	24 March – 16 April	353	*723*	3	21	617	3
1970	23 March – 28 April	52	*2,315*	5	0	296	6
1972	26 April	–	*2,078*	1	–	–	–
1973	24 March	43	–	1	–	–	–
1974	19 March – 21 May	4	*838*	3	–	–	–
1975	15 April	–	*2,047*	1	–	–	–
1976	09 March – 05 May	150	*711*	3	100	–	1

[1] Including all areas near Shepody (see Table XIII-2) and Memramcook River marshes (mostly dykeland).

The decline and virtual disappearance of large goose flocks from the Shepody area in spring paralleled that seen in the Border marshes, but began earlier, around 1970. The hypothesis (see Chapter XII, this volume) that earlier disappearance of snow and ice from fields and marshes in Prince Edward Island in recent years may explain the change applies in both areas at the head of Chignecto Bay. Geese now pass through directly to P.E.I. in spring, without a pause on the Fundy salt-marshes which formerly became snow-free much earlier than those in P.E.I.. The earlier abandonment of the Shepody spring staging area suggested that the Shepody dykelands might be less attractive to geese than the combination of salt-marsh and sod-farm in the Border area. It is not obvious why this might be so, except that the dyked marsh at Harvey would not have become snow-free as a result of macro-tidal action. The more extensive areas of farmland, with nearby shores subject to less tidal variation, in Prince Edward Island seem to be preferred over these smaller areas by the Bay of Fundy.

7. Literature cited

Squires, W.A. 1952. The birds of New Brunswick. Monogr. Ser. no. 2. The New Brunswick Museum, Saint John. 164 pp.

XIV. CANADA GEESE AROUND THE MINAS BASIN AND COBEQUID BAY, NOVA SCOTIA

by A.J. Erskine 1/ and F.J. Payne 2/

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1. Abstract

Several thousand migrating Canada Geese frequent salt-marshes and agricultural fields around the southern bight of Minas Basin and the upper reaches of Cobequid Bay, in Nova Scotia. Numbers in spring in the last 20 years approached 10 000 birds, but fall numbers were less than half as large. Very few geese over-wintered in these areas. The numbers using these areas increased, with earlier spring arrival and later fall departure, from about 1975, and have remained high since then.

2. Introduction

Canada Geese used the salt-marshes, dyked grasslands, and adjacent upland fields around both arms of the upper Bay of Fundy in the past, but no systematic studies have been made in the southern areas, around Minas Basin and Cobequid Bay. This chapter treats data from the sporadic surveys and scattered observations in these two areas.

3. Study area

General considerations of geology, sedimentation processes, and land-use in these areas, influenced by some of the highest tides on Earth, were treated in the introduction (C, this volume) to the chapters on the Fundy region. The Minas Basin–Cobequid Bay areas (Fig. XIV-1) are closed off from the cooling influence and fog of the main Bay of Fundy by the Cape Split peninsula. The tides which rush in and out through the 5-km wide Minas Channel have little cooling effect on the shores of the inner basin, especially in the southern bight of Minas Basin. Thus the salt-marshes and fields there become clear of snow and ice somewhat earlier, on average, than those around the upper reaches of Chignecto Bay.

Marine sedimentation differs between areas, probably because of their orientation. The tidal currents entering through Minas Channel sweep eastward across northern Minas Basin with little interruption into Cobequid Bay, losing only the coarser sediments on the way. Thus, flats of coarse sand line the lower reaches of Cobequid Bay, and salt-marsh development (on mud and silt) there is restricted to the narrow upper bay near Masstown, Lower Onslow, and Truro. The southern bight of Minas Basin, away from the direct line of the incoming tidal currents, features vast flats grading from sandy mud to fine silt from the north southward (Hicklin 1981). The lowlands adjoining the Minas Basin make up the most important agricultural region of Nova Scotia, with open habitats comprising a higher proportion of the landscape than in most other parts of the province (Blomidon Naturalists Society 1992).

4. Sources

Most of the information used came from three sources: the computerized aerial survey files, including both CWS and provincial Wildlife Division surveys; records published in *Nova Scotia Birds* and *Nova Scotia Bird Society Newsletter*; and an unpublished report plus unsummarized files assembled by Fred Payne and George Boyd of Nova Scotia Wildlife Division. Additional data for the Minas Basin area of Kings County, N.S., were from J.S. Erskine (1968; unpubl. notes) and the *Blomidon Naturalist Society Newsletter* (BNS; 1984–present).

5. Results

5.1 Minas Basin

Traditionally geese used the Kings County dykelands and salt-marshes in spring and fall, with the fall flocks less obvious after they were dispersed by hunting. The assembled data confirmed that pattern, but also indicated that since 1975 geese returned earlier in spring, and even over-wintered in the area, probably in response to reduced snow- and ice-cover in recent years. The available data provided only broad patterns, as few systematic (repeated) surveys were made.

The only report before October was of five geese, one of which bore a yellow neck-collar (i.e. marked in the coastal corridor of the Atlantic Flyway outside of breeding season), near Kentville 15 September 1987; the marked bird stayed, with a flock of pinioned geese, until 20 December. Counts on the Minas Basin Wildlife Management Area (WMA; closed to hunting August 1977) near Medford in 1978 to 1982 provided most of the fall records (Table XIV-1). Evidently few geese arrived before 10 October in most years, with peak numbers in mid-November and departure early in December. Some independent counts in the same area later were slightly larger: 700 on 26 November 1986, 700 on 9 November 1989. Migrating flocks included 500 flying south near Kingsport 22 October 1986 and 250 near Windsor 31 October 1987 (BNS). The few aerial counts were made in 1961 to 1975 when fewer geese were present. The aerial surveys covered all shores of the southern bight of Minas Basin, and showed a similar pattern to the ground observations, with 28, 32, and 125 on three October surveys vs. 385, 445, and 0 on three counts in late November.

December reports were mostly from the Wolfville Christmas Bird Counts (CBCs), made each year since 1920 except 1947 to 1951 (data since 1948 summarized in Table XIV-2), plus BNS reports. Until 1966, most CBCs found no geese, but counts in 1953, 1957, and 1961 had 121, 110, and 169, respectively. Geese were noted every year from 1972, but counts regularly exceeded 100 only from 1980, with numbers in 1981, 1983, and 1987 matching recent fall peaks. One earlier aerial survey in winter (6 January 1975) found 401 geese.

Freezing probably drove most geese away in some years, as February aerial surveys in 1977 and 1986 found only 35 and 12, respectively. Similarly, BNS reports in 1984 to 1991 noted less than 50 geese in any year between mid-January and early March. Reports of hundreds or thousands of geese in the area "in winter" in 1984 and 1992 may have referred to early migrants, as did reports of "many thousands" in late February 1976 and "many" in late February 1978, or to flocks lingering into December. J.S. Erskine's (1968) counts, 4–10 times each

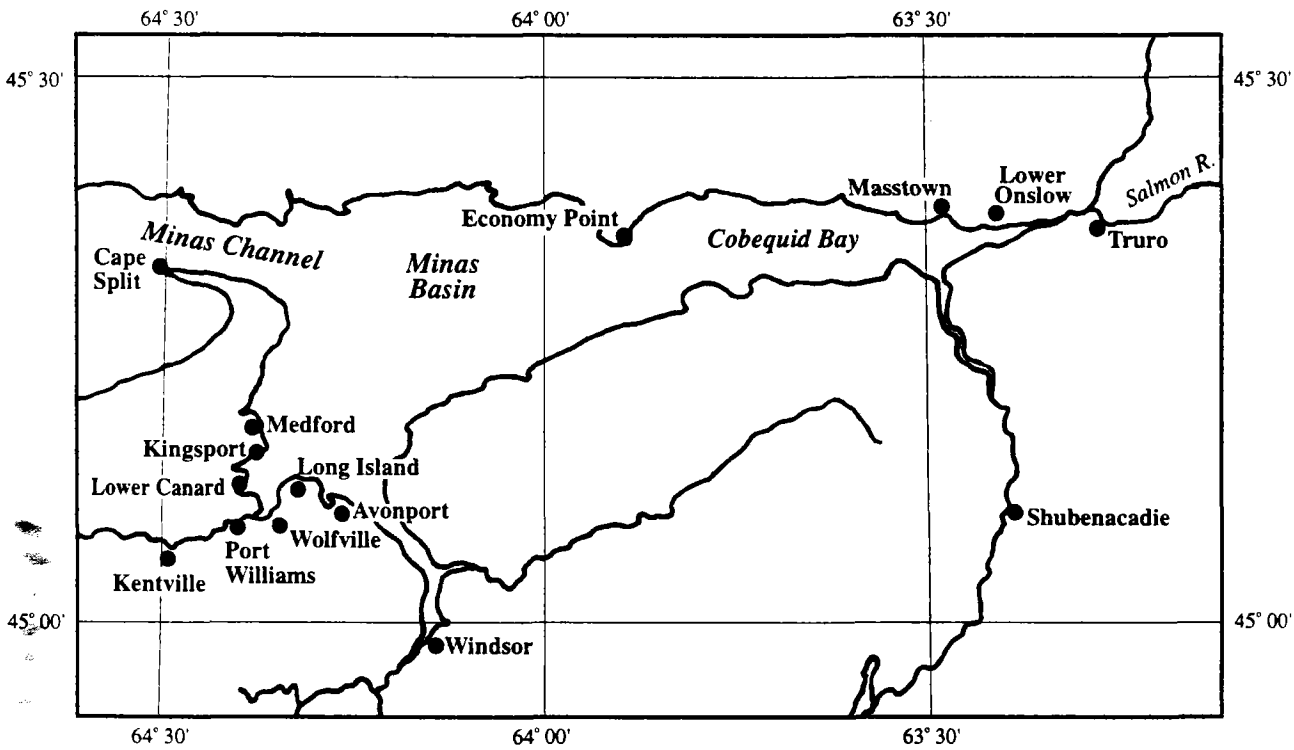

Figure XIV-1 The Minas Basin-Cobequid Bay region of Nova Scotia, to locate Canada Goose staging and wintering areas.

Table XIV-1. Canada Goose counts at Minas Basin Wildlife Management Area, autumns 1978–82, from unpublished report by F. Payne and G. Boyd, Wildlife Division, N.S. Department of Lands & Forests (now Natural Resources), surveys grouped in 5-day periods (no surveys in periods marked -).

Month	Number of geese counted 1978	1979	1980	1981	1982
October					
05	–	–	–	–	48
10 – 14	103	66	0	55	130
17 – 21	128	266	136	60	–
24 – 26	175	–	94	11	220
27 – 31	253	350	–	–	390
November					
04 – 06	–	0	375	–	–
11 – 14	390	–	385	380	420
15 – 19	385	340	150	166	505
20 – 22	350	–	500	–	614
26 – 30	180	50	–	230	–
December					
02 – 07	0	400	0	106	557
10 – 14	–	0	–	428	0
15	–	–	–	90	–

winter along the dykes between Wolfville and Long Island and Port Williams, spanned dates between 8 November and 21 March in 1948 to 1968. Most of his goose sightings were in November or March; only the annual summaries were published (see Table XIV-2), but his raw data for 1961-62 showed only one sighting of 10 geese between 9 December and 13 March. He saw no geese at all in 7 winters out of 20, and encountered them on three or more surveys in only five winters.

Migrating geese usually returned to the area in March (except late February records in 1976 and 1978 noted above). Small flocks appeared in early March, and there were few reports of hundreds until later, e.g. 31 March 1961 (300), 21 March 1966 (400), 17 March 1979 (2000), 13 March 1985 (1600), 18 March 1988 (1800), 22 March 1989 (5000). However, an aerial survey 9 March 1976 found 4318 geese, about equally divided between the Wolfville and Avonport salt-marshes. Other large aerial counts were later, 7 April 1976 (1855), 15 April 1975 (7614), as was a ground count, 6 April 1975 (5000). Late April counts were lower, the maximum 1443 geese on 27 April 1989, and few lingered into May, e.g. 126 on 5 May 1976 (aerial).

5.2 Cobequid Bay

Canada Geese stopped off regularly in spring along the marshes where the Salmon River estuary widens into Cobequid Bay, as in the past, but in fall only the provincial Debert Sanctuary (near Lower Onslow) held large numbers for long. Only the few aerial surveys showed substantial numbers in spring, mostly in early April (Table XIV-3). Anecdotal reports (H.R. Webster, B.C. Carter, CWS, unpubl.) from 1950 to 1953 indicated that early-arriving geese then usually rested on the ice of McElmon's Pond (where Debert Sanctuary was later established) while waiting for ice to clear off the salt-marshes in March.

Maximum numbers in fall varied little, e.g. 1,050 at Debert Sanctuary 19 October 1976, 700–1000 near Lower Onslow 8 October 1986, and 1000–2000 there in October to November 1987, but reports were lacking in most years. Detection of first arrivals may be complicated by the presence of feral Canada Geese breeding in the countryside near Shubenacadie (35 km south). Repeated counts at Debert Sanctuary in 1976 showed fewer than 65 geese in late September, possibly all feral birds, whereas 450 on 1 October presumably included migrants. Counts from 6 October through 5 November showed over 750 geese, but only 100 remained by 15 November. Several geese near Lower Onslow in 1987-88 bore numbered yellow neck-collars placed on birds in New Jersey to North Carolina in winters 1984 to 1988 (see Chapter XVIII). The few geese, <60 on any survey, seen in the area in winter were probably feral birds from Shubenacadie.

Table XIV-2. Summary of winter counts of Canada Geese near Wolfville, Nova Scotia, from Christmas Bird Counts (CBCs) and surveys by J.S. Erskine (1968, + unpublished data; see text for coverage).

Winter	Number of geese noted	
	CBC	JSE (surveys with geese/all surveys)
1948–49	n.s.[1]	0 (0/8[2])
1949–50	n.s.	0 (0/8)
1950–51	n.s.	0 (0/11)
1951–52	n.s.	22 (1/8)
1952–53	151	150 (2/10)
1953–54	121	10 (2/10)
1954–55	missing	319 (5/12)
1955–56	0	33 (1/12)
1956–57	0	49 (1/8)
1957–58	110	0 (0/9)
1958–59	0	0 (0/8)
1959–60	0	108 (3/12)
1960–61	0	0 (0/12)
1961–62	169	243 (6/14)
1962–63	0	12 (1/16)
1963–64	0	286 (6/14)
1964–65	0	0 (0/15)
1965–66	2	79 (2/20)
1966–67	74	195 (5/21)
1967–68	29	95 (1/24)
1968–69	c.p.[1]	missing[2]
1969–70	30	missing
1970–71	0	missing
1971–72	9	0 (0/22)
1972–73	0	35 (1/22)
1973–74		n.s.
1974–75	178	
1975–76	18	
1976–77	68	
1977–78	90	
1978–79	13	
1979–80	45	
1980–81	183	
1981–82	700	
1982–83	134	
1983–84	501	
1984–85	385	
1985–86	130	
1986–87	254	
1987–88	573	
1988–89	154	
1989–90	48	
1990–91	295	
1991–92	186	

[1] n.s. = no survey; c.p. = count period, not count day.

[2] Only 2 of J.S. Erskine's 4 survey routes ("walks") included dykeland/salt-marsh areas where geese would be expected; the numbers of surveys shown here are half the published totals for each year. His published series ended with the 1967–68 winter; surveys were continued for 5 more years, but not all data have survived.

Table XIV-3. Canada Geese on spring aerial surveys, Cobequid Bay, Nova Scotia.

Year	Date	Numbers noted in survey block: Masstown (west)	Truro (east)
1966	21 April	145	150
1973	19 April	722	22
1975	15 April[1]	0	3000
1976	09 March	291	0
	07 April	966	50
	05 May	71	45

[1] Also 110 near Economy Point (farther west).

6. Discussion

Geese were reported more regularly and in much greater numbers in spring than in fall both at Minas Basin and Cobequid Bay throughout the period. This might reflect only that geese were disturbed by hunting in fall, but the numbers seen then at the Minas Basin WMA and the Debert sanctuary, where no hunting was allowed, never approached the higher spring counts in those regions. This pattern parallels that seen in similar habitats around the head of Chignecto Bay (Chapters XI–XIII, this volume).

Numbers of geese frequenting Minas Basin and Cobequid Bay increased markedly starting around 1975. Spring migrants appeared earlier as well as in larger numbers, and fall migrants more often lingered past the end of November, but wintering seemed not to have become regular. Those changes were correlated with less severe winters since 1971, when recurring thaws removed much of the snow- and ice-cover from salt-marshes and dykelands. Geese in those areas seldom fed more than 1–2 km from salt water, even on the dykelands, although upland fields sloping towards the sea near Lower Canard were sometimes used in spring (BNS, AJE).

The higher recent numbers here in spring differed from the pattern found in the Amherst and Shepody marshes. In those areas, goose numbers in spring increased in the 1960s and subsequently declined, apparently as a result of geese moving through without stopping to stage in Prince Edward Island. That different behaviour correlates with the more intensive agriculture—as in P.E.I.—in the Wolfville and Truro areas, which thus may provide better feeding there than around Chignecto Bay.

7. References

Blomidon Naturalists Society 1992. A natural history of Kings County. Acadia University, Wolfville, N.S.. 196 pp.

Erskine, J.S. 1968. Winter birds of Wolfville, Nova Scotia: 1948–1968. N.S. Museum Occas. Paper no. 7, Sci. Ser. no. 5. 15 pp.

Hicklin, P.W. 1981. Use of invertebrate fauna and associated substrates by migrant shorebirds in the southern bight, Minas Basin. Unpubl. M.Sc. Thesis, Acadia University, Wolfville, N.S. 212 pp.

D. CANADA GOOSE STAGING ELSEWHERE IN NEW BRUNSWICK

XV. CANADA GEESE MIGRATING IN THE SAINT JOHN RIVER VALLEY AND SOUTHWESTERN NEW BRUNSWICK

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1. Abstract

Little is known of the use by Canada Geese of staging areas in western New Brunswick, although tens of thousands of geese must cross that region during each migration. In 1961 to 1966, several thousand geese stopped annually on the lower Saint John River marshes during March–April, but that area was used by smaller numbers both before and after that period. Only a few hundred geese are reported annually there in fall. The southwest coast of New Brunswick and the Saint John River valley above Fredericton are not used regularly by staging geese though occasional groups, in transit or stopping briefly, have been noted there.

2. Introduction

The southwestern quarter of New Brunswick is the most densely settled by people, and it includes much of the fertile farmland and the only extensive floodplain in the province. The most concentrated waterfowl hunting in New Brunswick occurs there, in the Saint John River marshes. This is also the "gateway" through which most migrant Canada Geese presumably enter the Maritimes in spring or leave the region in fall, but few geese are reported there relative to the many thousands that must pass through in each migration. Major variations in numbers of geese seen in southwest New Brunswick occurred both before and during the period treated in this compendium (see Squires 1952, 1976). This chapter summarizes the sparse data, which do not fit readily with those from other parts of the Maritimes.

3. Study area

The southwestern quarter of New Brunswick (Fig. XV-1) includes two important but very different waterfowl habitats, the rocky and much dissected tidal coastline, and the landlocked channels and marshes of the lower reaches of the Saint John River, as well as other inland areas less used by waterfowl. The coast west from St. Martin's is based on hard rocks, scoured by the chilly waters and fierce currents of the Bay of Fundy. Islands and rocks offshore provide protection from wave action for many shallow-water areas, with reefs and ledges exposed at low tide (tidal range 4–8 m) providing most of the sparse habitat available there for geese (used mainly by Brant *Branta bernicla*; see e.g. Erskine 1988). The present tidalregime prevailed only since the Bay of Fundy rose to near present levels around 3500 years ago. Although tidal action is felt for 140 km up the Saint John River, to near Fredericton, fresh water dominates the regime there, with a major freshet each spring following snow-melt around the headwaters. This inland area features an alternation of parallel ridges and valleys, the latter underlain by softer, sedimentary rocks. The Kennebecasis estuary, the Long Reach of the main river plus Belleisle Bay, and Washademoak Lake occupy successive valleys south of the main floodplain and Grand Lake, where the "sedimentary triangle" reaches the river from the northeast. The major marsh area extends downriver from Maugerville (20 km SE of Fredericton) to near Hampstead, where the river breaks through a ridge to the Long Reach, in which the Oak Point–Grassy Island marshes are relatively isolated from the main block. Fewer geese use the Kennebecasis and Nerepis marshes farther downstream, perhaps because more continuous human settlement now creates more disturbance there than is tolerated by these birds.

4. Sources

Nearly all of the available data in this region came from volunteer naturalists. Few geese were detected on aerial surveys of the Fundy coastline, as the surveys were not timed to coincide with low tides when resting and feeding opportunities there would have been greater. Published records in *Nature News/N.B. Naturalist*, with the New Brunswick Museum files on which those were based, were the principal sources both for coastal and inland areas, and annual reports of the Fredericton Field-Naturalists Club provided some additional data for the inland area. Some records from 1942 to 1945 were extracted from unpublished reports by Harold S. Peters, flyway biologist of U.S. Fish & Wildlife Service (copies in CWS files).

5. Results

5.1 Spring

Canada Geese were seen regularly in spring, with first arrivals on the coast ranging from early to late March and along the Saint John River from mid- to late March (Tables XV-1,2). In both areas arrivals tended to be earlier since 1970. Numbers reported on the coast were mostly

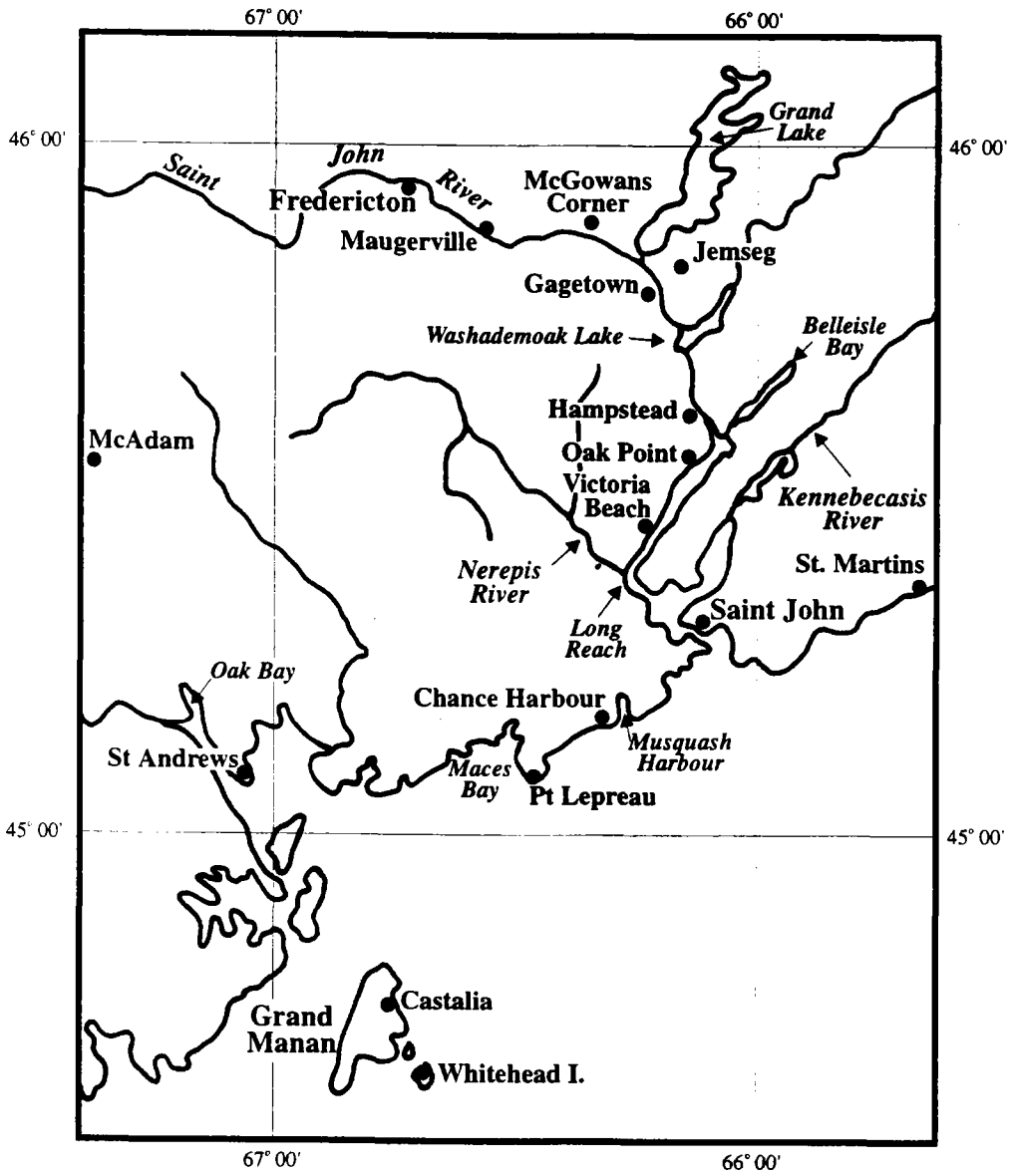

Figure XV-1 The southwest quarter of New Brunswick, to locate Canada Goose staging areas along the St. John River and in the southwest coastal region..

Table XV-1. Spring reports of Canada Geese, southwest coasts of New Brunswick, including first arrivals and dates with highest numbers, from H.S. Peters' reports, *N.B. Naturalist/Nature News*, New Brunswick Museum files, and CWS aerial surveys (*).

(a) First arrivals

Years	Range of first arrival dates	Mean
1884–97	10–31 March	21 March (9 years)
1936–59	14 March – 2 April	20 March (6 years)
1960–67	11–30 March	19 March (8 years)
1971–79	8–17 March	13 March (3 years)
1981–90	late February – 22 March	10 March (6 years)

(b) Concentrations (100+)

Year	Places and dates of spring goose assemblies (no. seen)
1885	St. Martins, 5 April (100)
1888	Grand Manan, 21 May (1000) ⟨ improbable; Brant? DSC⟩
1893	Point Lepreau, 14 March (600) ⟨ perhaps Brant?⟩
1946	Saint John, 24–26 April (large flocks flying E)
1960	St. Martins, 2 April (many)
1961	St. Martins, 4 April (100), 8 April (400)
1963	St. Martins, 7 April (100)
1964	St. Andrews, 12 April (100)
1967	Musquash & St. Martins, 1 April (197 & 250, resp.)
1972	Saint John, 25 March (300); Musquash, 30 March (150)*; Mace's Bay, 26 April (192)*
1974	Chance Harbour, 17 April (253)*
1983	Saint John, 16 March (100)

Table XV-2. First arrivals of Canada Geese in spring, Saint John River marshes, N.B., summarized by area, from H.S. Peters' reports, *N.B. Naturalist/Nature News*, Fredericton Field-Naturalists Club annual reports, and New Brunswick Museum files.

Years	First arrival date in area Kennebecasis/Long Reach	Maugerville/Jemseg	Frederiction/Scotch Lake
1900–23	14 March		14 March – 3 April; (mean (9yr) 22 March)
1942–49	22–29 March (mean (2yr) 26 March)	24 March–6 April; (mean (3yr) 30 March)	
1950–59	13–26 March (mean (5yr) 19 March)		
1960–69	14–26 March (mean (4yr) 19 March)	19–31 March (mean (3yr) 25 March)	27–30 March (mean (3yr) 28 March)
1970–79	2–18 March (mean (5yr) 10 March)	3–31 March (mean (7yr) 17 March)	1 April
1980–89	2–15 March (mean (3yr) 9 March)		

Table XV-3. Spring counts of Canada Geese, Saint John River marshes, N.B., for years with several dates or large counts (excluding arrival dates summarized in Table XV-2), by span of dates with geese noted, plus date with highest number, from H.S. Peters' reports, *N.B. Naturalist/Nature News*, Fredericton Field-Naturalists Club annual reports, and New Brunswick Museum files.

Year	No. of dates	Span of dates with geese noted (no. seen)	Peak count (number)
1942	1	23 April (80)	–
1943	2	13 April (32) – 4 May (17)	–
1944	2	30 April (150) – 7 May	7 May (200)
1960	1	15 April (100+)	–
1961	6	early April (1000) – 25 May (75)	27 April (8500+)
1962	8	7 April (700) – 12 May (100)	28 April & 6 May (2500)
1963	10	6 April (175) – 11 May (20)	29 April (1000)
1964	6	28 March (250) – 3 May (120)	26 April (1000–2000)
1965	5	4 April (279) – 2 May (110)	24 April (1500–2500)
1966	3	22 April (50+) – 7 May (342)	29 April (3000+)
1969	2	28 April (100) – 2 May (100)	–
1971	2	27 March (150) – 9 May (75)	–
1972	1	23 April – 29 April (300+)	23 April (580)
1973	1	31 March	31 March (430)
1974	1	23 March	23 March (750–1000)
1977	3	27 March (83) – 1 May	1 May (450)
1983	1	2 April (110)	–
1986	1	30 March (200)	–

small, few assemblages exceeding 300, although far more Brant regularly stage in those areas (Erskine 1988). Along the River, groups totalling a few hundred Canada Geese were seen in most years from late March through April into early May (Table XV-3). In 1961 to 1966, the spring concentrations were much larger and peaked later, usually in the last week of April, with over 8500 noted 27 April 1961 from Oak Point to near Jemseg. That maximum figure partly reflected more extensive coverage that day, as most large counts were by Fredericton-based observers and included only the marshes between McGowans Corner and the (lower) Gagetown ferry. The scarcity of reports from the Saint John River marshes since 1970 suggested that fewer geese stopped there in recent years, as sightings of even a few thousands of geese surely would have been reported. However, inadequate reporting may account for part of the apparent decline, as geese still occur in hundreds there in spring (DSC, pers. obs.). Few geese were reported after 10 May, the latest 75 on 25 May 1961.

5.2 Fall

Reports of geese in fall in western New Brunswick were scattered in space and time, but a few counts exceeded 200 birds. Probably many reports were of passing flocks, but this was seldom stated explicitly. A few were seen at Oak Bay on 12 September 1971 and at Grand Manan 14 September 1891 (both sightings perhaps of feral birds raised in N.B.?; see Chapter XVI, this volume), and small groups were at Scotch Lake on dates between 24 September and 4 October in 1909 to 1913, but no others were reported before mid-October. Aerial surveys along the Saint John River in 1969 found 250 between Grand Falls and Fredericton and 316 on the lower River 15–16 October, and 632, all below Fredericton, on 19–21 November. Although most sightings, from ground or air, were of small flocks, reports at Payson Lake, NW of Woodstock, in late October 1989 (2000 geese), at Scotch Lake 5 November 1905 (400) and at Lakeville and Woodstock in mid-October 1974 (400, and many large flocks, respectively) confirmed that substantial numbers pass over at that season. In fact, most of the fall numbers reported came from west of Fredericton, with some

clumping of records in late October and mid-December. Widespread hunting of waterfowl throughout October may deter most goose flocks from settling in fall on the readily accessible marshes along the lower river whence most spring reports originated. The few reports there in fall involved migrating groups of 150–200 geese, with 1000 noted as roosting off Victoria Beach in early November 1974. The main exodus across the province in December was somewhat better reported, with passing flocks totalling up to 400 birds and one report of 1000 geese at Grand Manan 30 November 1887. Christmas Bird Counts at Fredericton, Saint John, and St. Andrews reported geese in some years, with over 100 birds on individual CBCs in 1962, 1981, 1983, and 1984, and 200 at Whitehead Island 26 December 1974. A few geese occasionally remained on the coast into early January, when belated migration was noted near Fredericton in 1970 and 1972, but overwintering was not reported.

6. Discussion

The picture of Canada Goose migration across the southwest sector of New Brunswick was blurred by the scarcity of data. The geese that stage around the southern Gulf of St. Lawrence in spring and fall must cross southern New Brunswick en route to or from the Gulf, as no such numbers (totalling many tens of thousands) were reported in southwestern Nova Scotia at any time recently. The spring reports in 1961 to 1966, years with heavy snows often lasting into May, confirmed that thousands of geese passed through the region then. Apparently that pattern of large numbers stopping on the Saint John River marshes in spring (Squires 1976) was a temporary phenomenon, as the earlier edition of the same book (Squires 1952) made no mention of it. As with the parallel pattern of large numbers of geese stopping-over in the 1960s and 1970s around the head of Chignecto Bay (Chapters XI–XIII, this volume), a plausible explanation is that spring staging areas in Prince Edward Island were often inaccessible before late April in those years owing to persistence of snow cover. With milder springs more recently, most geese now move directly to P.E.I. without intermediate stops in New Brunswick. Geese sometimes fly thousands of kilometres nonstop (e.g. Cooch *in* Hochbaum 1955), so Canada Geese certainly can travel without a stop between staging areas in New England and Prince Edward Island when feeding areas are accessible at their destination. Most potential stopover areas in western New Brunswick are disturbed by waterfowl hunting during October, so it is plausible that most migrating geese then pass over, at night or high enough that few are noticed, without settling anywhere in the region. Geese migrating southwest from staging areas in northeast New Brunswick also may contribute to the records west from Fredericton, as the potato fields of the middle Saint John River valley are the first extensive agricultural lands traversed after those geese leave the Gulf of St. Lawrence.

Except for a few years in the 1960s, southwestern New Brunswick has been of minor significance in the picture of Canada Goose staging in the Maritimes in recent decades. It seems likely that geese stopped over in the Saint John River marshes in larger numbers before European settlement began, when native hunting presumably was less disturbing to the birds. The passage of geese through this region is inadequately documented though evidently substantial in numbers.

7. References

Erskine, A.J. 1988. The changing patterns of Brant migration in eastern North America. J. Field Ornithol. 59: 110–119.

Hochbaum, H.A. 1955. Travels and traditions of waterfowl. Univ. Minn. Press, Minneapolis. 301 pp.

Squires, W.A. 1952. The birds of New Brunswick. Monogr. Ser. no. 2. The New Brunswick Museum, Saint John. 164 pp.

Squires, W.A. 1976. The birds of New Brunswick. 2nd ed. New Brunswick Museum, Monogr. Ser. no. 7. 221 pp.

E. ADDITIONAL INFORMATION ON CANADA GEESE, SUMMARIZED FOR THE MARITIMES AS A WHOLE.

XVI. WILD-BREEDING CANADA GEESE IN THE MARITIME PROVINCES

by A.J. Erskine

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1. Abstract

Former native breeding stocks of Canada Geese in the Maritime Provinces were extirpated by about 1900. Introductions and escapes from captive flocks led to establishment during the last 40 years of at least eight local breeding stocks, with a few outliers, in all three provinces. The breeding population totals a few hundred pairs and is probably increasing. Some flocks may be more or less sedentary, but most birds move from inland areas to the coasts in fall and winter and mingle with flocks of migrant geese from farther north. Few geese that breed in the Maritimes are year-round residents of breeding areas owing to snow and ice restricting feeding opportunities there in winter.

2. Introduction

Canada Geese evidently bred in the Maritime Provinces in the past. Squires (1976) reported breeding on Miscou and Grand Manan islands in New Brunswick in the 19th Century, but those stocks were extirpated by soon after 1900. Tufts (1962) and Godfrey (1954) knew of no authenticated breeding in the wild by Canada Geese in Nova Scotia and Prince Edward Island, respectively, up to the dates of their compilations. Virtually all geese now breeding in the Maritimes originated from recently captive stocks, either through deliberate releases of flightless young birds or by free-flying offspring settling in the wild near captive stocks. The situation up to 1990 (Fig. XVI-1) was briefly summarized by Erskine (1992; cited hereafter as "the Atlas"), to which this account adds some historical details.

3. Sources

No comprehensive account of the introduced geese of the Maritimes and their descendants has been published, but records of broods are scattered through naturalists' bulletins and anecdotal reports exist for most stocks. This account summarizes information from readily available sources, but full documentation of all individual cases was not attempted as it would have needed much time for the small improvement in perspective anticipated.

4. Results

4.1 New Brunswick

Canada Geese were held captive under avicultural permits in many parts of the province, especially in the southeast, for many years. Free-flying birds derived from a captive flock at McAdam were breeding in the wild before 1960, probably before 1950. Feral breeding around the captive flock at the Woolastook Wildlife Park west of Fredericton began in the 1970s. Birds from those stocks were scattered over the intervening area by 1990, and probably accounted for most breeding in western New Brunswick (breeding confirmed there in the Atlas in ten 10x10 km squares). Two records west of Plaster Rock were so far north of all others that a separate source seemed likely. All but rapid waters in inland New Brunswick freeze over, so all these geese are believed to leave their breeding areas in winter. Band recoveries (Chapter XVIII, this volume) indicated that the McAdam goose flock wintered on Long Island, N.Y.

A few pairs of Canada Geese were breeding on islands around Grand Manan Island in 1987, but most breeding reported there in the Atlas, confirmed in four squares, resulted from releases by an aviculturist in (probably) 1988. Those geese may be year-round residents, as some shoreline and shallow-water areas there remain ice-free in most winters.

Flightless young geese were released near the N.B.–N.S. border (Missiquash Wildlife Management Area) by the Nova Scotia Wildlife Division, Dept. of Lands and Forests (now Dept. of Natural Resources), in 1966 (n=30), 1971 (n=68) and 1972 (n=18). Scattered breeding occurred nearby in both provinces (five squares with confirmed breeding in the Atlas) in most recent years. Some geese have overwintered in the area, but probably not in every winter. Three isolated records (50–90 km distant) of confirmed breeding inland in southeast New Brunswick are of unknown origin, but those birds must move away (to coasts) in winter.

4.2 Nova Scotia

In addition to breeding geese in the border region of Nova Scotia (see preceding paragraph), the largest group of free-breeding Canada Geese in the Maritimes is scattered through the broad upper valleys of the Stewiacke and Musquodoboit Rivers, within 20 to 30 km of the captive flock at the Nova Scotia Wildlife Park near Shubenacadie, which formerly included free-flying birds and from which the local stock evidently originated. Wild breeding there probably occurred before 1970, but was not confirmed until around 1980. Hunting was never restricted in that area, although the Wildlife Park provided refuge in hunting season. Some of those geese may be year-round

residents in the province, but others join flocks of northern origin migrating to the eastern United States, especially since feeding of local goose stocks at the Park ceased around 1980. Recoveries of geese banded and released at Shubenacadie (summarized in Chapter XVIII, this volume) were mostly in Nova Scotia (12 locally, 4 on Halifax Co. shores, 2 more distant), with two in southeast New Brunswick, one each in Newfoundland and the Gaspé, and two in east coast states. Captive geese were also held in the Blandford area west of Halifax in the 1960s and 1970s, as well as by various aviculturists, but local breeding in the wild did not result from those stocks.

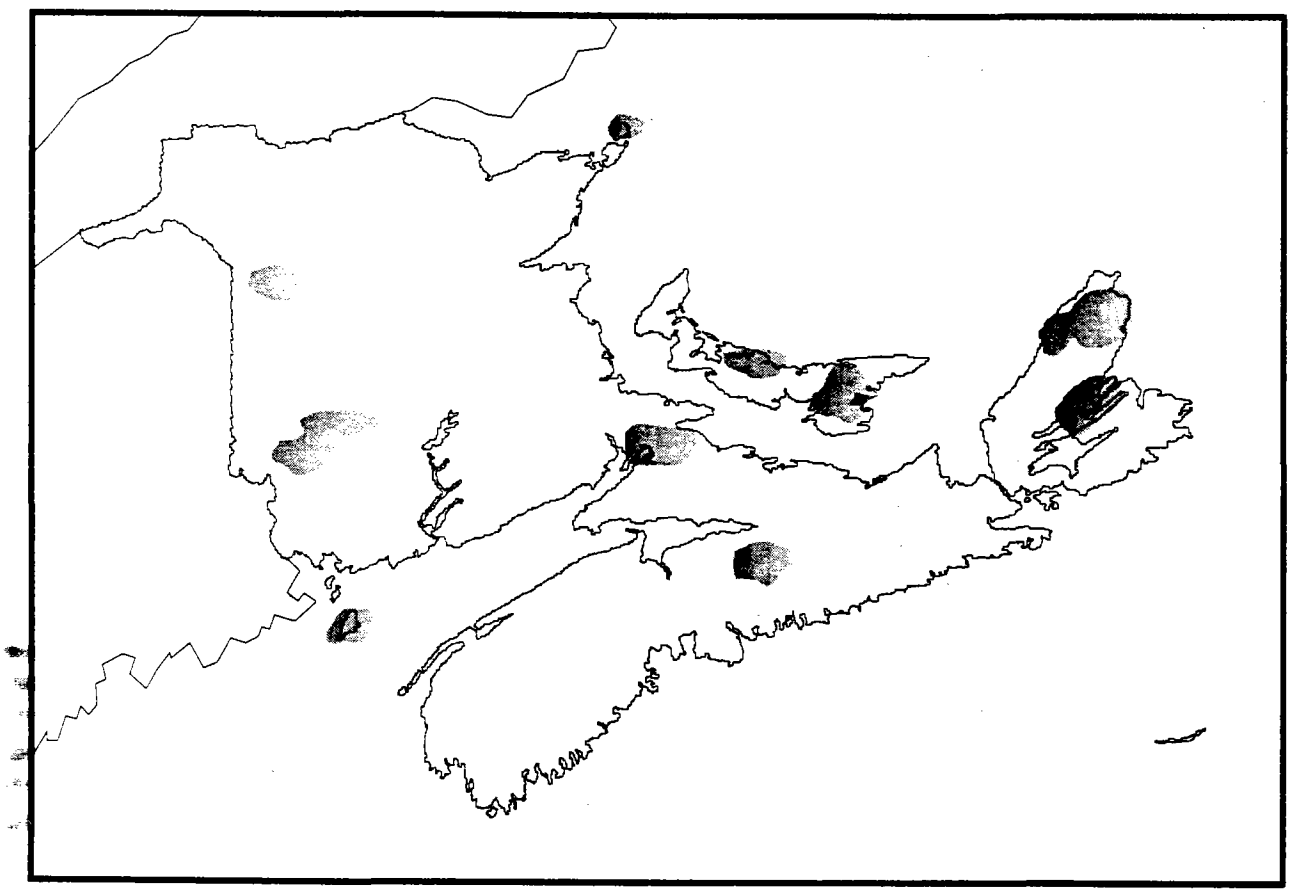

Figure XVI-1 The Maritime Provinces of Canada, with shading in areas with recent(introduced) or former (indigenous) breeding Canada Geese.

Anecdotal reports of pairs of Canada Geese in summer on the Cape Breton Highlands plateau suggested breeding there, but an aerial survey on 24 June 1960 found none. A few captive-reared young geese were released near Baddeck in 1963, but none was known to have survived the first hunting season. Another introduction attempt in Cape Breton Island, with goose hunting closed in the northern counties there in 1980 to 1988, was more successful. Releases totalling 757 young geese were made near Cheticamp (1980), and Baddeck (1981–84), and six squares there with confirmed breeding in 1986 to 1990 (Atlas) showed that the stock had become established. Banding confirmed that those birds migrate to the Atlantic coast, some moving farther, in winter. Of 89 recoveries of banded birds released on Cape Breton Island, 63% were in Nova Scotia, the remainder being in Prince Edward Island, New Brunswick, Ontario, and in east coast states, with one in the Dominican Republic. That stock predictably adopted migratory habits, as wintering in Cape Breton is marginal always and impossible in some years.

A few records of confirmed breeding elsewhere in Nova Scotia (in Atlas) may not have been derived from recently introduced stocks. Geese nesting on barrens and offshore islands in Guysborough and Yarmouth Counties seem likely to have originated from the stocks that traditionally migrated along those coasts rather than from recent releases elsewhere. Some others were perhaps outliers from the Shubenacadie flock, although one near Annapolis might stem from Grand Manan Island (N.B.) (80 km west).

4.3 Prince Edward Island

Free-flying young from captive Canada Goose flocks at Moore's Sanctuary (Milltown Cross) and Prince Edward Island Wildlife Park (North Rustico) were breeding locally by 1960 and 1970, respectively. The Atlas showed confirmed breeding in fifteen and four 10x10 km squares, respectively, centred on those parks. Those flocks probably accounted for most geese that attempted to winter on the Island, although few can have over-wintered successfully in some winters.

4.4 Breeding populations

Estimates published in the Atlas suggested a total of about 300 breeding pairs, roughly 75 pairs in New Brunswick, 125 pairs in Nova Scotia, and 100 pairs in Prince Edward Island (Erskine 1992). Those figures were only informed guesses, but they probably indicated the correct order, i.e. a few hundred pairs rather than a few thousands. The data suggested that all stocks were stable or growing at present.

5. Discussion

Although aviculturists in the Maritimes held up to one thousand Canada Geese captive at times during the past 40 years, rather few wild-breeding stocks became established by escapes and free-flying offspring of captive geese. The majority of captive geese were held in areas around the Gulf of St. Lawrence where goose-hunting is traditional and widespread. Perhaps geese escaping or "breeding-out" from captive flocks there mostly were shot in hunting seasons before they could breed. Geese now breeding in the Maritimes are mostly in areas with little tradition of goose-hunting, e.g. southwest interior N.B., east-central interior N.S., and central Cape Breton Island, or where refuge areas were available, as in Prince Edward Island and around Shubenacadie, N.S.. The larger breeding stocks have been established for 10 to 30 years, and seem likely to persist. The Grand Manan Island birds and some isolated breeding records found in the Atlas study are more recent, and may not include enough birds to maintain breeding stocks permanently.

Most of the Maritimes is marginal (or worse) winter range for Canada Geese, and some established breeding flocks are in areas that freeze completely each winter. Thus, most breeding stocks must move to nearby sea-coasts or farther in winter, and this has been documented for some of them. Problems associated with "home-grown flocks" of Canada Geese, common in more temperate areas where the birds are fully sedentary, have been minor on the local scene thus far. Complaints of introduced geese feeding in vegetable gardens and croplands in Prince Edward Island and Nova Scotia and of defensive ganders frightening children in cottage areas near Shubenacadie are isolated cases.

Most native Canada Goose populations breed in relatively open situations, nesting in extensive marsh or bog areas or on small islands to avoid terrestrial predators. Settlement of the Maritimes by people from Europe was accompanied by decimation of most mammalian predators of nesting geese, e.g. wolves, bears, although foxes persisted in varying numbers. Predation of and disturbance to nesting geese by humans, before and since the start of European settlement, evidently more than cancelled-out any relaxation of pressure by wild predators, as the local goose stocks were extirpated by 1900.

Some goose flocks now breeding free in the Maritimes may be viewed by local people as "park birds", despite not being confined in any way, as some are relatively tolerant of people, but those breeding away from settled areas are indistinguishable in behaviour from wild geese. Releases of flightless young geese were undertaken in hopes of establishing huntable stocks as well as for the pleasure most people experience in seeing these impressive birds in their local area. The present situation in the Maritimes generally with breeding Canada Geese may be somewhat analogous to that of pheasants, also introduced in all three provinces to establish huntable stocks but now persisting in N.B. and P.E.I. mainly with winter feeding by people who like to see them around, and with protection from hunting except in (parts of) Nova Scotia.

6. Literature cited

Erskine, A.J. 1992. Atlas of breeding birds of the Maritime Provinces. Nimbus Publishing Ltd. and Nova Scotia Museum, Halifax. 270 pp.

Godfrey, W.E. 1954. Birds of Prince Edward Island. Nat. Museum Canada Bull., 132: 155–213.

Squires, W.A. 1976. The birds of New Brunswick. 2nd ed. New Brunswick Museum, Monogr. Ser. no.7. 221 pp.

Tufts, R.W. 1962. Birds of Nova Scotia. Nova Scotia Museum, Halifax, N.S. 481 pp.

XVII. FEEDING AND HABITAT USE BY CANADA GEESE IN THE MARITIME PROVINCES

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1. Abstract

Eelgrass was the staple food of Canada Geese in the Maritimes, and it remains important in most areas, except in the upper Bay of Fundy where eelgrass is lacking and salt-marsh grasses were used instead. Freshwater wetlands were little used in most areas. Farmlands were created only after European settlement of the region began in the 1600s, and opportunities for geese to forage safely on fields and croplands emerged mainly in the last 40 years. Use of agricultural lands by geese has become the dominant mode mainly in Prince Edward Island, the most extensive productive farmland area in the region. Climate limits the use of most habitats in the Maritimes, and geese overwinter here only where eelgrass shallows remain ice-free through the winter.

2. Introduction

Canada Geese used different foods and frequented various habitats in different parts of the Maritimes. The availability of, and safe access to, particular foods presumably determined whether a habitat or an area was used by geese. Major changes in goose use occurred in the past, even before European settlement in the Maritimes began, and changes continued through the last 40 years on which this volume focussed. This chapter summarizes the meagre information and inferences regarding goose foods and habitat use across the Maritimes.

3. Sources

Only the thesis studies in this volume (Chapters III, IV, XI) considered feeding by geese explicitly. The evidence elsewhere was largely anecdotal, based on unsystematic observations by the authors and others, and including inferences drawn from the vegetation available in areas where geese were seen feeding.

4. Results

4.1 Eelgrass (*Zostera marina*) and its shallow-water habitats.

Eelgrass was the most widespread food of geese here, and it was the only important food plant in many areas (see Chapters III, IV, this volume). Eelgrass grows in shallow waters over sandy to muddy bottom, in bays, inlets and lagoons, where tidal ranges do not exceed four metres. In the upper Bay of Fundy, where tidal ranges often exceed twelve metres, surface muds are soft and the water is turbid from suspended silt, so eelgrass is lacking, and geese there mainly used other habitats and foods.

4.2 Salt-marsh grasses and the intertidal zone

Cord-grasses (*Spartina alterniflolia and S. patens*) are the main saltmarsh-forming plants in the north Atlantic and Canada Geese near Sackville, N.B. were reported to feed on those grasses (Boyer 1951). Van Zoost (1970, this volume), however, found that geese near Amherst, N.S., preferentially used a scarcer salt marsh grass (*Puccinellia americana*). It is possible that use of *Spartina* had been inferred erroneously, on the assumption that the more common grasses were being taken when geese were seen feeding in salt-marshes.

4.3 Sedges and grasses of inland bogs and marshes

Some freshwater wetlands were used by geese in former times, where extensive open habitats allowed them to detect and escape from potential predators, on four legs or two. Canada Geese bred in bogs of northeastern New Brunswick, particularly on Miscou Island, until around 1900 (see Chapter XVI, this volume), but bogs are not very productive habitats and no data suggest that bogs here were used extensively by geese at other seasons. Freshwater marshes along the St. John River were used by migrating geese in spring during the 1960s (Chapter XV, this volume), but nothing is known of the foods taken there. Some feeding on crop wastes (see below) may have occurred in that farming area, but that source could have supported the peak numbers seen in 1961 to 1966 for only a few days.

4.4. Grasses and crop residues on agricultural lands

Before European settlement, farmlands, whether dyked meadows or upland pastures and croplands, had never existed in the Maritime Provinces. These habitats appeared on the local scene only in the last 300 years, and they probably became attractive to geese only in the 1800s or even later. Some early farming occurred on or adjacent to former salt-marshes after these were enclosed by dykes, but this did not add to the total area of potential goose habitat. Farmlands smaller in total area than about 50 ha probably were never attractive to geese, even in the absence of disturbance by hunting. Much farming in the Maritimes was sub-marginal up until World War II or later, and geese attempting to use farmland here before 1950 probably were hunted whenever this was legal and sometimes when it wasn't. With more enforcement of hunting restrictions and fewer people living near the poverty line in rural situations, farmlands near suitable coastlines gradually became more accessible to geese over the last 40 years. Only fields near the shores would have been used at first, with traditions developing in places

Table XVII-1. Habitats used by Canada Geese in different staging/wintering areas in the Maritime Provinces (compiled from various sources). Use: - habitat absent; + minor; ++ moderate; +++ important.

Area (Chap. Ref.)	Shoreline (km - estimate)	Habitat presence and use: Eelgrass shallows	Salt-marsh	Fresh marsh	Farm-lands
Yarmouth County (I)	100	++	+	+	-
Port Joli area (II, III, IV, V)	100	+++	+	-	-
Halifax County (VI)	100	+++	+	-	-
Cape Breton County (VI)	40	++	+	-	-
Antigonish County (VII)	40	++	+	-	+
Northumberland Strait S (VIII)	200	++	+	-	+
Prince Edward Island (IX)	600+	+++	+	-	+++
N.E. New Brunswick (X)	400	+++	+	+	+
N.B.-N.S. Border (XI, XII)	40	-	++	+	+
Shepody Area (XIII)	30	-	+	+	+
Minas-Cobequid (XIV)	30	-	+	+	++
St. John River (XV)	80	-	-	++	+

where the birds not disturbed (see Hochbaum 1955). During the CWS aerial survey of Prince Edward Island in April 1983, several inland transects were flown (up to 10 km from salt water), but few geese were found more than 1 km inland. Martin and Guignon (1983) reported regular use both in fall and spring 1974-75 of Prince Edward Island croplands which had been harvested (of grain, corn, or peas, usually), but they did not specify how far inland the geese then ranged. Recent observations in Prince Edward Island (during surveys for neck-collared geese) emphasized the use by geese of potato fields, including those where potatoes surplus to marketing board quotas were dumped, in addition to grain stubble - probably the most frequently used habitat - and pasture grasses. Geese used fields for resting both in spring and fall if they were not disturbed there. The use of fields for roosting was not always distinguished from use for foraging, but not all geese seen on fields were feeding there.

5. Discussion

Reasoned guesses as to the relative availability of potential foraging habitats in the various areas used by Canada Geese in the Maritimes (Table XVII-1) provide some perspective on the overall situations now and in the past. As yet, no serious studies of the use by geese of different foraging habitats, when more than one type was available, have been made in the Maritimes (compare Reed et al. 1977, for the St. Lawrence valley in Québec).

Geese on the Atlantic coast of Nova Scotia (Chapters I-VI, this volume) stage and over-winter regularly through almost exclusive use of eelgrass, and ice cover limits the possibilities of wintering there as much or more than does the availability of eelgrass. Martell (1969, this volume) suggested that eelgrass provided geese wintering near Port Joli with sufficient crude protein and perhaps with sufficient energy for maintenance of body condition. He considered that the wintering geese were not unduly stressed, despite winter temperatures substantially lower than the stress threshold proposed by Lefebvre and Raveling (1967). Newman Smith (1983, this volume) compared energy requirements of wintering geese, as provided by digestion of eelgrass, with the availability and winter depletion of eelgrass in the Port Joli area. She concluded that goose use, at levels then current, approached but did not exceed the potential carrying capacity of eelgrass stocks in the area. This seems intuitively plausible for what had been the northernmost regular wintering area for geese in the northeast, but

confirmation using a more rigorous sampling protocol might be desirable.

Eelgrass apparently was important to geese also around the southern Gulf of St. Lawrence (Chapters VII-X, this volume). Before European settlement of the region made farmlands and crop wastes accessible to geese, especially in the last 40 years, eelgrass presumably was the major goose food there too. Although no studies of goose foods have been made there, we infer that eelgrass still is the major food used in the southern Gulf, except in Prince Edward Island where productive farmlands provide an alternative that is energetically favourable. Foraging on nearby salt-marshes also occurred there in late spring after many fields had been re-cultivated (Martin and Guignon 1983), and in fall hunting and cultivation in their study area often limited use of fields by geese, which mostly foraged in marine areas at that season.

Geese foraged on salt-marshes mainly where eelgrass was lacking (Chapters XI-XIV, this volume), or when other foraging areas were temporarily unavailable. As goose use of upper Fundy salt-marshes was largely restricted to early spring, before marshes and fields in the southern Gulf of St. Lawrence were free of ice and snow, and as use of those salt-marshes declined when the other habitats became available early in the season, salt-marsh greasses probably are less preferred foods, eaten mainly in the absence of something better.

Geese in the Maritimes made limited use of freshwater wetlands, perhaps because only a few large marsh areas also provided sufficient security from terrestrial predators (including hunting). Only in the lower Saint John River valley (Chapter XV, this volume) were freshwater areas used by geese more than other habitats. The virtual disappearance of staging geese from that area after favoured staging areas elsewhere became available early in spring suggested that freshwater habitats offered mainly less preferred food plants.

Use of agricultural lands by geese was of major importance in the Maritimes mainly in Prince Edward Island. Martin and Guignon (1983) suggested that, when accessible, grain stubble and other harvested fields were used in preference over all natural foraging habitats, because of greater ease in foraging there or more nutritious vegetation (compare Reed 1976, and Kear 1963 cited therein). Similarly, use of the Amherst sod farm in preference to nearby salt-marshes (Chapter XII, this volume) implied that geese can forage more profitably on certain farmlands than in aquatic habitats. The relative scarcity of geese foraging on other fields, such as haylands and pastures, suggested that introduced grasses may be favoured only while they are green, thus in spring mainly where recently mowed, and in fall seldom if at all.

Snow- and ice- cover preculded geese from wintering in areas where foraging on farmlands or salt-marshes was regular, and wintering occurred only in areas where eelgrass shallows remained at least partly ice-free through the winter. Climate is thus the main limitation on the wintering of geese in the Maritime Provinces, but availability of suitable habitats, and opportunity to use them safely, must limit the numbers present at other seasons.

6. Literature cited

Boyer, G.F. 1951. An ecological study on the marshes of the New Brunswick-Nova Scotia border region with special reference to waterfowl. Unpubl. M.S. thesis, U. Illinois, Champaign. 78 pp.

Hochbaum, H.A. 1955. Travels and traditions of waterfowl. Univ. Minnesota Press, Minneapolis. 301 pp.

Lefebvre, E.A. and Raveling, D.G. 1967. Distribution of Canada geese in winter as related to heat loss at varying environmental temperatures. J. Wildl. Manage. 31:538-546.

Martell, A.M. 1969. A study of winter waterfowl ecology at Port Joli, Nova Scotia. Unpubl. M.Sc. thesis, Acadia University, Wolfville, N.S. 275 pp.

Martin, K., Guignon, D. 1983. Canada Goose numbers, daily movements and foraging patterns on Prince Edward Island. Proc. N.S. Inst. Sci., 33: 107-114.

Reed, A. 1976. Geese, nutrition and farmland. Wildfowl, 27: 153-156.

Reed, A., Chapdelaine, G., Dupuis, P. 1977. Use of farmland in spring by migrating Canada Geese in the St. Lawrence valley, Quebec. J. Appl. Ecol., 14: 667-680.

Smith, G. Newman 1983. The utilization of Port Joli, Port L'Hebert and Sable River by migrating and overwintering Canada Geese. Unpubl. M.Sc. thesis, Acadia University, Wolfville, N.S. 60 pp. (+ 28 tables & 25 figures not paginated)

Van Zoost, J.R. 1970. The ecology and waterfowl utilization of the John Lusby National Wildlife Area. Unpubl. M.Sc. thesis, Dept. of Biology, Acadia Univ., Wolfville, N.S. 183 pp.

XVIII. MOVEMENTS OF CANADA GEESE WITHIN, TO, AND FROM THE MARITIME PROVINCES, SHOWN BY BAND RECOVERIES AND NECK-COLLAR SIGHTINGS

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1. Abstract

Band recoveries and neck-collar sightings linked most Canada Geese that pass through the Maritime Provinces with the main Atlantic Flyway winter range (New Jersey to North Carolina). Few records provided direct links with breeding areas, but fall band recoveries in Labrador suggested that as the main source. Although the largest concentrations of band recoveries and neck-collar sightings were in Prince Edward Island at all seasons, some geese that pass through the Island in spring seem to move southward from Labrador through New Brunswick directly to New England in fall. The scarcity of both band and neck-collar evidence of Atlantic Region geese in Maine suggested that those geese routinely bypassed or overflew that state without stopping. The geese that frequented the Atlantic shores of Nova Scotia were poorly represented in the accumulated neck-collar sighting files, but recoveries of birds marked in Nova Scotia suggest that these geese belonged to a separate population, probably that breeding on the Island of Newfoundland.

2. Introduction

The use of numbered metal leg-bands and of other marking devices, for recognition of individual birds when they are subsequently recaptured, has become widely established since the early 20th Century, and the literature making use of such relocation of birds is very extensive (e.g. Aldrich *et al.* 1949; Bellrose 1976). Geese are favourable subjects for studies using banding and other marking devices, as they are large, conspicuous, and sought-after by hunters, thus ensuring usefully high return rates on the effort devoted to tracking their movements. However, geese also are highly gregarious, so the movements of members of one group may be representative only of a local sub-population. The capture and marking, and subsequent recapture—by shooting, trapping, or reading of a neck-collar, of geese is usually much easier (and thus less costly) in favoured areas, and thus these efforts tended to be concentrated there, sometimes to the virtual exclusion of other areas regularly used by geese. These advantages and disadvantages applied in the Maritimes as elsewhere. This chapter summarizes geographic information obtained to date from recoveries of Canada Geese that moved to or through the Maritime Provinces, and such information from neck-collar sightings as applied to the delineation of migration corridors and related movements. This is not an exhaustive treatment either of band recovery or neck-collar sighting data from these areas.

3. Methods and sources of data

Band recovery listings for Canada Geese banded or recovered in the Maritimes were obtained from the Canadian bird-banding office (CWS, Hull, Qué.). Although dated June 1992, those listings included no returns after January 1990. Listings of Canada Geese neck-collar numbers reported elsewhere were made available by successive Atlantic Flyway coordinators, Richard Malecki and Jay Hestbeck, of New York and Massachusetts Cooperative Wildlife Research Units, respectively. The listings used were received in 1987, 1989, and 1993, but they were not complete up to those dates. Atlantic Region summaries of marking and resighting of neck-collared geese were obtained from CWS–AR files.

Band-recovery data were sorted by banding location and recovery location (identified to 10-min block of latitude/ longitude; thus 453-0671 represented a recovery in the 10-minute block having its southeast corner at lat.45°30'N, long.67°10'W). Neck-collar data were sorted, firstly to assemble repeated sightings of the same bird, secondly to group data by banding and resighting locations, and thirdly by season of resighting. Mapping of data involved much recombining of minor groupings earlier segregated. In general, band returns in the area where the geese were banded were ignored, whether in the same or later seasons, as such homing has been demonstrated many times.

4. Results

4.1. Movement patterns of geese marked or re-located in Labrador (with a few returns in Québec east of long. 68°W)

Only 13 recoveries, originating from bandings at four widely spaced locations, were available from geese marked in Labrador, and none of those was obtained in the Maritime Provinces. Three were in southern Québec (Gaspé to Québec City), and the others in coastal areas from southeast New Hampshire to Cape Hatteras, N.C. (Fig. XVIII-1). These meagre returns reflected the limited banding effort in Labrador to date.

Recoveries in Labrador of geese banded farther south were more numerous, totalling 102, with the larger numbers marked in North Carolina (28), Delaware (26), and Maryland (11). Their distribution within Labrador (Fig. XVIII-2) may indicate where hunters were able to shoot geese, better than they showed where geese occurred. Nearly one-third (32) of those recoveries were along the coasts of Labrador and Québec east of longitude 60°W, a region farther (south-)east than any recoveries from Labrador bandings.

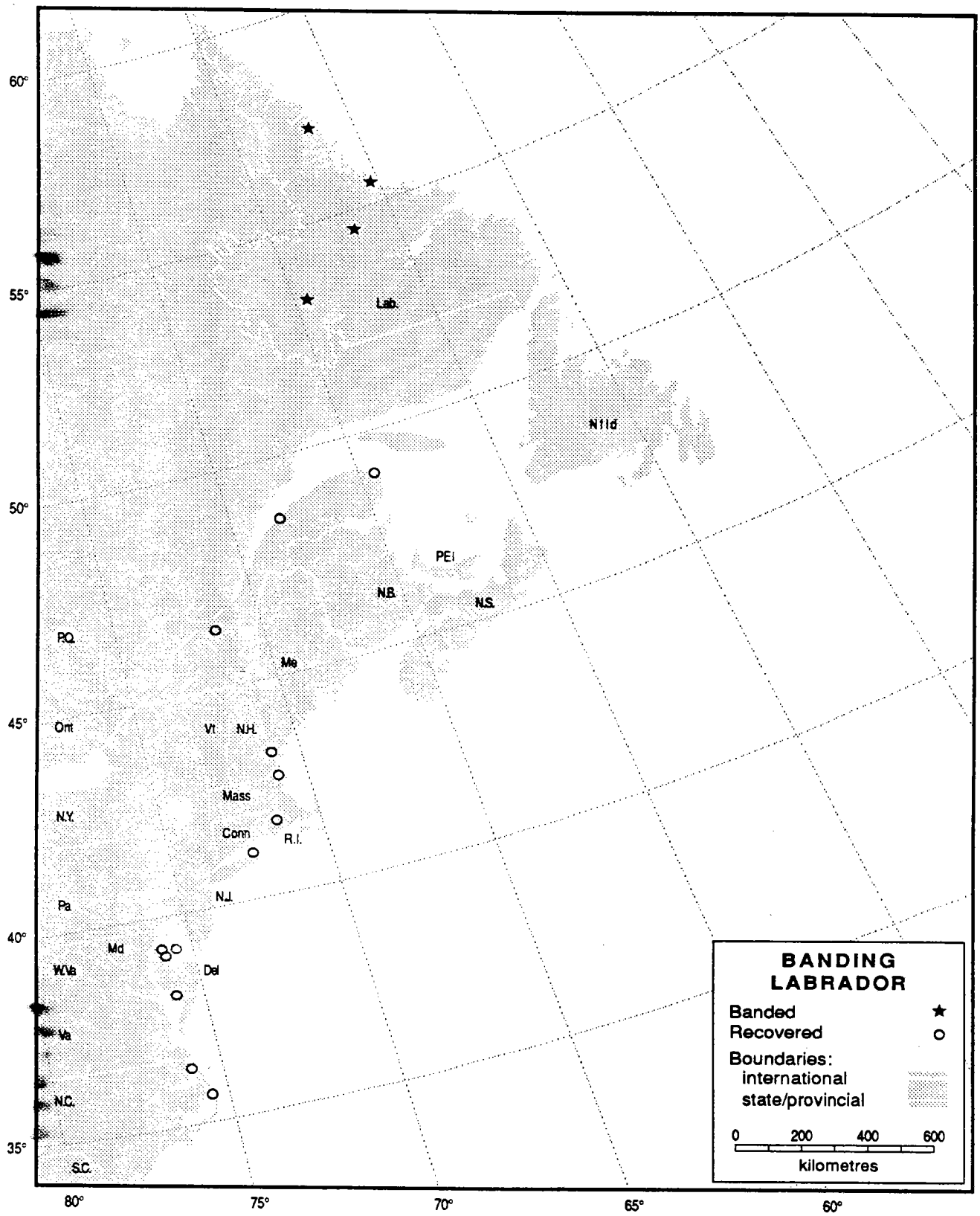

Figure XVIII-1 Distribution of recoveries of Canada Geese banded in Labrador and recovered elsewhere. Stars represent banding locations and dots represent recovery locations.

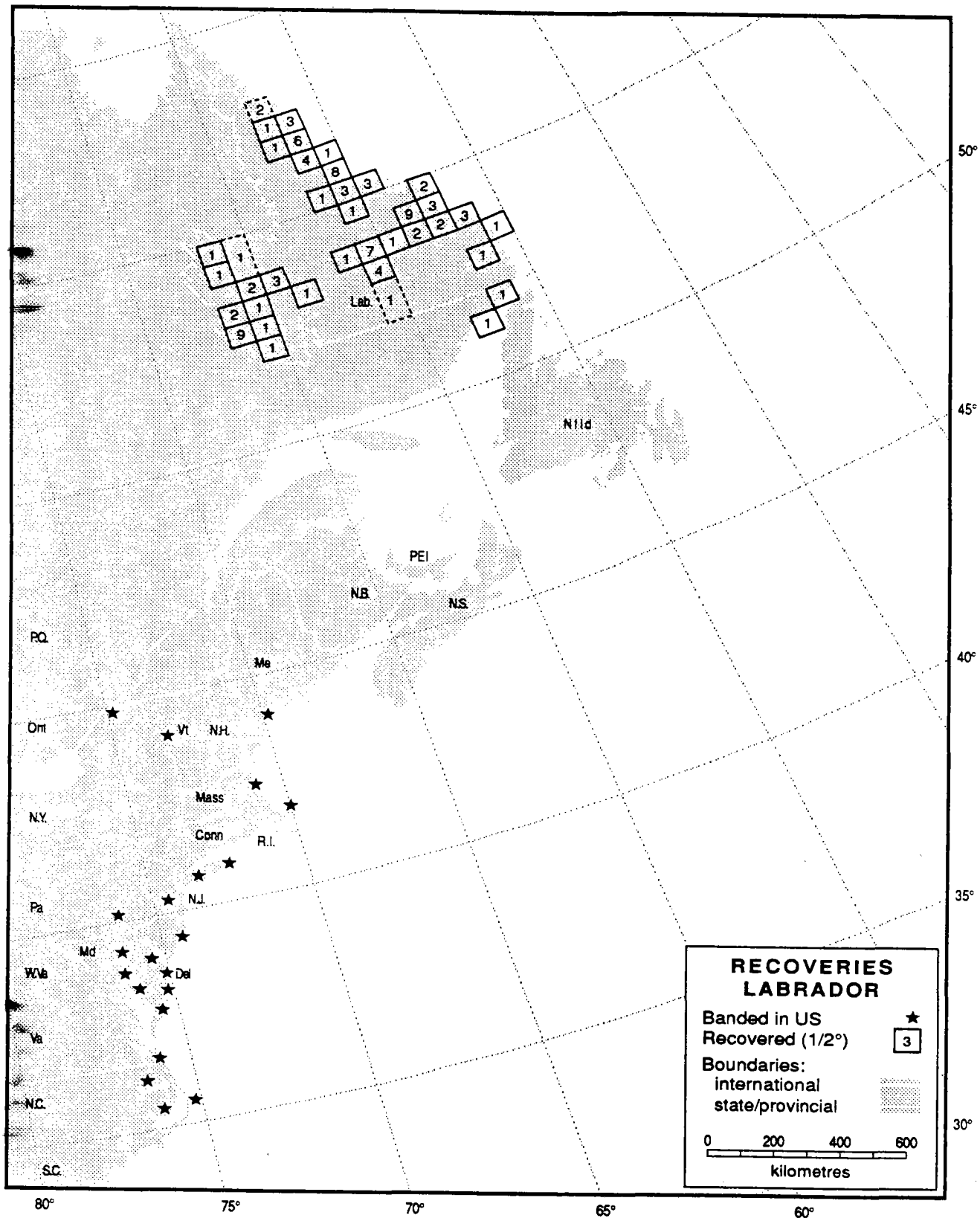

Figure XVIII-2 Distribution of recoveries of Canada Geese recovered in Labrador and banded elsewhere. Numbers of recoveries are summarized for blocks of one-half degree latitude by one degree longitude.

No neck-collars applied elsewhere have yet been reported from Labrador or east Québec, where no serious efforts have been made to detect and report neck-collared geese. Eleven (of a total of 65) Canada Geese marked with neck-collars at Baikie Lake, Labr. (532-0643), in late summers 1989 and 1990, were sighted south along the Atlantic Flyway in succeeding autumns and winters, all between eastern Massachusetts and Chesapeake Bay, Md., except for one at Bathurst, N.B. (Fig. XVIII-3), roughly parallelling the pattern of recoveries from Labrador bandings but with a number of records from inland areas in Massachusetts to New Jersey. Furthermore, most spring (late March–early May) sightings of Labrador neck-collars were in western Prince Edward Island (11) or by the lower St. John River, N.B. (2), where no Labrador collars were reported in fall.

4.2. Movement patterns of geese marked or re-located in New Brunswick

The only distant recoveries of Canada Geese banded in New Brunswick stemmed from a feral population established near their original release site at McAdam (453-0671), near the Maine border. All except two recoveries outside the local area were on eastern Long Island, N.Y. (32), between 1 December and 14 January, dates presumably spanning the local hunting season in that wintering area (Fig. XVIII-4). The exceptions were one bird recovered on the Maine coast, on a direct line between banding and wintering areas, and one in coastal North Carolina, on a continuation of the same line beyond the usual winter range. All those records involved a small and discrete goose population, and the main Canada Goose movement through New Brunswick probably includes other areas.

The distribution of 105 recoveries in New Brunswick of geese banded south and west of Maine spanned most areas of the province known to be used regularly by geese (Fig. XVIII-5; compare chapters X, XV, this volume). The majority were recovered along the eastern N.B. coasts from Richibucto north to Miscou Island, with smaller numbers in the southeast, near Bathurst, and around Grand Lake. Those birds were mostly banded in eastern North Carolina (41), Delaware (28), and Maryland (15). Recoveries (11) in New Brunswick from April bandings at Merrymeeting Bay, Me., were in the same east or southeast areas. However, 33 of 37 other N.B. recoveries from Maine bandings, mostly of moulting adults or flightless young in summer (not mapped), were west of long. 65°W, in areas where concentrations of migrating geese are rarely reported (compare Chapter XV, this volume). Those recoveries apparently involved local movements of stocks established by releasing captive-reared geese, and they seem unlikely to represent the main movement patterns of geese that migrate through New Brunswick.

Except for 19 Canada Geese neck-collared at Bathurst (474-0653) in fall 1990, none were marked in New Brunswick, but neck-collars were read, intermittently and on a small scale, near Bathurst in each autumn and in several springs 1986 to 1990. A few other neck-collars were read near Grand Lake, Miramichi Bay, Moncton, and Sackville, in one or more years 1984 to 1990, but no systematic effort was made to search for marked geese in this province. Only two collars applied at Bathurst were reported again, both read the next spring, in western P.E.I. and near Grand Lake, N.B., respectively. Other neck-collars read at Bathurst had been applied in New York, New Jersey, Maryland, Virginia, and North Carolina, all or nearly all in the same coastal banding areas from which other geese travelled to the Atlantic Provinces (Fig. XVIII-6). One New York collar was read near Moncton. Some of these same neck-collars were read subsequently in Prince Edward Island, and one at Grand Lake, N.B., but only in spring, as with the collars applied in Labrador and at Bathurst.

4.3. Movement patterns of geese marked or re-located in Prince Edward Island

The numbers of geese that frequented Prince Edward Island were larger than in all other parts of the Maritimes combined. Success in hunting, banding, and neck-collaring there comprised even larger proportions of the totals for those activities in the Atlantic Region, so the available data were voluminous.

Very little goose banding occurred in P.E.I. before 1984, and two-thirds of all recoveries arising from P.E.I. bandings were from that province (mostly within 50 km of banding locations). About 50 distant recoveries provided information on migration corridors, with only seven north of P.E.I. banding areas. Three in Labrador, with one each on Newfoundland's Northern Peninsula (503-0571) and in eastern Québec (512-0571), suggested southeastern Labrador as one important breeding area. Single recoveries on the Gaspé Peninsula, in northeastern New Brunswick, and in southwest Newfoundland, were well outside the narrow corridor indicated by all other distant recoveries (Fig. XVIII-7), which continued south to North Carolina. The larger numbers of distant returns were from Delaware (10), Massachusetts (6) and Long Island, N.Y. (5), the narrowly coastal distribution and narrow time-span of recoveries reflecting presumably where hunting was allowed and when it was permitted, rather than the full range of areas frequented and time spent there. Eight returns on the Atlantic coast of Nova Scotia (long. 0630 to 0655) were the only recoveries reported between Prince Edward Island and Cape Cod, Mass.. As they occurred in five years (1985–93), those recoveries seemed unlikely all to have arisen as a result of straying; all but one were of geese banded southeast of Charlottetown.

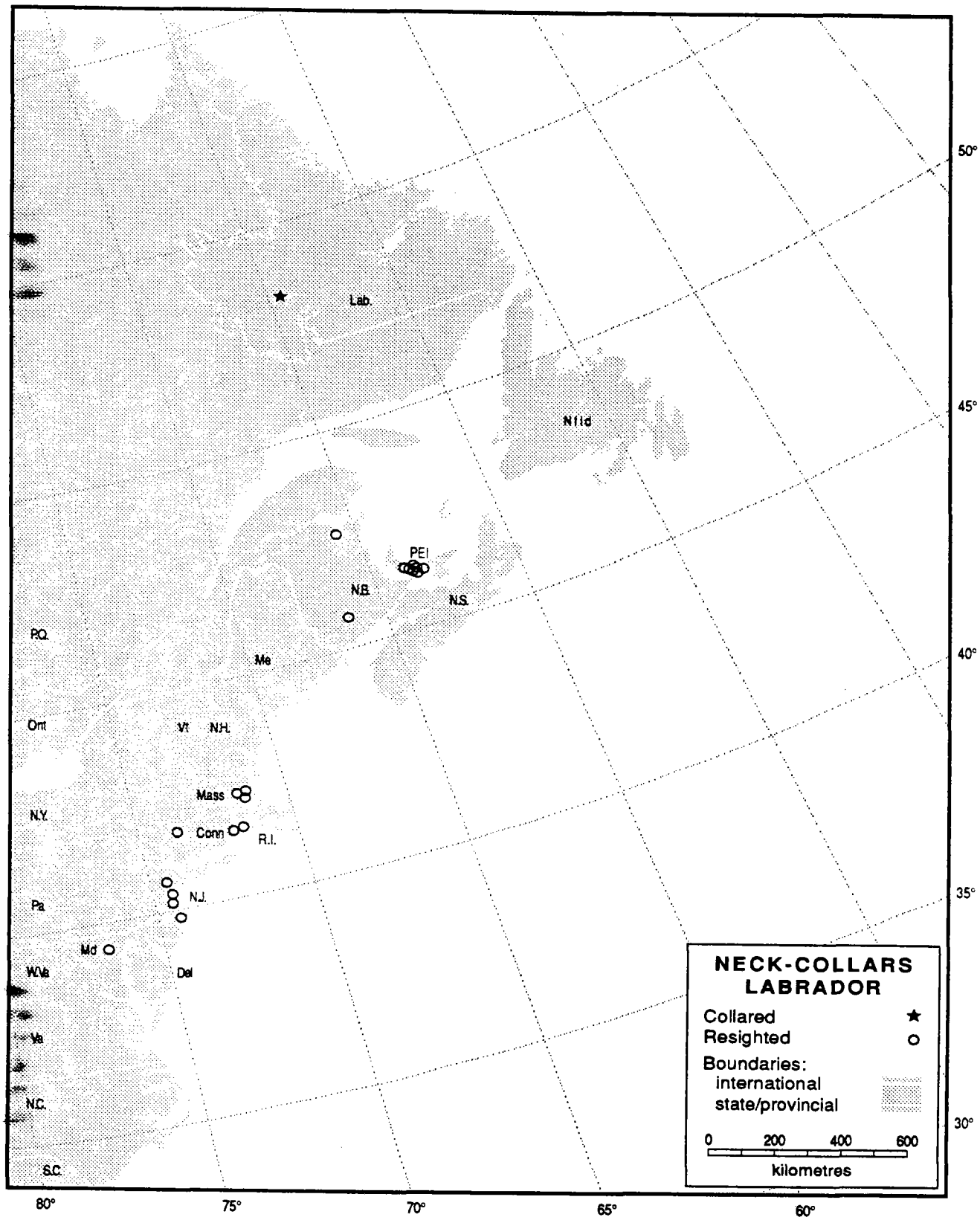

Figure XVIII-3 Distribution of marking and re-sighting locations for neck-collared Canada Geese handled or sighted both in Labrador and elsewhere.

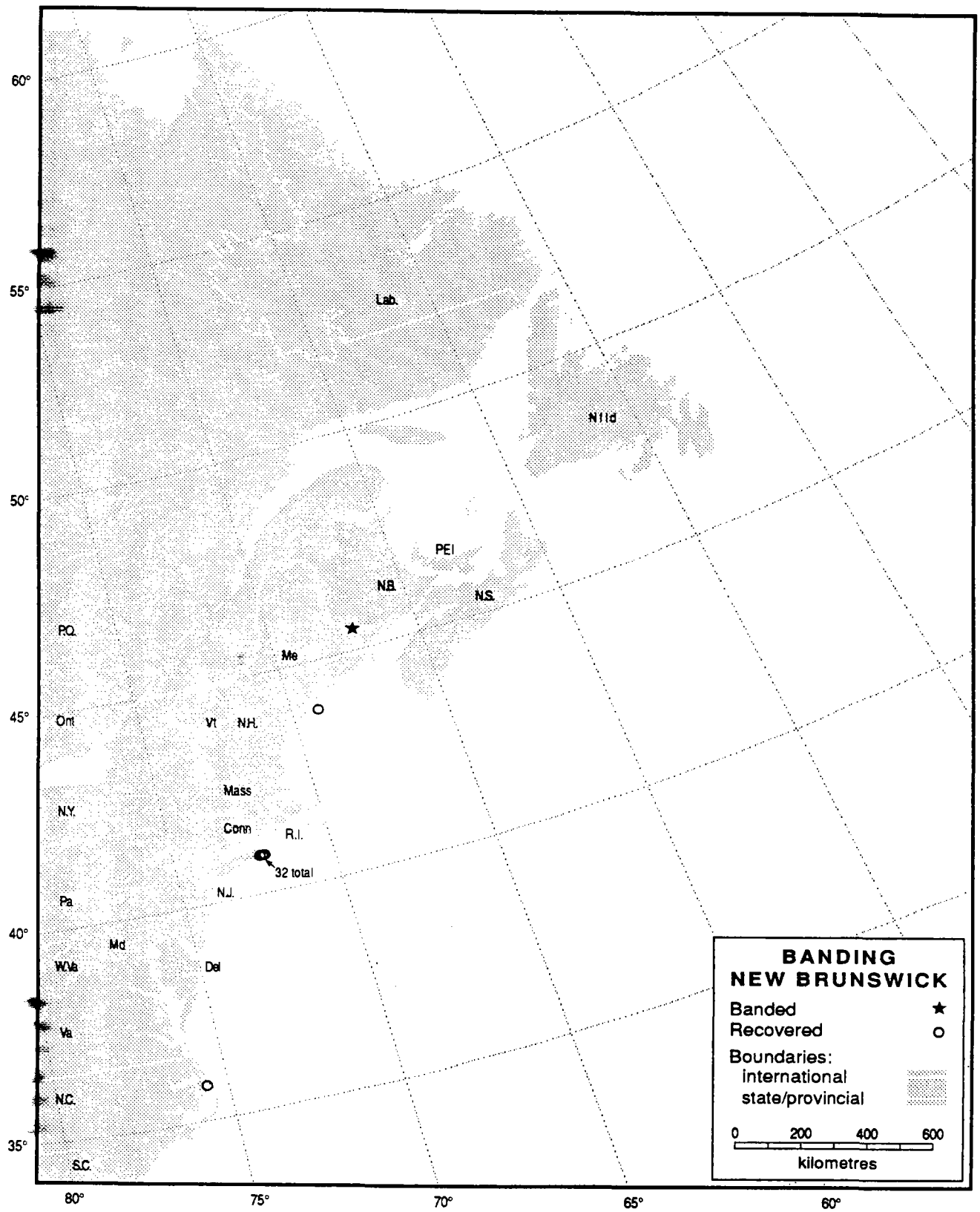

Figure XVIII-4 Distribution of recoveries of Canada Geese banded in New Brunswick and recovered elsewhere. Key as in Figure XVIII-1.

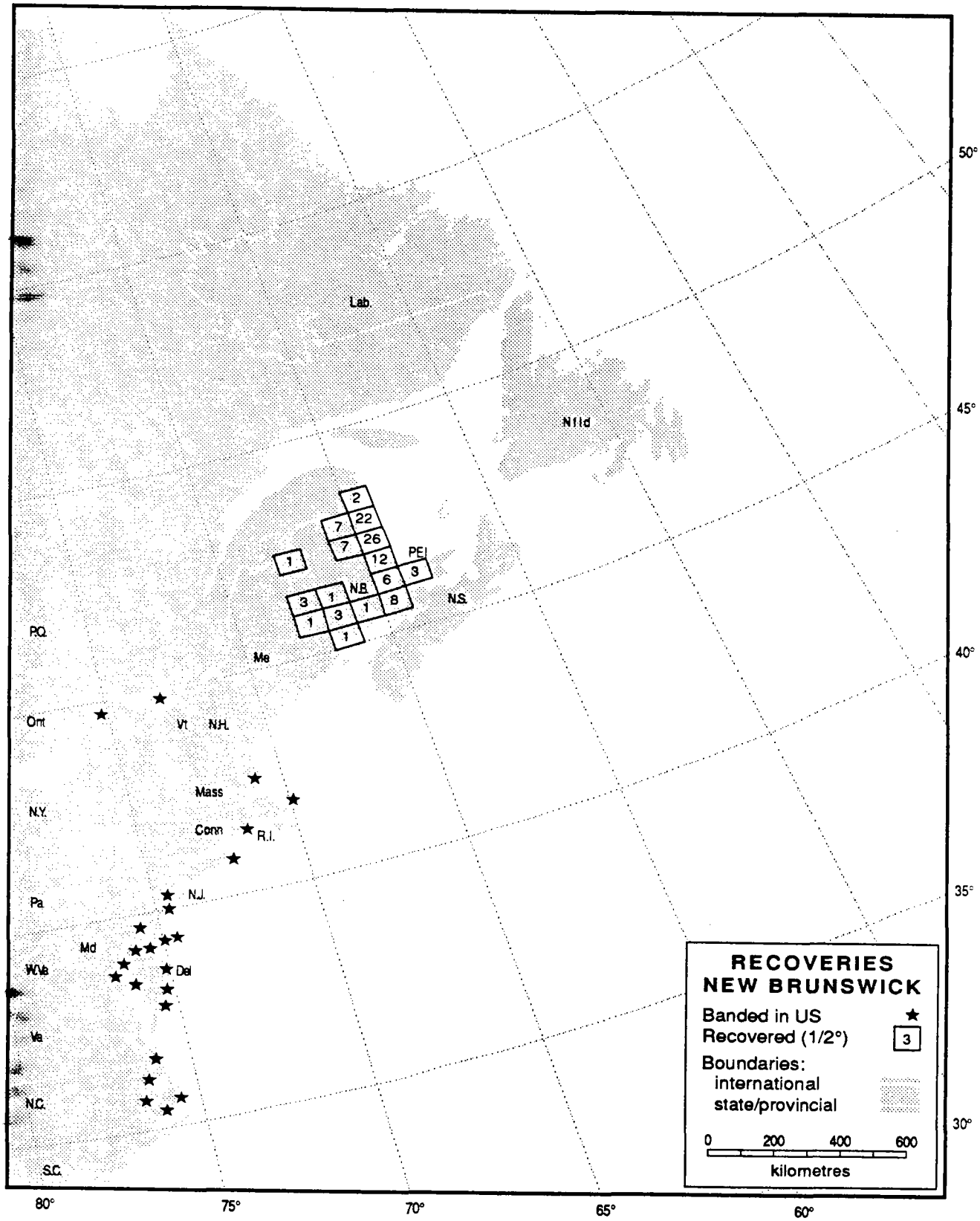

Figure XVIII-5 Distribution of recoveries of Canada Geese recovered in New Brunswick and banded else- where. Numbers of recoveries are summarized for blocks of one-half degree latitude by one degree longitude.

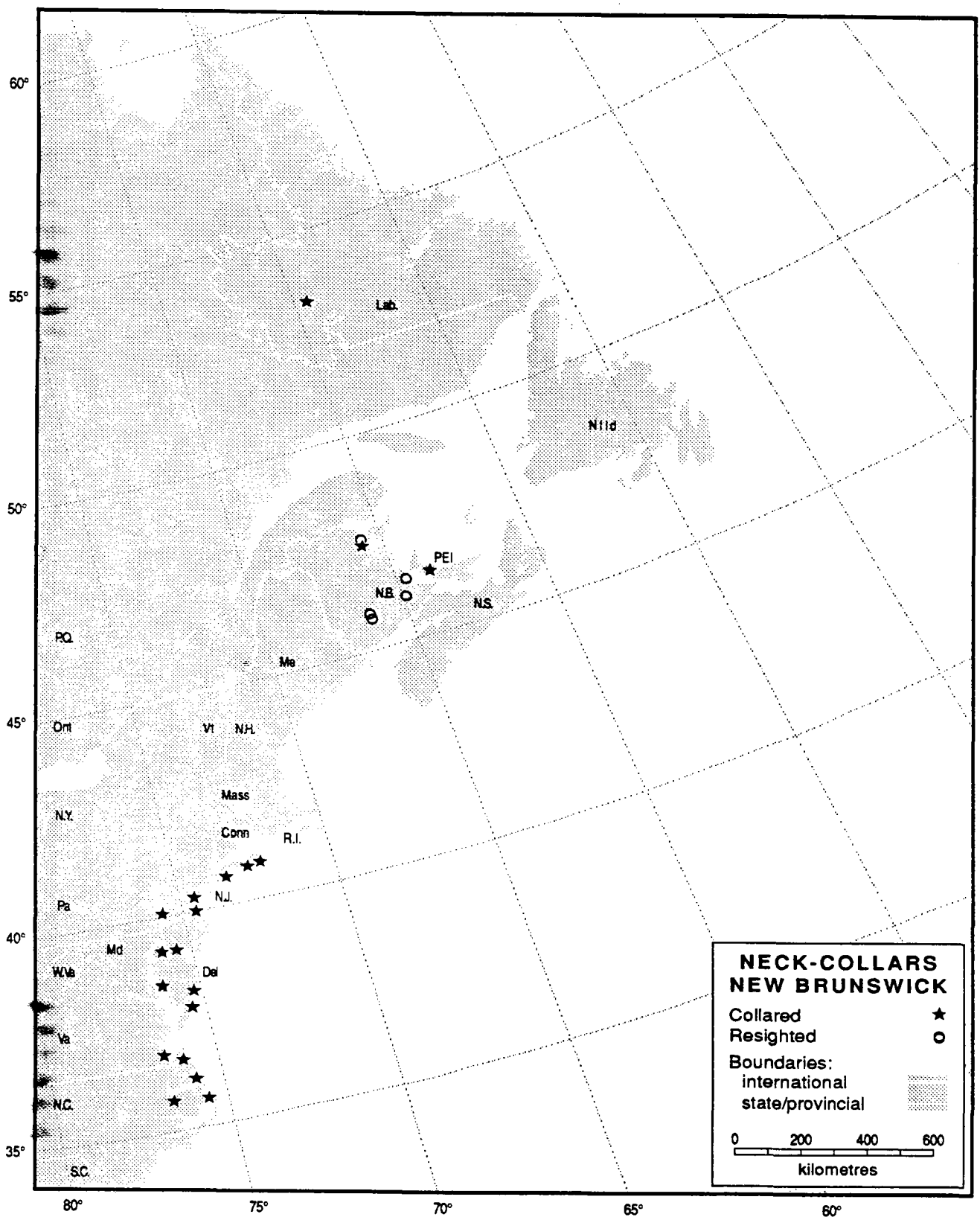

Figure XVIII-6 Distribution of marking and re-sighting locations for neck-collared Canada Geese handled or sighted both in New Brunswick and elsewhere.

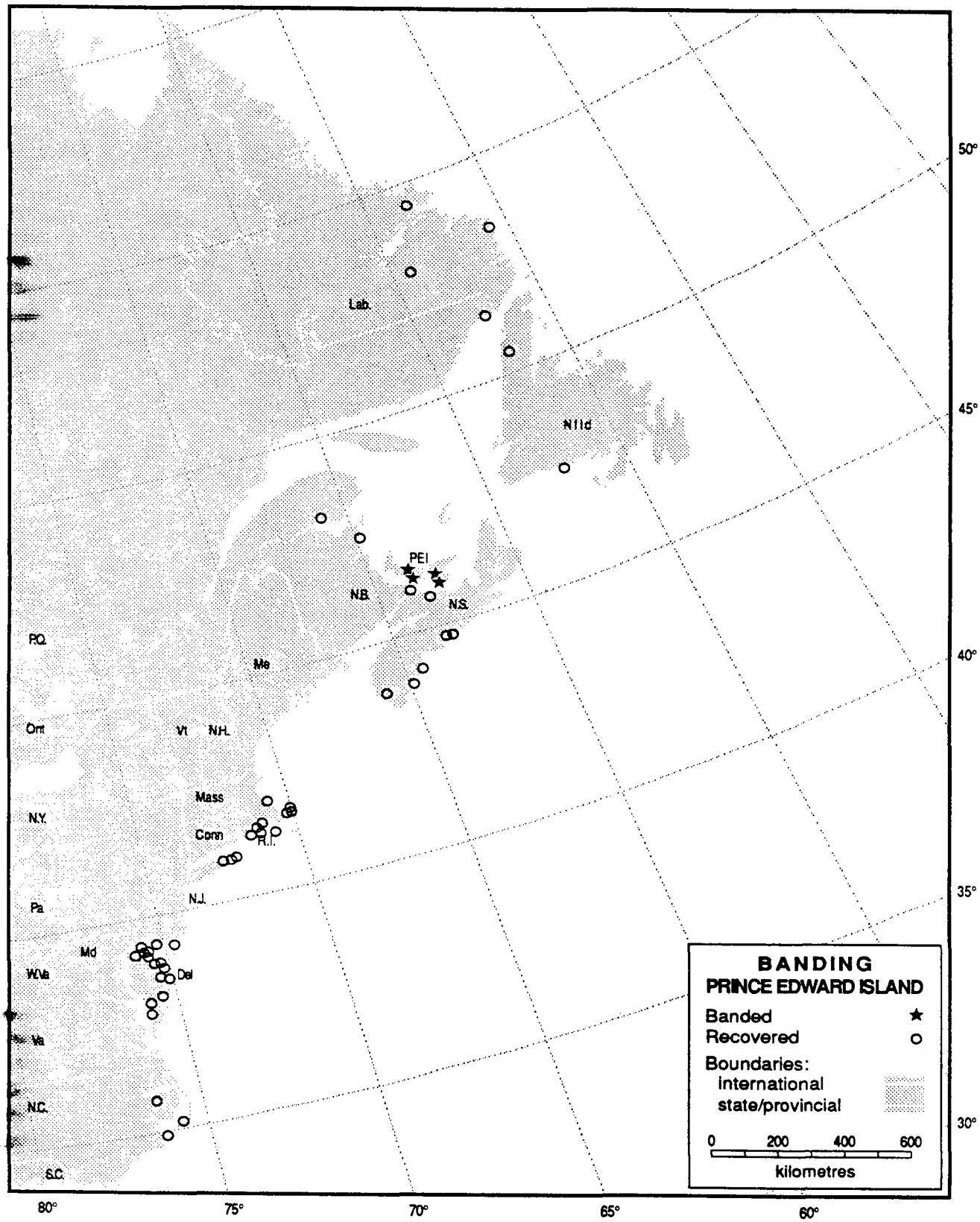

Figure XVIII-7 Distribution of recoveries of Canada Geese banded in Prince Edward Island and recovered elsewhere. Key as in Figure XVIII-1.

Many Canada Geese banded elsewhere in the Atlantic Flyway were recovered in Prince Edward Island, mainly in the extensive farmlands of eastern Prince County (Fig. XVIII-8). Much smaller numbers were recovered southeast of Charlottetown, and in the far east (near Souris) and northwest (Alberton–O'Leary) parts of the Island. Two-thirds of the total came from North Carolina (101), Maryland (52), and Delaware (41). The timing of those recoveries spanned the P.E.I. hunting season, starting in early October but with few recovered after 24 November although the season continued two to three weeks later. Twenty-seven geese banded in Nova Scotia, including 14 captive-reared juveniles and two captured with drugged baits, were later recovered in P.E.I.; however, it seems unlikely that those movements to the Island are typical of wild-bred geese that pass through Cape Breton Island, where half of those birds were marked. One goose banded at Ungava Bay, Qué. (582-0673), was later shot in P.E.I., far to the east of the expectable migration route south-southwest from that banding area.

The migration patterns based on neck-collar sightings in P.E.I. of geese also sighted or marked south along the Flyway corresponded quite well with those from band recoveries, with one obvious difference. Many neck-collared geese seen in Prince Edward Island, as with the much smaller samples of those neck-collared in Labrador, were also sighted inland in southern New England and New Jersey; perhaps no geese were banded in those areas, as none were recovered northeastward in the Atlantic Region. The other distant sightings or markings were mostly concentrated in coastal areas from New Hampshire to North Carolina (Fig. XVIII-9), except for a few apparently involving geese that had shifted between different migration corridors, e.g. birds seen near Montezuma NWR, N.Y. (425-0764) or Watertown, N.Y. (440-0755). Most others were within 80 km of and usually much closer to coasts of sea, bay, or estuary, regular use of areas farther inland being mainly in eastern Massachusetts and Connecticut and in New Jersey. The largest groupings of different sightings were in eastern Long Island, N.Y., southern inland New Jersey, and north of Cape Hatteras, N.C.. Far fewer were sighted in Maryland and Delaware (perhaps owing to less effort expended there in searching for and reading neck-collars?), and only one was reported on the Atlantic coast of Nova Scotia, in contrast to the larger numbers linked to those areas by band recoveries. North of Prince Edward Island, areas linked to that province by neck-collar sightings included only the three stations where geese were neck-collared (Bathurst, N.B., Baikie Lake, Labr., and Grand Codroy, SW Nfld.), plus two unusual records in eastern Newfoundland (for which see below, under 4.5.).

4.4. Movement patterns of geese marked or re-located in Nova Scotia

More Canada Geese were banded in Nova Scotia than in the other Atlantic Provinces, the majority having been captive-reared birds marked before release. Many were shot in the release areas (same or adjoining 10-minute blocks) in the same autumn or later hunting seasons, and only more distant recoveries are treated here. Two partially overlapping patterns were distinguishable (Fig. XVIII-10). The birds marked on the Nova Scotia mainland gave most recoveries in Prince Edward Island (14), Maryland (17), and North Carolina (9), with only 7—all marked near Shubenacadie (only 45 km inland)—on the Atlantic coast of Nova Scotia. Most Cape Breton-banded geese were recovered elsewhere in Nova Scotia (41), with P.E.I. (13) and Mass./ R.I./Long Island (11) the other concentrations.

Recoveries in Nova Scotia from bandings farther south (Fig. XVIII-11) were concentrated in the main goose-hunting areas along Northumberland Strait, near Truro and Wolfville, east of Halifax, and along the South Shore (Yarmouth to Liverpool). States contributing most recoveries were North Carolina (22), Maryland (21), Delaware (13), and Massachusetts (19). North Carolina bandings gave no recoveries east of Halifax, whereas Massachusetts bandings gave proportionately fewer returns in the Minas-Cobequid and Northumberland Strait areas and more on the Atlantic coasts than came from more southern banding areas. Of 22 banded in the Carolinas and recovered in N.S., only five were on the south shore; of 32 banded in the Delmarva peninsula and adjacent areas, 6 were recovered on the south shore of N.S. vs. 26 farther north; but of 22 returns of geese banded in New Jersey to Maine, 16 of them at Cape Cod in 1932 to 1943, 11 were obtained on the south shore vs. 11 farther north.

No extensive searching for neck-collared geese has been undertaken in Nova Scotia, and the few sightings by volunteers added little to the patterns deduced from band recoveries, as all were in goose-hunting areas (Fig. XVIII-12). Eight sightings near Debert (452-0632) in autumns 1984 to 1987 linked geese in that area with Prince Edward Island on the one hand and with eastern Long Island, N.Y., New Jersey, and coastal North Carolina on the other. Ten sightings along Northumberland Strait (455-0633 to -0641) in 1984-85 similarly linked that area with Prince Edward Island and with coastal New York, New Jersey, southeast Pennsylvania, and coastal North Carolina. Another goose, banded in New Jersey 2 March 1984 and sighted near Tidnish, N.S. (455-0641), 10 December 1984, was reported next near Montezuma NWR, N.Y. (425-0764), 19 March 1985, later appearing in Prince Edward Island in autumn 1989, which suggested a change of migration corridors and then a return to the original one, unless the Montezuma or P.E.I. sightings were in error. Two neck-collars from North Carolina and one from New Jersey were read in the Kentville–Wolfville area in spring and fall of 1987. Finally, two geese marked in summer 1992 (moulters? from feral stock?) in Maine were found in Nova Scotia in summer 1993, when one was shot because it was harassing domestic geese (!) near Kentville, and the other was accompanying another goose with a collar (not read) and a brood, near Maccan (455-0640). The absence of neck-collar "connections" between Nova Scotia and southern New England probably reflects

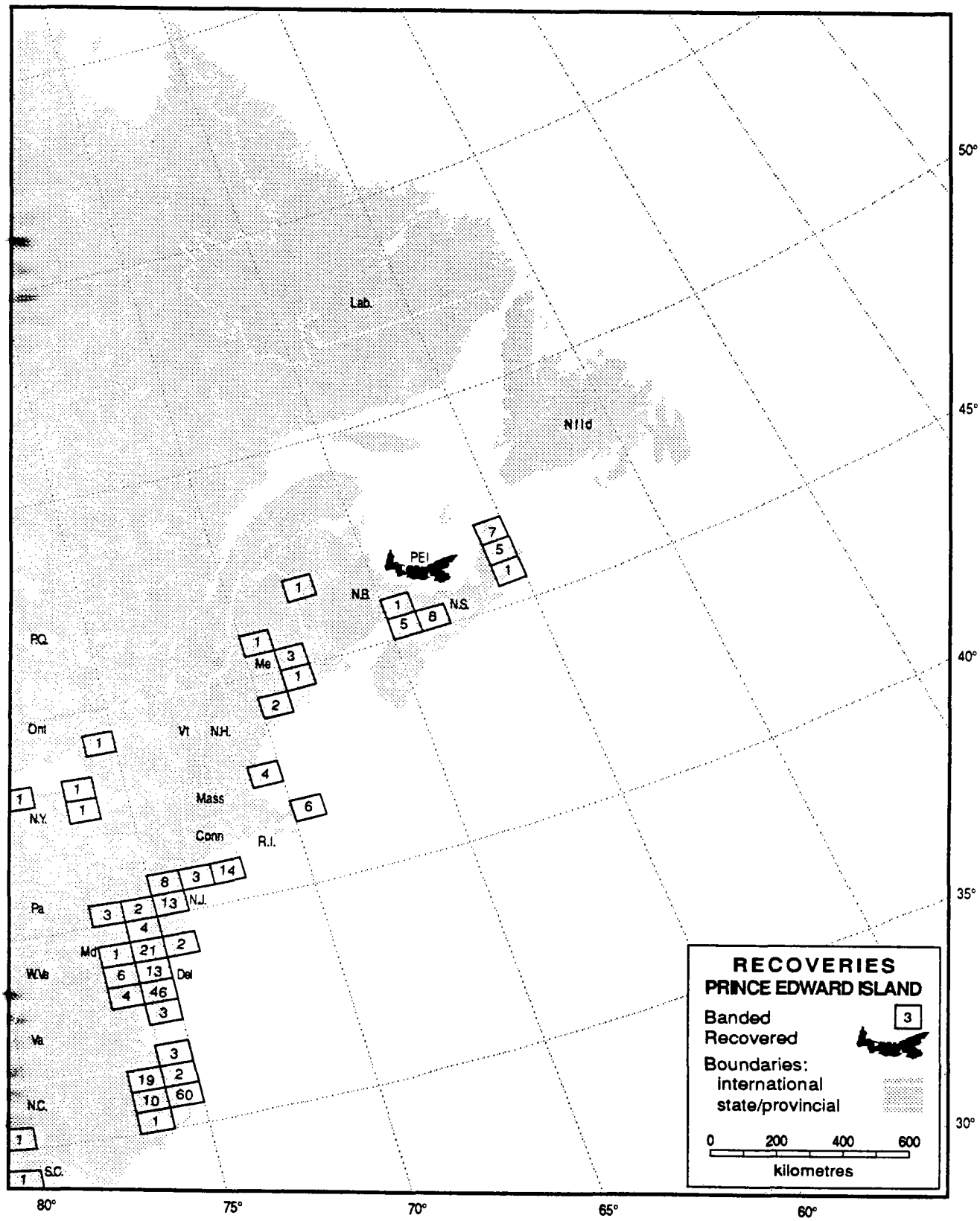

Figure XVIII-8 Distribution of banding locations of Canada Geese recovered in Prince Edward Island.

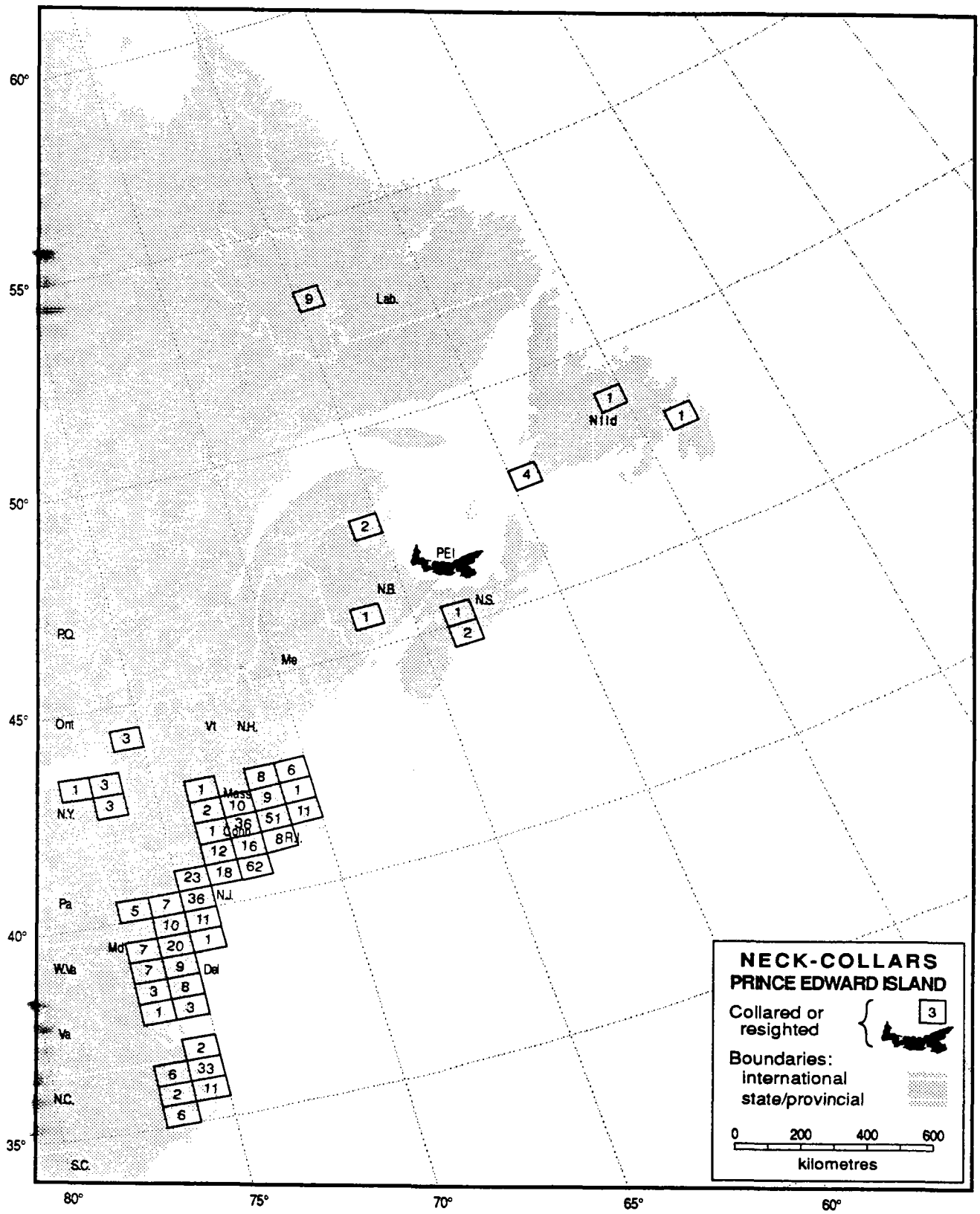

Figure XVIII-9 Distribution of marking or re-sighting locations elsewhere for neck-collared Canada Geese handled or sighted in Prince Edward Island.

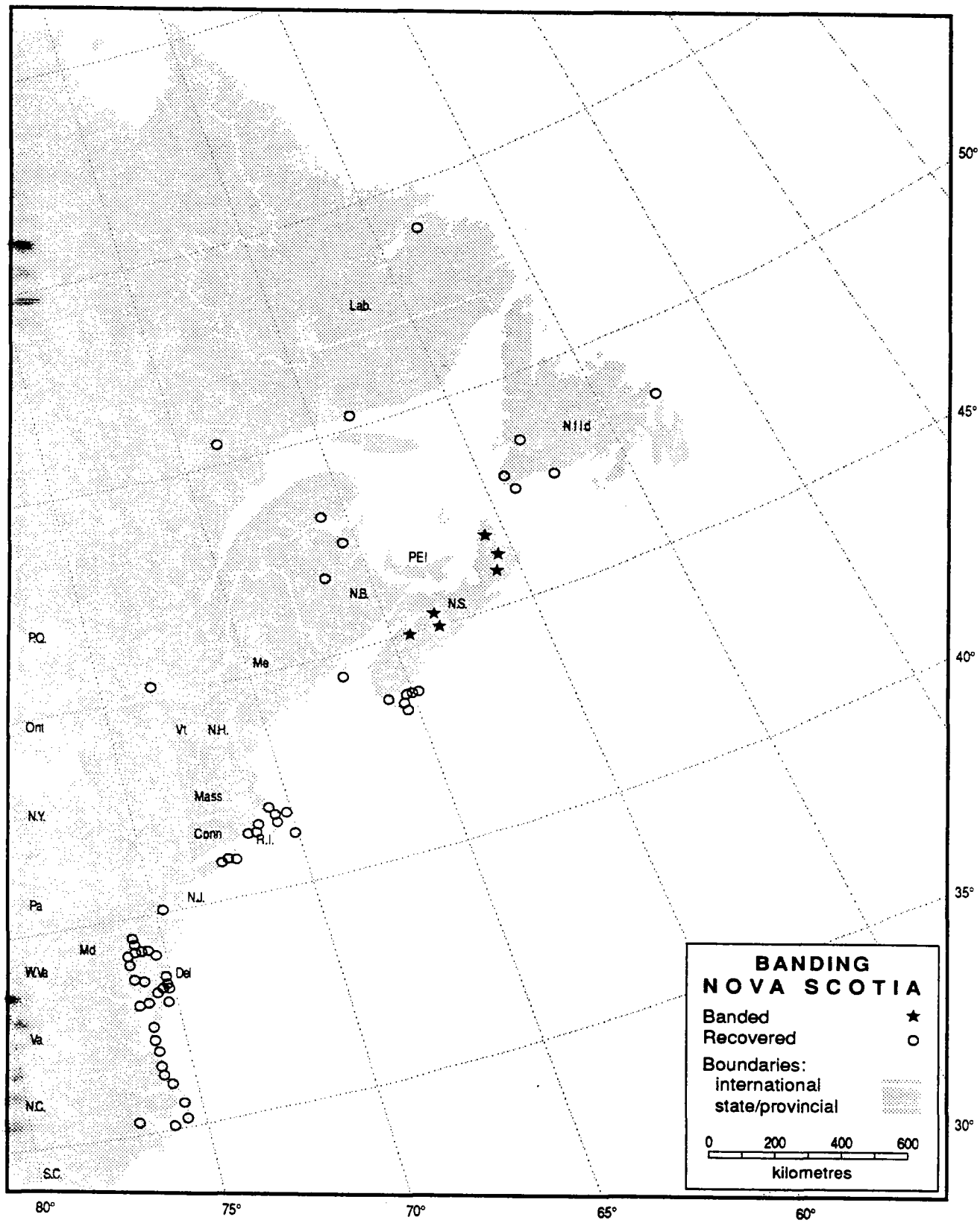

Figure XVIII-10 Distribution of recoveries of Canada Geese banded in Nova Scotia and recovered elsewhere. Key as in Figure XVIII-1.

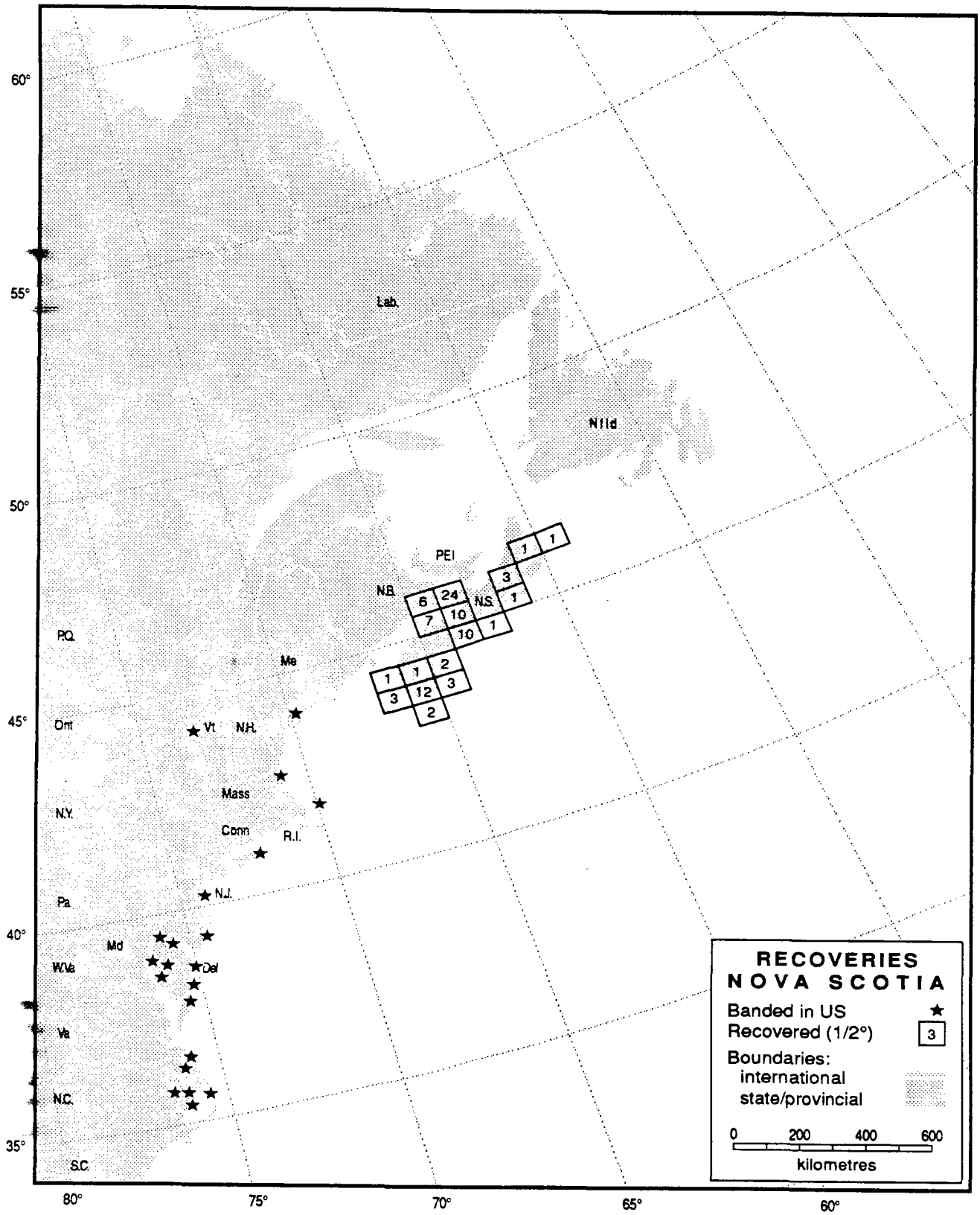

Figure XVIII-11 Distribution of recoveries of Canada Geese recovered in Nova Scotia and banded else- where. Numbers of recoveries are summarized for blocks of one-half degree latitude by one degree longitude.

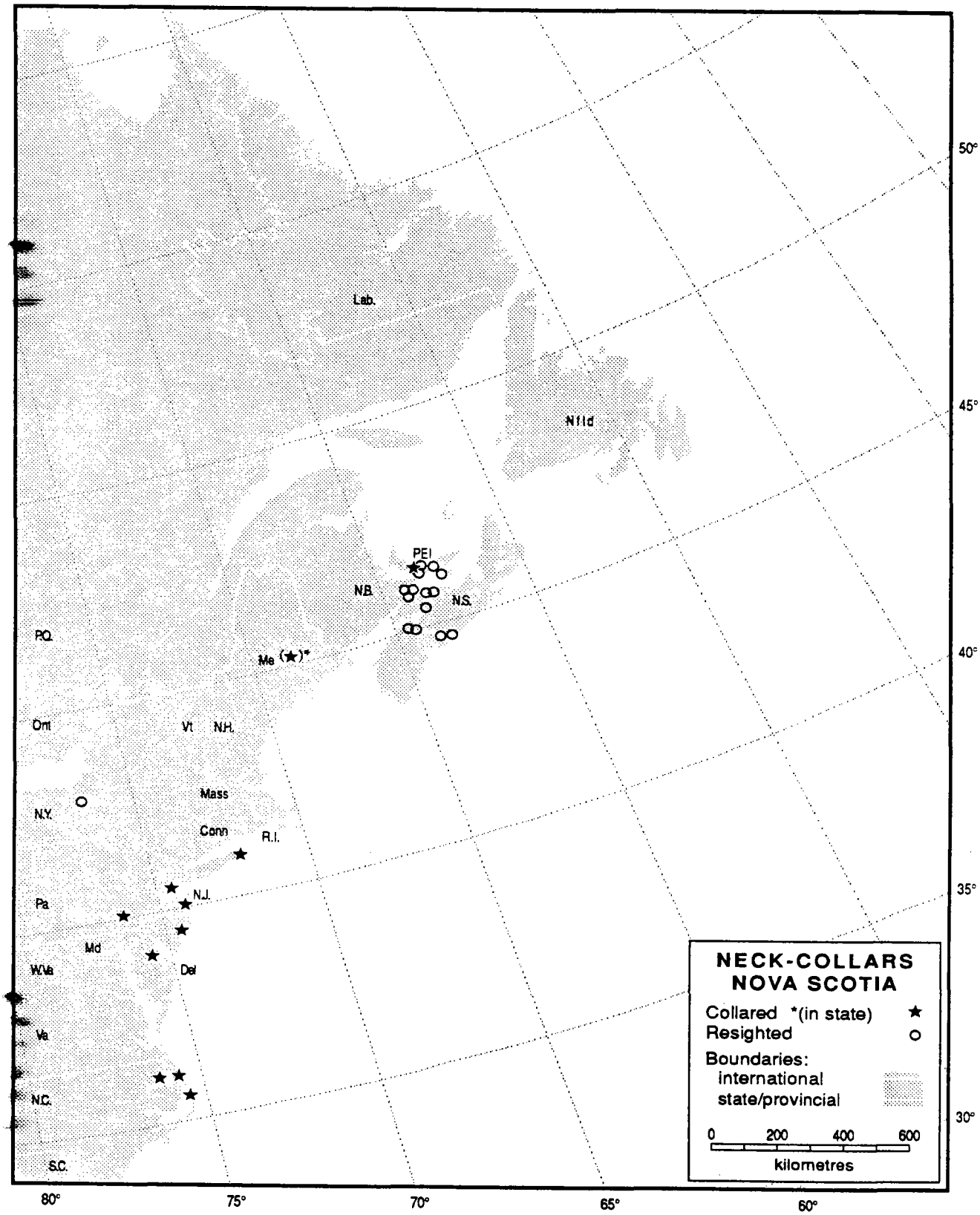

Figure XVIII-12 Distribution of marking and re-sighting locations for neck-collared Canada Geese handled or sighted both in Nova Scotia and elsewhere.

that most neck-collar work in the latter area was after 1990, when few observations were made in Nova Scotia.

4.5. Movement patterns of geese marked or re-located in insular Newfoundland

Two of nine Canada Geese trapped near Grand Codroy, in late April–early May 1989, were recovered in the next winter, near New Bedford, Mass., and on eastern Long Island, N.Y. (Fig. XVIII-13). No other geese banded on the island of Newfoundland have been recovered.

Recoveries in insular Newfoundland of geese banded elsewhere were only slightly more numerous (Fig. XVIII-14). Two banded in Maryland were retrieved on "The Rock", one far up the Northern Peninsula and the other on the central barrens (484-0565). Three from Long Island, N.Y., were recovered, two on the Avalon isthmus (474-0535) and the third in the north-central basin (493-0570). All the others (11) were banded in 1932 to 1943 at the Wellfleet Sanctuary on Cape Cod, Mass., and recovered in the eastern half of the island (even fewer Newfoundlanders lived in the western half then than at present).

The nine geese banded at Grand Codroy in 1989 produced four neck-collar sightings as well as the two recoveries (Fig. XVIII-15). Two (adult male & adult female, probably a pair) were re-sighted together on two dates in November 1989, and another was seen in late March 1990, all in eastern Prince Edward Island. A fourth was back at Grand Codroy in May 1990, and then seen southeast of Charlottetown, P.E.I., in September 1990. One goose neck-collared in North Carolina in winter 1986-87 was reported in southeast Newfoundland in May 1987. Two records involved breeding season reports. One was of an adult female banded and marked near Pownal. P.E.I. 7 April 1993, re-sighted 60 km farther west in P.E.I. 16 April, and located on a nest (with eggs) near Tom Joe Brook, Nfld. (485-0555) during a CWS waterfowl survey by helicopter 21 May 1993. The other had an even more unusual history: it was banded in central Long Island, N.Y., in winter 1985-86, and spent the next summer—presumably as a non-breeder—in central P.E.I. (sighted 3 June, 2 July, 2 September 1986); it was found near Hearts's Delight, Nfld. (474-0533) 29 June 1987, was back in central P.E.I. 20 May 1988, again near Heart's Delight, Nfld. 6 June 1988, and once again in central P.E.I. 13 October 1988!

4.6. Other movements of northern Atlantic Flyway Canada Geese documented from band recoveries or neck-collar sightings

4.6.1. Movements within the Maritimes

Many neck-collared geese were sighted or re-captured during more than one migration season, mostly in Prince Edward Island where efforts to read neck-collars were made each year from 1987, especially in spring. Probably more than half of all marked geese in P.E.I. have been seen more than once, but the database is still incomplete, and new members of earlier-marked cohorts are detected in each migration. Of the marked geese sighted more than once in P.E.I., about one-third were detected only in one of the four parts of the island where sightings were sought frequently (Table XVIII-1). Expectably, birds sighted in more seasons were less often seen only in one area. The only grouping that departed from the usual low fidelity to an area was the geese seen only in two fall migrations. Seven of 10 resighted only in the same area were in the southeast sector, perhaps reflecting uneven sampling effort at that time of year, when hunting made geese too wary to allow reading neck-collars in many areas where this was done in spring.

Interchange between different parts of Prince Edward Island involved all areas. Although only one goose was sighted in all four areas, at least 20 were each seen in three areas. The western area was the most frequented as well as the largest, but some geese seen there also used each of the other areas, the combination of west and south-east occurring more often than west with the closer south-central area—but less observational effort was put forth in the latter. Some geese moved between areas within a single season, an extreme case being neck-collar 2XY4, placed on a goose in the south-east area 28 March 1990; the same collar was read three times next spring, in the south-central area 19 March, in the east 25 March, and in the west 25 April 1991. Such movements were less easily distinguished in 1992 to 1993, when sightings for all parts of Prince Edward Island were entered in the computer database with one (central) location, although the actual locations could have been (but were not) extracted from field records. Movements between P.E.I. and other Maritime Provinces were treated in earlier sections of this account.

4.6.2. Arrivals and departures of migrating geese farther south

Unlike band recoveries, the timing of which is closely tied to the duration of local goose-hunting seasons, neck-collar sightings could be obtained at any time when marked geese were present in an area. The dates of neck-collar sightings suggested that few observers were active in U.S. staging and wintering areas before hunting began in early October [Table XVIII-2(a)]. Geese reached New England early in October, with larger numbers late in that month. Less effort in reading goose collars was put forth farther south, but arrivals there were mostly later (except perhaps in Maryland). Spring neck-collar sightings were scarcer, especially in the south [Table XVIII-2(b)], and virtually no neck-collars were read in the U.S. after 10 April, by which time many geese had reached the Maritimes.

A few re-sightings bracketing migrations provided direct evidence of when longer movements occurred (Table XVIII-3). These reinforced other indications of both early (6XU2, 6XU7, H5R) and late movements (Y43U, 7XU8, 7XY3) in fall, and also the long period in which geese remain in Prince Edward Island in spring (compare Mar.–Apr. movements thither from N.J., Ct., R.I. with May movement onward to Nfld.).

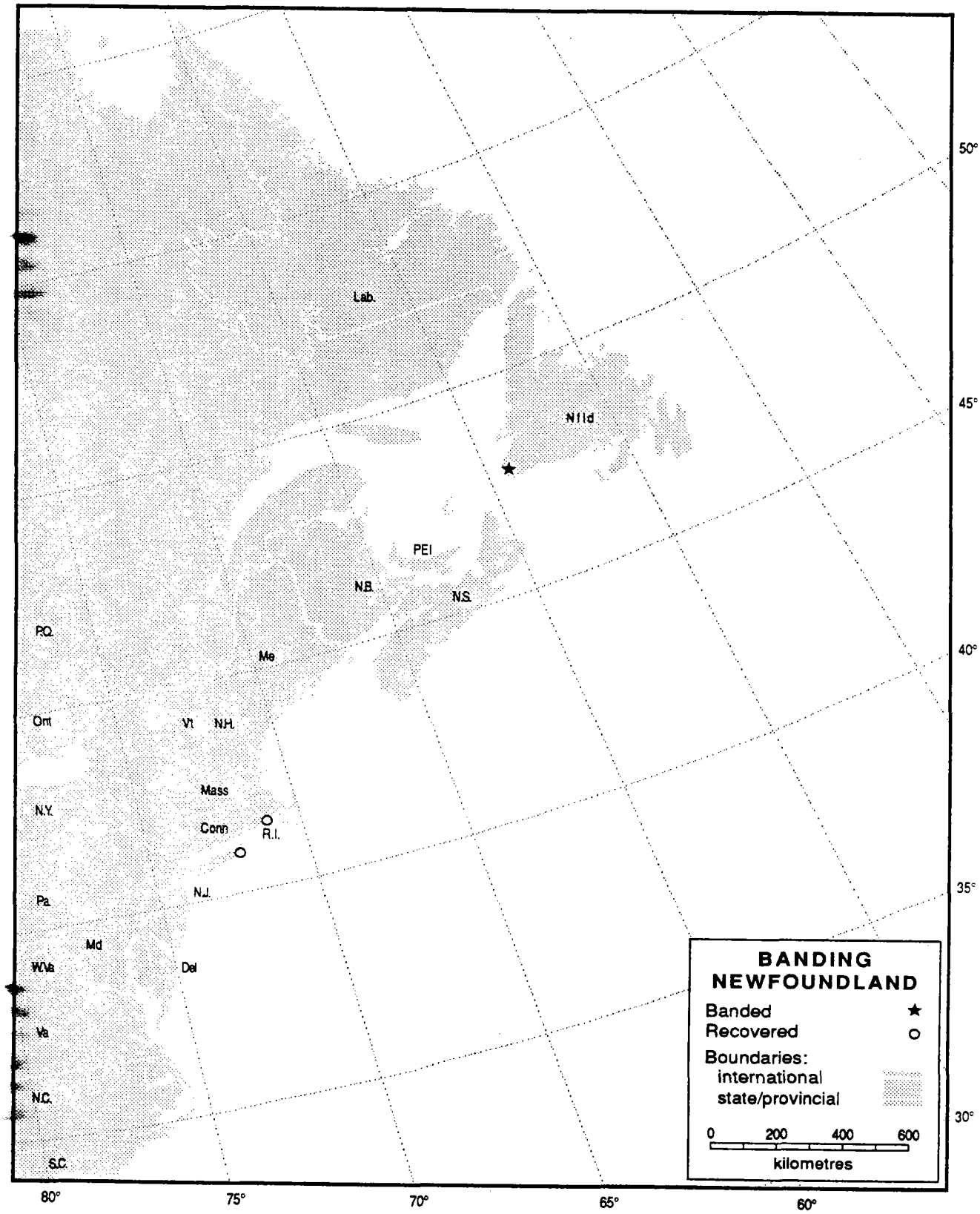

Figure XVIII-13 Distribution of recoveries of Canada Geese banded in (insular) Newfoundland and recovered elsewhere. Key as in Figure XVIII-1.

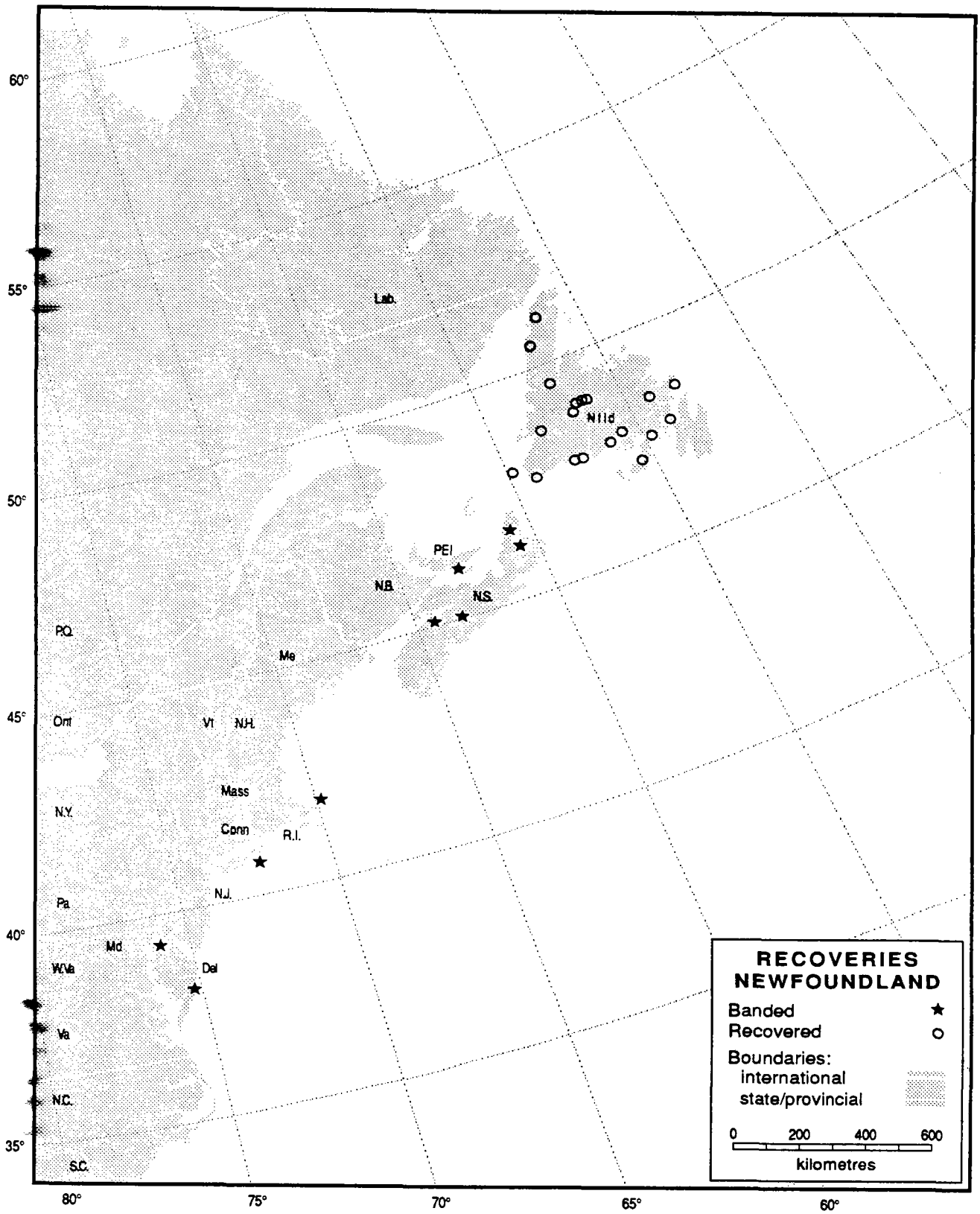

Figure XVIII-14 Distribution of recoveries of Canada Geese recovered in (insular) Newfoundland and banded elsewhere. Key as in Figure XVIII-1.

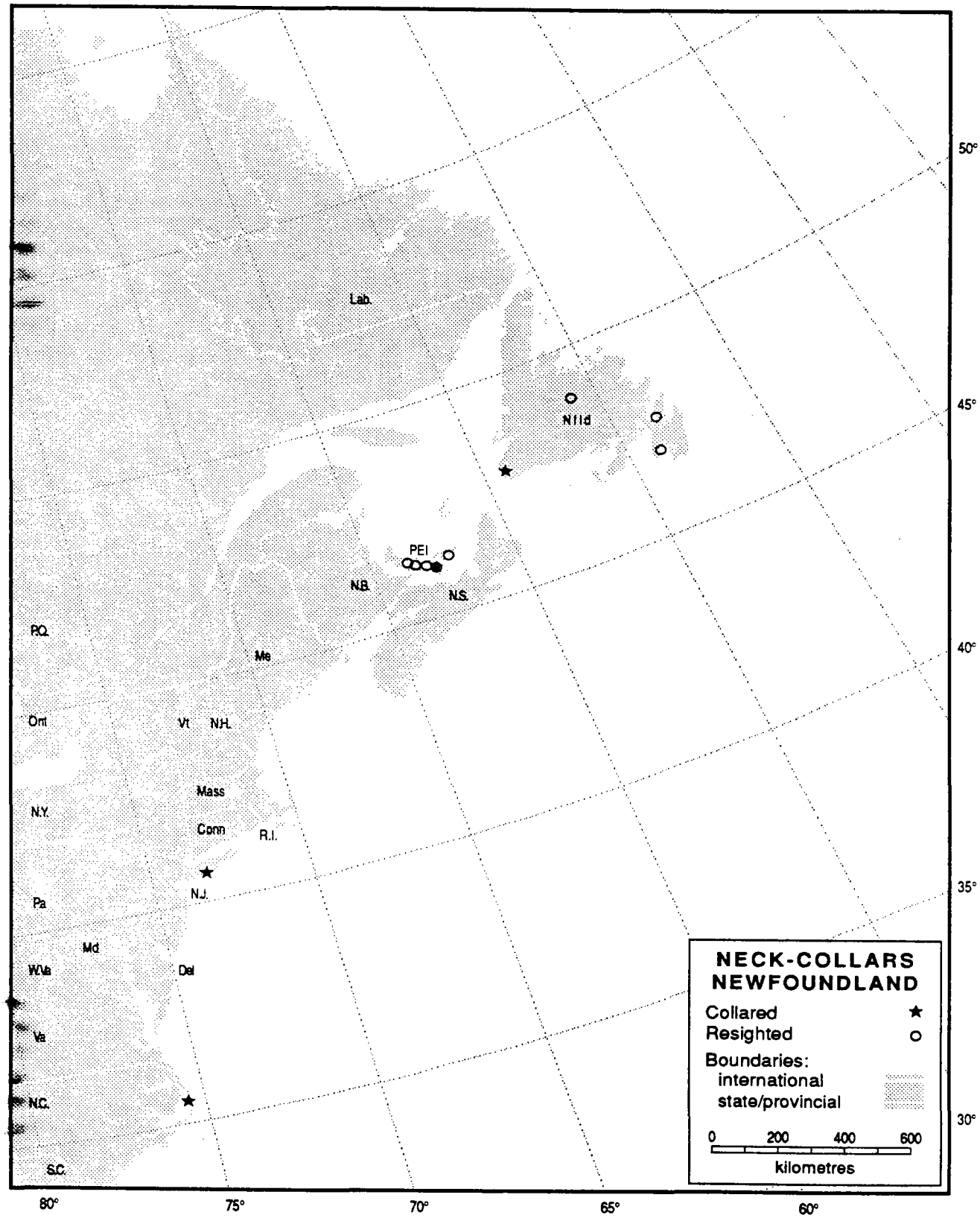

Figure XVIII-15 Distribution of marking and re-sighting locations for neck-collared Canada Geese handled or sighted both in (insular) Newfoundland and elsewhere.

Table XVIII-1. Numbers of neck-collared Canada Geese sighted in more than one migration season in Prince Edward Island, 1987–93.

Seasons of sightings[1]	Numbers of geese reported			
	Total in all areas[2]		Only in one area	
2 springs	98		31	
3 springs	33		9	
4 springs	4		2	
5 springs	1		0	
Subtotal		*136*		*42 (31%)*
2 falls	15		10	
Subtotal		*15*		*10 (67%)*
1 spring, 1 fall	66		24	
1 spring, 2 falls	17		5	
1 spring, 3 falls	2		0	
Subtotal		*85*		*29 (34%)*
2 springs, 1 fall	25		8	
2 springs, 2 falls	7		3	
2 springs, 3 falls	2		1	
Subtotal		*34*		*12 (35%)*
3 springs, 1 fall	9		0	
3 springs, 2 falls	2		0	
3 springs, 3 falls	2		0	
4 springs, 1 fall	8		0	
Subtotal		*21*		*0 (0%)*
Grand total		*291*		*93 (32%)*
Subtotal (2 seasons)		*179*		*65 (36%)*
Subtotal (3 seasons)		*75*		*22 (29%)*
Subtotal (4 seasons)		*22*		*5 (23%)*
Subtotal (5 seasons)		*13*		*1 (7%)*
Subtotal (6 seasons)		*2*		*0 (0%)*

[1] Includes initial capture for geese marked in P.E.I. Mutliple sightings within a season counted once only.

[2] Areas: West — Summerside–Darnley–Bedeque;
South-central — Borden–Tryon;
South-east — Pownal–Orwell;
East — Souris–Fortune.

4.6.3 Other movements

Among neck-collared geese seen in the Maritimes, at least 54 were sighted in U.S. wintering areas in two winters (only one in three winters). Fourteen were seen in the same area both winters, and 20 more in nearby areas (50–150 km apart). Of 20 geese seen in more widely separated areas in different winters, five were in similar latitudes both years, three were farther south in the later year, and 12 were farther north. Ten of those last 12 were apparently less than a year old in the first winter they were sighted, but the samples that wintered in the same or nearby areas in different winters also included many first-year birds.

There was also evidence from neck-collar sightings that some geese moved from Canada to Greenland to moult. One bird in a flock of 32 Canada Geese in west-central Greenland (713-0554) (in summer 1992?) bore a neck-collar (yellow with black symbols) like those used in the Atlantic Flyway in 1982 to 1990. Similar neck-collars were placed on 10 Canada Geese among 700 moulting in Greenland (670-0503) in July 1992; three of those birds were recovered in northern Labrador (564-0612; ca. 1200 km south) in fall 1992 and one on Long Island, N.Y., in January 1994. One Canada Goose, originally neck-collared in Maryland February 1992, was seen in Scotland in November 1992, with Gray-lag Geese

Table XVIII-2. Arrivals of geese in various states, from neck-collar sightings during migrations, Atlantic Flyway.

(a) Fall migration — Numbers of different neck-collared geese first sighted

States[1]	October 1–10	October 11–20	October 21–31	November 1–10	November 11–20	November 21–30	December 1–10	December 11–20
N.H. Mass., R.I., Ct.	9	7	20	7	15	4	8	18
N.Y., N.J., Pa.	0	2	4	2	3	3	7	3
Del., Md., Va., N.C.	1	1	1	1	2	3	1	5

[1]Abbreviations as in earlier U.S. usage.

(b) Spring migration — Numbers of different neck-collared geese first sighted

States	February 11–20	February 21–29	March 1–10	March 11–20	March 21–31	April 1–10
N.H., Mass., R.I., Ct.	15	5	5	10	8	4
N.Y., N.J., Pa.	5	8	17	4	4	0
Del., Md., Va., N.C.	5	1	4	0	0	0

(which do not breed in Greenland, although other "gray goose" species that winter in Scotland do). The shortest crossing from Labrador to west Greenland is ca.600 km, whereas Scotland is 1800+ km distant from goose-breeding areas in east Greenland, and 800+ km farther from west Greenland.

5. Discussion

5.1. Difficulties in interpreting evidence from band recoveries and neck-collar sightings

As noted in the Introduction, the question of whether or how well the patterns deduced from the relocation of banded or otherwise marked birds represent the population as a whole is fundamental to the use of those techniques, and failure to answer it may weaken any hypotheses based on these data. The use of banding data in waterfowl management is of long standing, but uncertainties over representativeness still bedevil most discussions based on band recoveries. Although neck-collars for geese were used in experimental studies from the 1960s (e.g. MacInnes *et al.* 1969), their use on the present large scale and in the Atlantic Flyway began only in 1983 (e.g. Shaeffer and Malecki 1987), and difficulties with the use of data from them have received little emphasis.

With band recoveries, the band may be re-examined to verify that it was read correctly, and the procedures for transferring banding and recovery information into the computerized database, though cumbersome, are well-standardized. The record of a neck-collar sighting also depends on field notes, of which the date and location are equivalent to these data accompanying a band recovery. The number on the neck-collar, however, cannot be verified later. It must be dismissed as in error if the neck-collar with that number had not yet been placed on a bird at the date when it was reported; several such cases were noted in both field notes and computer listings used in this study. To err is human, but the database management procedures for the neck-collar records need more polishing. Other difficulties arose from mis-reading of handwritten field notes or summary sheets by persons other than the one who wrote them. Some numbers reported were ones that had never been used, but most other errors of this type could not be surely recognized even when they seemed unlikely. Key-punching errors provided problems too, as double entry of all data seems not yet to be done routinely in the goose neck-collar database. Transposition of numbers was sometimes obvious when a latitude of 640 fell amid a series of 460s, or when a location was far out at sea, but other unusual records were not obvious as errors. Another apparent difficulty was in conversion from calendar to Julian dates (1 January = 1; 1 February = 32; 1 March = 60 (or 61), etc.). A number of records in the computer listings differed from parallel sightings in the field sheets by precisely one month; these might have been separate sightings, but the recurrence of this anomaly suggested a need for double entry at this stage also. In summary, some (or many?) records in the neck-collar sighting files are suspect until verified, and it seemed wiser to treat as

Table XVIII-3. Evidence of timing of migrations, from Canada Goose neck-collar resightings Atlantic Flyway (north to south)[1].

Neck-collar number(s)	Migration/Movement Location A/Date	Location B/Date	Distance/ Interval
6XU2, 6XU7	central Labrador	northern N.B.	575 km
	17 September 1990	4 October 1990	17 days
C9C9	central P.E.I.	eastern Newfoundland	750 km
	20 May 1988	6 June 1988	17 days
7XY3	southeast P.E.I.	mid-Atl. coast N.S.	165 km
	11 January 1989	26 January 1989	15 days
Y43U	north shore N.S.	east Long Island, NY	850 km
	1 December 1984	14 December 1984	13 days
H5R	southeast N.H.	south-central Ct.	150 km
	2 October 1991	21 October 1991	19 days
1XM4	Rhode Island	southeast P.E.I.	850 km
	29 March 1989	3 April 1989	5 days
X6F	Rhode Island	P.E.I.	850 km
	26 March 1993	8 April 1993	13 days
C1E5	Rhode Island	west P.E.I.	850 km
	11 March 1991	10 April 1991	30 days
X71	east-central Ct.	west P.E.I.	850 km
	5 April 1993	21 April 1993	16 days
7XU8	east-inland Ct.	south-central N.J.	290 km
	8 December 1992	22 December 1992	14 days
8XY3, 8XY0	SW-inland N.J.	southeast P.E.I.	1300 km
	1 March 1989	28 March 1989	27 days
H37	Chesapeake Bay, Md.	east-central Ct.	450 km
	19 October 1991[2]	25 October 1991	6 days

[1] Only neck-collars applied or seen in the Maritimes are included here. Many other records of movements within the United States also exist.

[2] Possibly a case of "overshooting" followed by reverse migration, but more plausibly a mis-read number in Md. (the same band number was read 5 times spanning 3 months in Ct.).

possible errors most single records that did not fit patterns based on these or other sources.

Representativeness remains the major difficulty with use of neck-collar sightings in deriving migration corridors. The impression that Canada Geese may be seen almost anywhere applies, if at all, only to passing flocks in flight. Goose stopovers are mainly in rather few areas, some on the shallow waters of bays, estuaries and lagoons, and others involving open fields. Most goose banding in the Atlantic Flyway takes place in field situations, and the sighting of neck-collars has been even more restricted to this habitat. Proportionately more goose hunting in the Maritimes occurs in habitats other than fields, but the majority of goose band recoveries here also are obtained in field situations.

Little effort to date has been devoted to searching for goose neck-collars in the Maritimes outside of Prince Edward Island. Neck-collar sightings may be representative of geese that pass through Prince Edward Island, but we cannot assume that those birds do not also frequent other areas where few or no sightings have been reported. Negative evidence, from neck-collars or other sources, remains unconvincing in the absence of other data. The information in this chapter alone is only a part of that used later (see Chapter XXI, this volume) in summarizing the distribution and migration patterns of Canada Geese in the Maritimes.

Data from breeding areas also may be unrepresentative. Shot recoveries before 1 September would be illegal and thus unlikely to be reported openly; "found dead", with an incomplete date, is widely recognized as a likely euphemism for "obtained illegally". Neck-collar sightings there also are scarce because geese mostly prefer to breed where few people live.

5.2. Migration corridors of Canada Geese in the Maritimes, from bands and neck-collars

The evidence of movements to and from Labrador was sketchy, owing to small samples, but it generally linked that area with passage through the western Maritimes. Only one band recovery, near Québec City, gave any

suggestion that geese from Labrador might pass along the St. Lawrence valley (where spring staging concentrations, bound for central and eastern Ungava, exceed 150 000 birds) rather than through the Maritimes. The absence to date in Prince Edward Island in fall of both band recoveries and neck-collar sightings of geese marked in Labrador suggested that those birds pass through New Brunswick directly to New England then, as the same small sample of neck-collared geese produced 11 sightings in P.E.I. in spring. The lack of banding and marking of geese in the southeastern third of Labrador hindered interpretation of the other data, but the few band recoveries on the coast south of 53°N did not suggest much migration of Labrador geese along the west coast of Newfoundland. Direct movement to and from Prince Edward Island, a distance of ca. 800 km or about 12 hours flight, which is well within the capability of these birds, seems more plausible.

The New Brunswick evidence was little more conclusive than that from Labrador because of small samples, except of recoveries of birds banded farther south. As with the Labrador records, most New Brunswick data fitted the perception of a narrow migration corridor along the Atlantic coast of the U.S.A., bypassing Maine, with most activity in eastern Massachusetts to east Long Island, N.Y.; New Jersey to Maryland; and eastern North Carolina. As with the Labrador neck-collar sightings, some birds that passed through Bathurst southbound, presumably from Labrador, appeared in Prince Edward Island in spring but not in fall. The recoveries in New Brunswick of geese banded in Maine in summer seemed to represent a different stock (or stocks) from most others encountered in the province, and their movements across New Brunswick were not parallelled in the records from the feral stock near McAdam, N.B.. We have not determined whether the Maine geese were of captive origin, but this seems likely.

The samples of band recoveries and neck-collar sightings of geese passing through Prince Edward Island were much larger than for Labrador or New Brunswick. These indicated a strikingly narrow migration corridor down the coast, coinciding from Cape Cod southward with that suggested by the sparser data from Labrador and New Brunswick. The narrowly coastal distribution and narrow time-span of recoveries probably reflected where hunting was possible and when it was permitted more than it did the full range of areas frequented and time spent there. The many sightings in southern New England of geese neck-collared or re-sighted also in Prince Edward Island, as contrasted to the absence of band recoveries linking that area to P.E.I., presumably reflected that hunting is not allowed in most inland areas in Massachusetts and Connecticut, so no geese were banded or recovered although many occurred there. Single recoveries from the Gaspé Peninsula and the southwest coast of Newfoundland may have been strays, but the recoveries on the Atlantic coast of Nova Scotia occurred in several winters so were unlikely all to have resulted from straying. Given the lack of fields and other open lands on the Nova Scotian Atlantic shore, and that geese there rest on the water far from shore to avoid harassment, the failure to observe P.E.I. neck-collars there indicated mostly that little effort had been made to find them, and that the effort might yield meagre returns if attempted. The virtual absence of band recoveries, as well as neck-collar sightings, of P.E.I.-marked geese in eastern Nova Scotia and insular Newfoundland, on the other hand, may be somewhat stronger negative evidence against the latter areas being included in the migration corridor described for geese from Labrador, New Brunswick, and Prince Edward Island.

Some Nova Scotia-banded Canada Geese also contributed to the main migration corridor discussed in preceding paragraphs, with recoveries from Cape Cod to Cape Hatteras, as well as in Prince Edward Island, New Brunswick, the Gaspé Peninsula, the Gulf North Shore, and eastern Labrador. However, they also provided recoveries in insular Newfoundland and on Cape Breton Island as well as along the South Shore of Nova Scotia. The bandings (all of captive-reared birds) on Cape Breton Island produced relatively fewer recoveries south of New Jersey and more north of there than the bandings on the Nova Scotia mainland (mostly near Debert and Avonport—migrants, or Shubenacadie—captive-reared). Recoveries of geese banded farther south divided unequally between the south shore and more northern areas of Nova Scotia. Although the patterns derived from winter bandings were less distinct, the data tend to support the idea of two stocks, one more focussed on the Atlantic coast of Nova Scotia and wintering in New England and northward vs. the other frequenting the northern mainland of Nova Scotia and wintering farther south. The few neck-collars read by minimal effort in Nova Scotia—along Northumberland Strait, and near Debert and Kentville—indicated that those areas were used by geese of the same stocks that visit Prince Edward Island.

The sparse data relating to insular Newfoundland reinforced the impression, gained from band recoveries to and from Nova Scotia, that goose migration links "The Rock" mainly to the Atlantic coast of Nova Scotia with some overflow to the outermost coasts of New England. This impression is not supported by positive neck-collar sightings, their absence reflecting unsuitable habitat as well as lack of effort. Two breeding season records from Newfoundland involved birds also seen in Prince Edward Island, but two records cannot provide a convincing pattern, even if we ignored the unusual history (one summer spent in P.E.I.) of one of them.

In summary, the band recovery and neck-collar sighting data are compatible with the hypothesis, mentioned earlier in this compendium and elaborated in Chapter XXI (this volume), that most geese in the Maritimes use one migration corridor, but with a separate corridor for geese that breed on the Island of Newfoundland and winter on the outer coasts of Nova Scotia. The captive-reared geese released in Nova Scotia and (earlier) in New Brunswick (see Chapter XVI, this volume) have adopted the migration patterns of other geese that move through those release sites or nearby coastal staging areas rather than developing sedentary

habits as is usual in more southern release areas where winters are less harsh. There is little evidence from marking of geese for the existence of a distinct northeastern population and coastal corridor, because of the difficulty of capturing geese along those coasts and the failure to search for neck-collars there. Those geese are there for parts of the year, and they go elsewhere at other times. The scarcity of positive evidence linking other geese to the Atlantic coasts of Nova Scotia or to the island of Newfoundland makes it more plausible that those areas harbour a separate population.

6. Literature cited

Aldrich, J.W., *et al.* 1949. Migration of some North American waterfowl. U.S. Fish & Wildlife Serv., Spec. Sci. Rep. (Wildl.) no. 1, 49 pp.

Bellrose, F.C. 1976. Ducks, geese & swans of North America. 2nd ed. Wildl. Manage. Inst. & Stackpole Books, Harrisburg, Pa. 544 pp.

MacInnes, C.D., Prevett, J.P., Edney, H.A. 1969. A versatile collar for individual identification of geese. J. Wildl. Manage, 33: 330–335.

Shaeffer, S.E., and Malecki, R.A. 1987. Distribution and derivation of the 1984–1986 Atlantic Flyway Canada Goose harvest. Trans. NE Sect. Wildl. Soc., 44: 48–52.

XIX. HUNTER KILL OF CANADA GEESE IN THE ATLANTIC PROVINCES

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1. Abstract

Canada Geese have been sought after by hunters in Canada's Atlantic regions for as long as both geese and people were present. Maintenance of goose populations while allowing hunting is a challenge for wildlife managers and the issue that made this compilation necessary. The Atlantic Provinces include almost the full spectrum of hunting, from urbanized sport hunters in the Maritimes to native hunters seeking geese in the Labrador wilderness on a near-subsistence basis.

Sport harvest, measured by CWS through national surveys, increased between 1973 and 1990 from less than 25 000 to over 55 000 geese, the increase since 1985 being especially striking. Nearly half the total sport kill was in Prince Edward Island, and the increase in kill was more evident there than elsewhere. Some increase also occurred on the Atlantic coast of Nova Scotia, which with insular Newfoundland were the next most important zones for goose kill. Goose hunting was less important in New Brunswick than the other provinces, but the kill there also may have increased since 1985. Kill of geese by native peoples was minor except in Labrador, where the combined kill by Inuit (coastal) and Innu (inland) may be as great as the estimated sport kill.

Trends in goose kill in the Maritimes were generally parallel to those in observational data. More sophisticated statistical comparisons are likely to be limited by the relatively small samples available. These produced such variable estimates that examination of data by individual zone may not be productive, but combining several zones may obscure important differences between regional goose stocks.

2. Introduction

Canada Geese are the largest game birds in eastern Canada. In Prince Edward Island, they are the only "big game" available to hunters. Geese have been hunted as food for as long as people were here to hunt them, and people at subsistence levels, whether natives or of European origin, still hunt geese mainly as meat for the table, although appreciating the recreation resulting from the hunt. Even where hunting is strictly recreational, geese in the hunters' bags are likely to be eaten, because of their relatively large size and high palatability. In this. geese resemble big game more than most small game species. Thus, goose hunting is widely seen as providing tangible returns as well as recreation.

This chapter contains an overview of the kill of Canada Geese by people in Canada's Atlantic Provinces over the last 20 years, as one feature of the overall picture assembled in this compendium. As in other chapters, it was necessary to fill in the picture from anecdotal and unstandardized sources, because kill by native people was not covered by any regular surveys.

3. Sources

Annual surveys of hunter performance conducted by the CWS include the Harvest Questionnaire Survey (HQS; earlier called National Harvest Survey, NHS) and the Species Composition Survey (SCS) (Cooch *et al.* 1978; Legris and Levesque 1991, and earlier annual reports cited therein). The first survey is based on responses to mailed questionnaires, the latter on returns by hunters of duck wings and goose tails from birds they killed. The extrapolated estimates of waterfowl kill, partitioned by species, age (and sex, for ducks only), are summarized as tabulations (available in the next spring) and subsequently as CWS Progress Notes (available some time later). Each Progress Note included the estimates for the last four years, which often differed from results first circulated by inclusion of returns received late. These CWS surveys began in 1967, and attained approximately their present form by 1973. Some earlier data were available from hunter questionnaire surveys conducted in New Brunswick and in Newfoundland and Labrador between 1958 and 1965 (Inder and Gillespie 1974; unpubl. reports in CWS files).

Data on goose kill by native people were extracted mainly from unpublished reports in CWS files (Cooch & McFarland; Northland Associates), and from papers by Alton Mackey and Orr (1987, 1988). These were supplemented by anecdotal information (not explicitly cited) from various sources, including Austin (1932), Peters and Burleigh (1951), and Todd (1963).

4. Human geography affecting kill of Canada Geese

Canada's Atlantic Provinces extend over 17° of latitude, from subarctic wilderness (the "Northeast Territories") to long-settled farmlands and over-exploited forests in the sub-boreal Maritimes. The hunting of geese in different parts of the region spans a similar range from near-subsistence levels (but using modern hunting equipment) to pure recreation. Three distinct categories are recognized here.

4.1 Labrador

The human population of Labrador is small and quite unevenly distributed, mainly near the coast except for a few new but large towns inland. The result is that hunting pressure on local sub-populations of geese in Labrador varies from heavy, perhaps with local extirpation in the past

of some coastal stocks, to nil, some interior birds probably departing and returning to Labrador without human molestation within its territories. Human kill of geese in Labrador seems unlikely to vary in parallel with changes in the total goose population and fall flight from that area, owing to uneven hunting effort as well as difficulties in sampling the kill.

Native peoples, including both Innu and Inuit, comprise 20% of the human population of Labrador, dominating coastal settlements north from Cartwright. Natives are not required to buy Migratory Game Bird Hunting Permits, so their kill is not reported in the regular CWS surveys, but it may approach or exceed that by licensed hunters in some years. Lifestyles and living standards in native communities average closer, but probably not much closer, to subsistence/survival levels than in the more remote coastal fishing settlements inhabited by settlers of European origins. The differences may be more in traditions than in equipment or practices. Conversely, people in the large inland towns hunt almost entirely for recreation, as in more southern areas.

4.2 The Island of Newfoundland

The human population of Newfoundland is twenty times that of Labrador. It comprises varied communities, from small cities and industrial towns with urbanized inhabitants hunting strictly for recreation, to coastal towns and villages with economies based until very recently largely on fishing, where hunting was part of a traditional way of life when fishing was slack. The inland barrens where most geese breed were remote from settlements, but not so remote as to preclude all hunting. Goose stocks in some accessible areas may have been extirpated in the 18th and 19th Centuries. The absence of extensive farmlands and of coastal salt-marshes precluded substantial staging areas where hunting might have become focussed, the sparsely settled Codroy area in the southwest being the only known exception. Relatively few Newfoundland hunters have the opportunity to hunt geese often, and it seems likely that the goose kill there at present bears quite unevenly on different parts of the island population. Although few local goose stocks there completely escape hunting before migration, and many more geese are killed there than in Labrador, it is unlikely that trends in Newfoundland hunting kill closely track changes in the fall flights from the island.

The indigenous native (Beothuk) population was exterminated soon after 1800, and the few Amerindian people now present there arrived from Nova Scotia within the last 200 years. "Native" kill of geese in Newfoundland probably is negligible in the overall picture for the island, although missed by the CWS surveys.

4.3 The Maritime Provinces

The earliest European settlements in the Maritimes (from 1605) were no earlier than the first in Newfoundland, and extensive occupation of lands for farming and forestry was delayed until after 1760. Virtually all lands near potential goose habitat in the Maritimes have been settled for over two centuries, and the locally greater fertility of the land and less harsh climate has allowed extensive farming, while also leading to dyking and drainage of salt-marshes. Although people in fishing communities on the Atlantic coasts of Nova Scotia and the east coast of New Brunswick continued traditional quasi-subsistence hunting of geese and other waterfowl into the 20th Century, few people here seriously depended on wild meat, and still less on birds as a source of such meat, after the early 1800s. The hunting of geese and other game provided variety in the diet as well as recreation long after it lost significance in a family's economy.

Local breeding stocks of geese in the Maritimes, probably never large (see Chapter XVI, this volume), were extirpated by 1900. All staging and wintering areas were accessible to some parts of the human population, which is much larger and more generally spread out than in Newfoundland and Labrador. Even with hunting mainly for sport, it seems plausible that most goose stocks in the Maritimes were exposed to substantial hunting pressure throughout the last 200 years. In this respect, the Maritimes differ from Newfoundland and Labrador, despite the probable parallels in extirpation of accessible breeding stocks.

The native population of the Maritimes may be larger now than at any time prior to European settlement, but it has become concentrated in a few areas, mostly remote from those used by geese. Thus the unrecorded native kill of geese apparently comprises only a minor part of the overall harvest picture here.

5. Results

5.1 Estimates of kill by licensed hunters

Data from the HQS and SCS were extrapolated to estimate the kill of Canada Geese in various parts of the Atlantic Provinces (Table XIX-1; Fig. XIX-1) in hunting seasons from 1973 through 1990 (Legris and Levesque 1991, and earlier CWS Progress Notes on the subject).

Another parameter often used to reflect hunting success is the kill per successful hunter (Table XIX-2). This figure is influenced by the chosen definition of a successful hunter; in the HQS, this apparently was defined as any hunter responding who had killed at least one duck or goose, upon the plausible assumption that anyone hunting ducks would also kill geese if the opportunity arose. Nevertheless, many hunters pursuing ducks operate in places where the likelihood of their encountering geese is vanishingly small, even if they are suitably equipped to kill geese as well as ducks. The actual kill per hunter among those seriously pursuing geese probably was substantially higher.

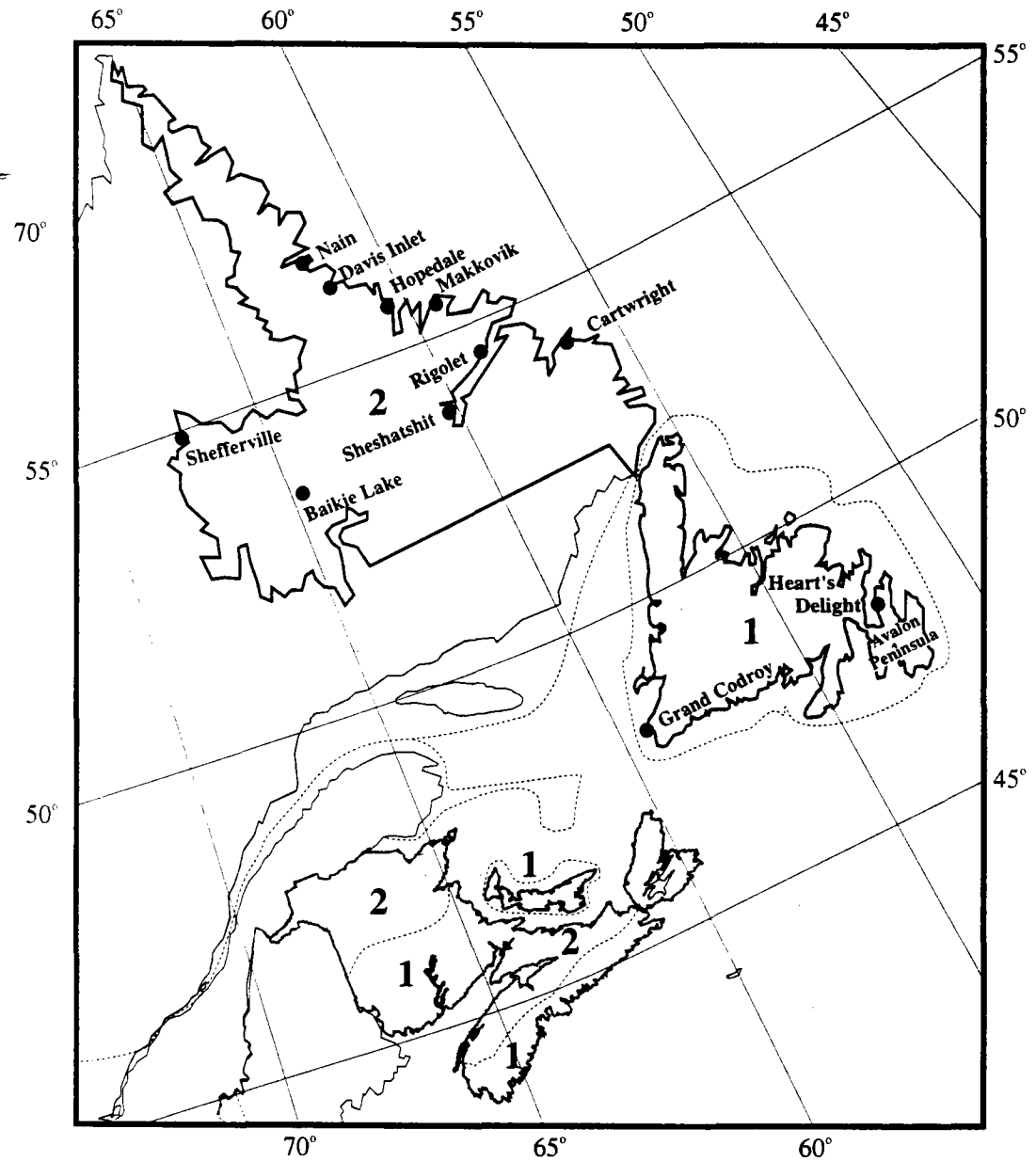

Figure XIX-1 Zones used by C.W.S. for summarizing annual waterfowl harvests (*not* often identical to the zones used in regulating hunting of these birds). Also shows place-names cited in text that do not appear on other maps.

Table XIX-1. Extrapolated estimates of Canada Goose kill by licensed migratory game bird hunters in the Atlantic Provinces, 1973–1990 (from CWS Progress Notes). Goose hunting in zone NS 1 regularly extended into January of the year following that cited.

	Goose kill in zone[1]						
Year	Labr.	Nfld.	P.E.I.	NS 1	NS 2	NB 1	NB 2
1973	2590	4432	7054	2922	2587	610	1383
1974	3166	5056	11 322	3124	2037	1381	1692
1975	3588	4563	6354	6574	2719	904	2085
1976	2640	5815	17 925	7622	3331	2500	4038
1977	4776	7784	18 653	4874	3883	741	1758
1978	4603	8441	11 823	4280	2529	1455	1760
1979	4896	8717	10 157	4383	1767	1153	1475
1980	3713	7102	18 894	6033	2346	1493	1422
1981	3329	6747	14 347	5639	1982	1641	2638
1982	2776	8409	13 427	2857	2459	1189	1589
1983	2113	11 559	15 694	7297	2435	672	6871
1984	4133	9451	13 331	5801	1108	1572	1518
1985	3927	7388	15 343	5291	1598	1093	3204
1986	5776	11 105	21 784	6516	3062	2123	3211
1987	5633	5290	21 236	9522	1910	1761	3128
1988	3185	6004	24 500	6542	3224	1110	3419
1989	4508	4739	22 608	13 543	2992	3599	3808
1990	3592	4403[2]	24 769	3967	2902	5357	3965

[1] Harvest zones as defined by Legris and Levesque (1991) and earlier CWS Progress Notes; Labrador = Nfld. zone 2; Nfld. = Nfld. zone 1, etc.

[2] Published estimates showed a kill of 1992 White-fronted Geese in Newfoundland in 1990, which obviously was an error; these were combined with the published kill of Canada Geese.

5.2 Estimates of kill by native hunters

The first attempt to estimate kill of Canada Geese (and other waterfowl) by native hunters across Canada (McFarland, F.J., Cooch, F.G., unpubl. rpt. in CWS files, 1976) used standardized assumptions to extrapolate from existing demographic information on native populations and locations (Table XIX-3). No systematic attempts have been made subsequently to estimate native kill of geese in the Maritimes or in insular Newfoundland.

The few direct surveys of native harvest in Labrador were of short duration (1+ yr), and the Innu communities (Sheshatshit = Northwest River; Davis Inlet) declined to participate, so data were limited and not easily extrapolated to total kills (Alton Mackey and Orr 1987, 1988; unpubl. rpt. by Northland Associates in CWS files). Extrapolations, using many unverified assumptions, to total native kill of geese (Table XIX-4) gave values of similar order to those obtained for Labrador by McFarland and Cooch (unpubl. rpt.).

6. Discussion

The CWS harvest surveys depend upon Canada Post Corporation for sale of hunting permits and prompt return of permit stubs (used in some samples), as well as for timely distribution and return of questionnaires and wing/tail envelopes. Strikes and other postal disruptions affected the harvest surveys and/or parts collections in parts or all of Canada in 1975, 1978, 1984, and 1988. If the estimated goose kill in those years was substantially different from those in both the years immediately before and after each disruption, one might assume cause-and-effect, thus: 1975—P.E.I. (lower); 1978 (no effect); 1984—N.S. 2 (lower), N.B. 2 (lower); 1988—Labr. (lower), N.S. 1 (lower), N.B. 1 (lower). All obvious differences were decreases (6, of 28 possible cases), which seemed unlikely to have arisen by chance. Most disruptions took place early in the hunting season, whereas harvest questionnaires were sent out late in the season, and returned still later. Decreases in estimates thus seemed unlikely to have resulted from postal disruptions. Most disruptions might be expected to affect returns from successful and unsuccessful hunters in proportion to their numbers, the main effects being reduced samples and increased variability of the estimates. Delays in delivery of wing envelopes created problems in the partitioning of duck kill, but not the estimates of Canada Goose kill; no other goose species is shot in the Atlantic Region in appreciable numbers, so the total goose kill (from harvest questionnaires) estimates the Canada Goose kill.

Table XIX-2. Total goose harvest (nearly all Canada Geese) per successful waterfowl hunter in the Atlantic Provinces, 1973–91 (after CWS Progress Notes).

	Goose kills/successful hunter in zone[1]						
Year	Labr.	Nfld	P.E.I.	NS 1	NS 2	NB 1	NB 2
1973	4.41	2.75	4.24	4.11	3.99	3.98	3.60
1974	3.82	3.08	5.38	3.06	2.90	3.09	2.42
1975	5.32	2.31	4.23	5.25	2.96	3.30	2.84
1976	4.87	3.17	6.97	5.29	3.99	4.37	4.37
1977	4.56	3.24	6.54	4.17	4.13	2.24	3.00
1978	5.59	2.87	5.02	2.88	3.30	2.48	3.03
1979	6.70	3.32	4.67	3.91	3.44	3.44	3.48
1980	4.49	2.69	6.63	4.62	3.12	3.21	3.22
1981	4.62	3.06	5.91	4.08	3.26	3.67	4.64
1982	3.59	2.82	5.55	3.96	4.23	3.48	3.04
1983	2.76	3.06	5.79	4.89	3.75	1.29	11.69
1984	4.76	2.89	4.94	4.75	3.05	2.77	3.69
1985	4.50	3.67	5.89	5.26	2.96	2.18	5.16
1986	5.34	3.30	6.92	6.00	4.24	3.33	4.98
1987	6.82	2.98	8.61	5.90	3.56	2.86	3.24
1988	5.55	3.12	8.37	6.13	4.44	3.15	4.75
1989	4.61	2.33	7.38	7.48	3.82	4.13	3.42
1990	4.77	2.69	9.46	3.96	6.18	5.31	4.62
1991	4.27	2.53	8.16	8.23	3.95	4.67	4.93

[1] Harvest zones as defined by Legris and Levesque (1991) and earlier CWS Progress Notes; Labrador = Nfld. zone 2; Nfld. = Nfld. zone 1, etc. (Fig. XIX-1).

Table XIX - 3. Extrapolated minimum and maximum estimates of annual Canada Goose kill by native peoples in the early 1970s (from McFarland and Cooch, unpublished CWS report 1976).

	Goose kill in zone[1]						
Estimate[2]	Labr.	Nfld.	P.E.I.	NS 1	NS 2	NB 1	NB 2
Minimum	508	35	259	75	486	54	230
Maximum	1286	35	423	98	782	82	425

[1] Harvest zones as defined by Legris and Levesque (1991) and earlier CWS Progress Notes; Labrador = Nfld. zone 2; Nfld. = Nfld. zone 1, etc.

[2] McFarland and Cooch showed kill by non-status natives only by provinces; these were assigned to the zone with the larger native population in Nova Scotia and New Brunswick, and to the island of Newfoundland in that province.

Table XIX-4. Canada Goose kill in Labrador by native peoples, extrapolated from Alton Mackey and Orr (1987, 1988).

(a) Goose kill by Inuit hunters

The year's use (= kill) of Canada Geese by residents (N = 333) of Makkovik totalled 754 kg, equivalent to 332 birds (Northland Associates Ltd., unpubl. rpt., evidently based on a "dressed weight" of 2.27 kg/bird; cf. mean weight of intact birds = 3.5 kg, Bellrose 1976), nearly all taken in early fall (= Sept.–Oct.) (Alton Mackey & Orr 1987, 1988). This was considered as representative of hunters on the central Labrador coast, including "settlers" as well as Inuit.

The Inuit of Labrador are concentrated largely in five coastal settlements (total population and approximate proportion Inuit in each shown in parentheses): from N to S, these are Nain (1069; 0.8), Hopedale (515; 0.5); Makkovik 370 (0.5); Rigolet (334; 0.5); Cartwright (611; 0.2).

By applying the Makkovik kill rate (above) across the proportion of Inuit in each community, the annual native kills of geese were estimated as: Nain 767; Hopedale 231; Makkovik 166; Rigolet 150 (141 *); Cartwright 110; total 1424 geese.

(b) Goose kill by Innu (= "Indian") hunters

No direct estimates of kill by Innu hunters have been obtained. Their hunting effectiveness may be assumed equal to that of Inuit hunters. They more often hunt inland, so they may encounter geese more often, especially in spring and summer; geese inland occur in smaller groups and may be even more wary, so may be less vulnerable to hunting, except when flightless young or adults in moult are involved. Thus, the kill rate used on the coast may be equally representative for Innu hunters.

Innu in Labrador, excluding those living and working in the major inland towns, are largely in three settlements (total population and approximate proportion Innu in each shown in parentheses): these are Davis Inlet (ca.200; 1.0); Sheshatshit (= Northwest River; 528; 0.9); Schefferville, Que. (only a few km from Labr. border, assume 50% of hunting occurs in Labr.; ca. 1100; 0.7).

By applying the Makkovik kill rate (above (a)) across the proportion of Innu in each community, the annual kills of geese were estimated as: Davis Inlet 179; Sheshatshit 426; Schefferville 345; total 950 geese.

Total of (a) + (b): 1424 + 950 = 2374 geese.

Variability in kill estimates between years was least in Newfoundland (largest kill 2.6x smallest) and greatest in N.B. zone 1 (largest 8.8x smallest), with all others between 5.0x and 3.2x. The small numbers of hunters available to be sampled in Labrador and P.E.I. killed rather high numbers of geese per hunter (Table XIX-2), which may explain why those areas did not show greater than average variability. Relatively few geese were killed in New Brunswick, so the inclusion in the sample of a few unusually successful hunters there might have affected the estimates. In N.B. zone 1, the kill estimates in 1976, 1989 and 1990 were much higher than in most other years (Table XIX-1); the kills per hunter (Table XIX-2) in those years were also high in this zone, which usually had the lowest goose kill in the region. N.B. zone 2 showed less variation, except that the figures for 1983 look highly improbable in comparison with the rest.

Earlier estimates (1967–72) from the national harvest surveys were of a similar order of magnitude, but may have been biased upward owing to sampling being restricted to people who had hunted in the preceding year (Cooch *et al.* 1978). The same bias presumably affected results of surveys in New Brunswick in 1958 to 1965 (unpubl. rpts. in CWS files); however, estimated goose kill in those years ranged from 1253 to 2346 birds, thus much lower than estimated in any year after 1973. That bias should not have applied to the estimates for Newfoundland and Labrador in 1959 to 1965 (1962 missing), as those were based on returns from license-stubs of the current year (Inder and Gillespie 1974). Those kill estimates ranged from 670 to 1426 in Labrador, and from 2246 to 2614 on the island of Newfoundland, also far lower than the 1973 to 1990 estimates. Possibly many hunters then did not buy small game licenses, so much of the kill was not registered by the survey.

McFarland and Cooch (unpubl. rpt.) made similar assumptions on hunting effort and success for natives in the Maritimes as in remote areas of Canada. That seemed inappropriate, as noted at the time by A.D. Smith (CWS–AR, *in litt.* 1977). Few Indian Reserves in the Maritimes are near known waterfowl concentration areas, and enforcement agents encountered few identifiable (unlicensed) natives engaged in hunting in the more productive hunting areas. The estimates by McFarland and Cooch of goose kill by natives in the Maritime Provinces were low by comparison with the estimates of sport kill there, but they may have been too high even so. With the acceptance by governments of wider hunting

"rights" for natives in Nova Scotia in 1991, some change in future may be anticipated. Current goose hunting in the Maritimes is in the areas where geese concentrate, and mainly far distant from Indian Reserves, so large increases in goose kill by natives in those provinces are not expectable, though possible.

The estimates of goose kill by native peoples in Labrador were all speculative, but independent estimates, by McFarland and Cooch (unpubl. rpt.), by Northland Associates Ltd. (unpubl. rpt.), and derived here (Table XIX-4) from Alton Mackey and Orr (1987, 1988), were all of a similar order. The McFarland/Cooch estimate was lower, but was apparently based on realistic estimates of the numbers of both Innu and Inuit in Labrador. The estimated native kill in Labrador seems to be nearly as great as the sport kill measured by CWS harvest surveys, and it may be even larger.

Unlike all other kill samples in the Atlantic Region, the Labrador estimates of native kill included some geese taken in late spring or summer on the breeding grounds. Although 3/4 of the kill in the Makkovik sample (Alton Mackey and Orr 1988) was in early fall, that may not apply where hunters travel inland. However, goose kill in Labrador, even by natives, probably occurs mostly in concentration areas, which are used mostly in fall rather than in breeding season.

Inexperienced young geese are potentially more vulnerable to hunting than older geese, although their inclusion in family groups travelling together on their first southward and northward migrations may reduce this effect. Productivity of arctic and sub-arctic geese varies greatly between years with more or less favourable weather conditions in the breeding areas. Variation in productivity might be expected to affect kill levels mainly in the first areas where geese encounter hunters, thus, within the Atlantic Flyway, in Labrador and Newfoundland. Given the much more maritime situation of (insular) Newfoundland, and its proximity to the warm air associated with the Gulf Stream (which never approaches Labrador), close correlation of kill fluctuations between those areas seemed unlikely. In fact, the kill levels in Newfoundland and Labrador changed in opposite directions as often (8 pairs of years) as in the same direction (both increased 4 times, both decreased 5 times).

From geography and migration patterns (see Chapter XXI, this volume), it seems likely that kills in the Island of Newfoundland and in N.S. zone 1 are from one breeding stock, and kills in the other zones from a separate stock. Kills in Newfoundland and Labrador are taken from their respective fall flights before these are available to other zones. If total kill from one stock approached the maximum sustainable level, an increase in kill in the northern zone should reduce opportunity and thus kill in the zones where the geese arrived later. No such effect was evident in any combination of zones here. The variability from other causes may be so great as to conceal the effect of sequential kill from any one stock, but the failure to detect such an effect supports the impression that current kill levels seldom approach the maximum sustainable by these populations.

Estimates of total goose kill by non-natives in the Atlantic Provinces ranged from less than 25 000 to over 50 000 birds between 1973 and 1990. Estimated kill levels increased progressively in P.E.I. (most pronouncedly), N.S. zone 1, N.B. zone 2, and perhaps N.B. zone 1. In the other zones there was no obvious trend. The increase in P.E.I. roughly parallelled the increases noted in field surveys of goose numbers (Chapter IX, this volume). The increase in N.B. zone 2 also agreed with the recent increases in geese seen near Bathurst (Chapter X, this volume). On the Atlantic coast of Nova Scotia (N.S. zone 1), no overall increase in goose numbers has been noted, but more geese now stage and winter close to the Halifax urban area than in the past (Chapter VI, this volume), providing increased hunting opportunity to the large human population there. Thus, in broad outlines the goose kill data followed the trends seen in regional goose numbers, summarized in the following chapter.

All recent estimates of kill, except that by natives, depended on extrapolations across all waterfowl hunters, as measured by sales of Migratory Game Bird Hunting Permits (Table XIX-5, Fig. XIX-2). The wide fluctuations in these numbers encourage caution in extrapolations based on them. Neither the estimates of total goose kill (Table XIX-1) nor of mean kill/successful hunter (Table XIX-2) showed obvious peaks corresponding to the peaks in permit sales in 1977 to 1979, so the fluctuations in indicated kill more likely arose from variations in returns of harvest questionnaires than from changes in permit sales. The latter reflect that many casual (=unsuccessful) hunters abandoned the pursuit of waterfowl during the last 20 years. Omission of such hunters from the sample to whom harvest questionnaires were sent might tend to over-estimate the total kill relative to earlier years when they were included.

7. Literature cited

Alton Mackey, M.G. and Orr, R.D. 1987. An evaluation of household country food use in Makkovik, Labrador, July 1980–June 1981. Arctic, 40: 60–65.

Alton Mackey, M.G. and Moore Orr, R.D. 1988. The seasonal nutrient density of country food harvested in Makkovik, Labrador. Arctic, 41: 105–108.

Austin, O.L., Jr. 1932. The birds of Newfoundland Labrador. Mem. Nuttall Ornithol. Club, no. 7. 229 pp.

Bellrose, F.C. 1976. Ducks, geese and swans of North America. 2nd ed. Stackpole Books, Harrisburg, Pa. 543 pp.

Cooch, F.G., Wendt, S., Smith, G.E.J., Butler, G. 1978. The Canada Migratory Game Bird Hunting Permit and associated surveys. pp. 8–39 *in* Migratory game bird hunters and hunting in Canada. (Boyd, H., Finney, G.H., eds.) Can. Wildl. Serv. Rep. Ser. no. 43. 127 pp.

Inder, J.G. and Gillespie, D.I. 1974. Estimates of the kill of migratory game birds in the Province of Newfoundland 1959–65; an analysis of Small Game License returns. Nfld. Wildl. Serv. Tech. Bull. no. 1. 46 pp.

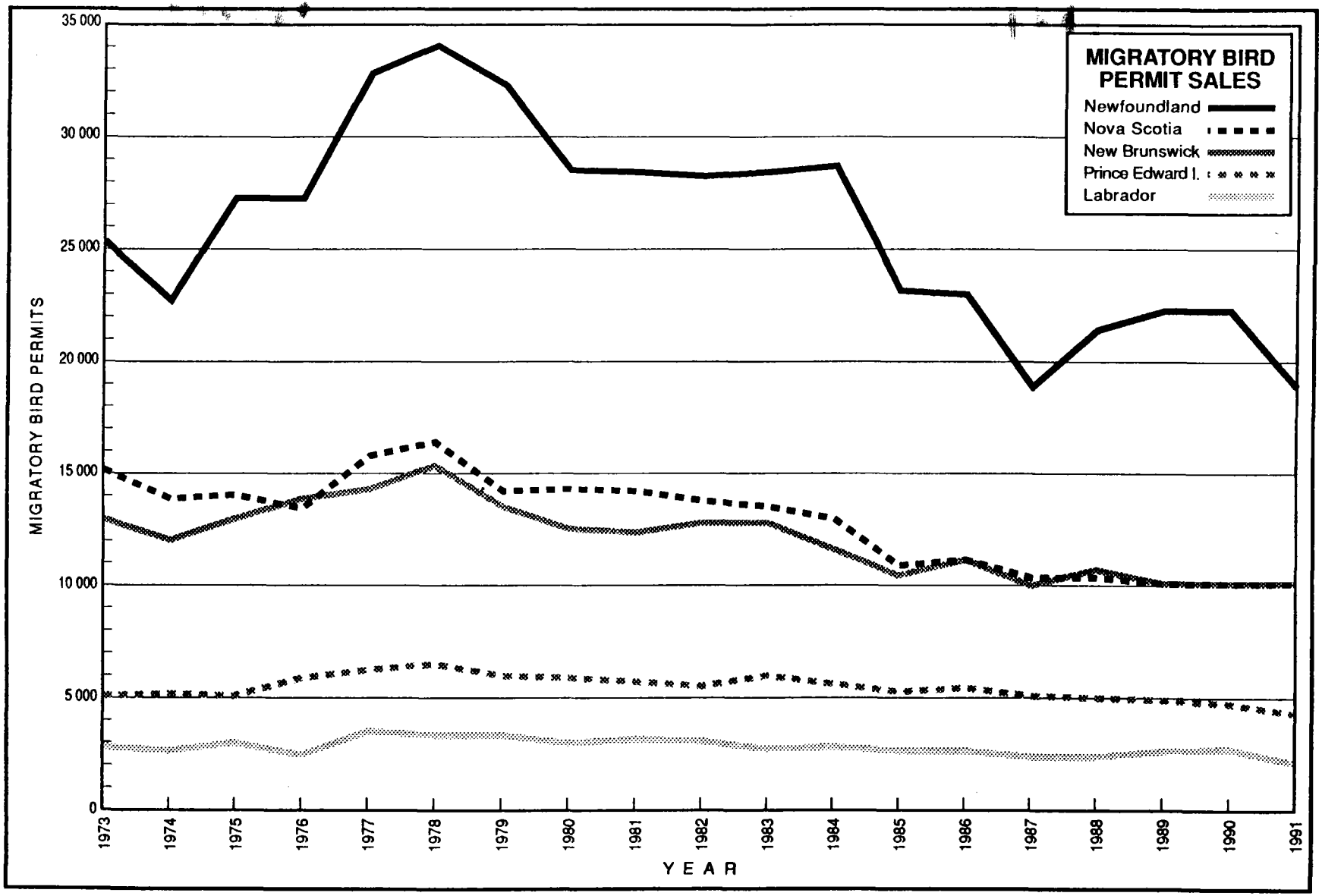

Figure XIX-2 Migratory Game Bird Hunting Permit sales, by province (Newfound and Labrador shown separately), Atlantic Provinces, 1973-1991.

Table XIX-5. Total migratory game bird permit sales, Atlantic Provinces, 1973–91 (after CWS Progress Notes).

	MGB Permit Sales in zone							
Year	Labr.	Nfld.	P.E.I.	NS 1	NS 2	NB 1	NB 2	Total
1973	2668	25 251	4972	10 547	4524	9295	3574	60 831
1974	2501	22 626	5038	9699	4092	8573	3343	55 872
1975	2908	27 207	4963	8349	5641	8896	4034	61 998
1976	2394	27 227	5756	8112	5214	9411	4332	62 446
1977	3400	32 788	6158	9986	5758	9785	4424	72 299
1978	3269	34 028	6396	10 580	5717	10 327	4922	75 239
1979	3247	32 243	5888	9369	4729	9138	4271	68 885
1980	2878	28 484	5802	9489	4768	8649	3822	63 892
1981	3070	28 331	5611	9339	4791	8336	3951	63 429
1982	3006	28 209	5461	9071	4657	8835	3924	63 163
1983	2642	28 335	5898	9064	4404	8621	4137	63 101
1984	2702	28 607	5525	8569	4327	7745	3741	61 216
1985	2515	23 137	5171	7317	3432	7096	3258	51 926
1986	2574	22 924	5300	7552	3495	7515	3568	52 928
1987	2311	18 769	4959	7206	3093	6823	3074	46 235
1988	2301	21 354	4906	7238	3026	7244	3402	49 471
1989	2512	22 195	4838	7222	2870	6551	3420	49 608
1990	2614	22 217	4625	7202	2913	6512	3462	49 545
1991	2005	18 773	4209	7310	2794	6510	3487	45 088

7. Literature cited (continued)

Legris, A.M., Levesque, H. 1991. Migratory game birds harvested in Canada during the 1990 hunting season. Can. Wildl. Serv. Progr. Notes no. 197. 40 pp.

Peters, H.S. and Burleigh, T.D. 1951. The birds of Newfoundland. Nfld. Dept. Nat. Res., St. John's. 431 pp.

Todd, W.E.C. 1963. Birds of the Labrador peninsula and adjacent areas. Univ. of Toronto Press, Toronto, 819 pp.

XX. CLIMATE IN RELATION TO CANADA GOOSE STAGING AND WINTERING IN THE MARITIME PROVINCES

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1. Abstract

Widespread impressions of milder winters and warmer springs in the Maritimes correlated plausibly with observed changes in goose distribution at those seasons recently. Preliminary examination of climatological data gave little support to the impression of milder and less snowy winters, although some suggestion of greater variation in winter weather emerged. Climate change thus seemed unlikely to be a major factor in the observed changes in winter goose distribution. Mean monthly temperatures in April were generally higher after 1975 than in earlier years, and total snowfall was lower despite higher total precipitation. This supported the impression of warmer springs in recent years, and made this more plausible as a factor in the recent shift of spring staging of geese to Prince Edward Island.

2. Introduction

Climate impinges on everything on the Earth's surface. Seasonal variations in climate influence annual cycles in the lives of all plants and animals. Changes in climate over longer time periods may modify recurring patterns in animal behaviour. Canada Geese, among the largest birds in the Maritimes, also are affected by seasonal and longer-term changes in climate.

Average temperatures generally decrease from south to north at all seasons. In winter, temperature falls as one goes from the sea to the interior of the continent, although the reverse trend may apply in summer, with intermediate situations prevailing in spring or fall. As temperatures fall below the freezing point of water, larger proportions of total precipitation fall as snow rather than rain. With still lower temperatures, surface waters freeze, sea-water freezing at lower temperatures than fresh water. Onshore winds may break up ice-cover, and offshore winds drive loose drift- or pack-ice out to sea. Winds also exacerbate the cooling effects of low temperatures. *Temperature, precipitation, and wind all affect the* distributions of water birds, including Canada Geese.

Supposed effects of climate or weather were a recurring theme in the preceding accounts of Canada Goose migration and wintering in the Maritime Provinces. This is among the northernmost wintering areas for the species, and it is a plausible assumption that winter climate sets limits on the distribution and numbers of geese, partly by influencing the habitats they use. Changes in climate over time may produce changes in the presence and numbers of geese using different areas during migration as well as in winter. In earlier chapters of this volume, subjective correlations of supposed changes in climate with changes in goose occurrence were noted. This chapter explores the subject more fully, using real data instead of impressions.

3. Climate and goose distribution in the Maritimes

3.1 Winter goose distribution vis-a-vis climate

Canada Geese over-winter in the Maritimes where temperatures remain mild enough that shallow waters over eelgrass beds are ice-free most of the winter. Other areas and habitats, in which geese feed at other seasons, are covered with snow or ice and thus are inaccessible to geese for several months each year. Table XX-1 summarizes climatic data for the winter months in some locations in the Maritimes near which Canada Geese either winter (milder areas) or do not winter regularly (cooler areas).

3.2 Spring staging of geese relative to climate

Canada Geese return to traditional staging areas in the Maritimes when, on the average, snow- and ice-cover has dwindled enough to allow feeding there. Some geese that wintered farther south stop-off temporarily in areas where other geese wintered in the Maritimes, but most migrating geese stage in spring in areas that were frozen and snow-covered for most of the winter. There must be trade-offs: areas where geese wintered have open water and bare shores earlier, but the wintering birds have reduced the standing crop of food plants there; some other areas that become snow- and ice-free early may offer lower quantity or quality of foods than become available later elsewhere. Table XX-2 summarizes spring climatic data for areas more or less preferred by geese for spring staging, showing that climate alone does not distinguish between areas used by greater or lesser numbers of geese.

3.3 Fall staging of geese in relation to climate

Migrating geese in spring terminate their flights in areas averaging cooler than those whence they had departed, so average climatic conditions in the destination areas presumably influence the timing of those flights. In fall, the southward migrations take them from cooler to milder areas. Climatic influences then seem more likely to take effect in the departure areas, and we would expect factors other than climate to determine which areas in the Maritimes are most used by geese in fall. As one would predict, there are no consistent, obvious correlations between climatic data and goose distribution in early fall.

Table XX-1. Mean monthly temperature and total monthly precipitation at selected stations in areas with and without wintering Canada Geese[1], Maritime Provinces, December-February, 1975–94. Data extracted from "Monthly record of meteorological observations in Canada", Atmospheric Environment Service, Environment Canada.

Locality	Temperature (°C) Dec.	Jan.	Feb.	Precipitation (mm) Dec.	Jan.	Feb.
(a) Areas with geese wintering regularly						
Yarmouth, N.S.	-0.5	-3.3	-3.2	140.9	138.9	96.4
Liverpool, N.S.	-1.6	-4.6	-4.3	162.4	167.6	113.3
Halifax, N.S.	-1.7	-4.7	-4.4	170.4	158.5	105.7
(b) Areas with geese wintering irregularly						
Sydney, N.S.	-2.4	-5.9	-6.9	172.2	153.2	124.7
(c) Areas without wintering geese						
Truro, N.S.	-3.9	-7.0	-6.9	134.3	123.9	85.9
Nappan, N.S.	-4.3	-7.7	-7.1	122.2	123.0	85.7
Charlottetown, P.E.I.	-3.9	-7.5	-7.5	122.5	107.1	80.3
Fredericton, N.B.	-6.3	-9.9	-8.0	102.3	100.3	68.1
Chatham, N.B.	-7.3	-10.9	-9.3	94.8	95.7	67.4
Bathurst, N.B.	-7.6	-11.4	-9.8	100.1	99.0	63.0

[1] All areas shown are used by staging geese.

Table XX-2. Mean monthly temperature and total monthly precipitation at selected stations in areas more or less favoured by spring-staging Canada Geese, Maritime Provinces, March–April, 1975–94. Data extracted from "Monthly record of meteorological observations in Canada", Atmospheric Environment Service, Environment Canada.

Locality	Temp. (°C) March	April	Precipitation (mm) March	April	Snowfall March	April
(a) Areas now favoured for prolonged spring staging by geese						
Charlottetown, P.E.I.	-2.9	+3.4	79.1	87.1	40.7	23.9
Truro, N.S.	-2.3	+4.0	107.2	87.5	43.3	17.6
Sydney, N.S.	-3.0	+2.2	137.5	136.2	58.7	24.3
(b) Areas now less used for spring staging by geese						
Yarmouth, N.S.	+0.2	+5.1	115.3	102.8	31.1	9.7
Liverpool, N.S.	+0.2	+5.7	153.1	135.7	36.0	8.6
Halifax, N.S.	-0.5	+4.7	135.7	129.9	31.1	7.1
Nappan, N.S.	-2.2	+4.0	99.3	90.1	52.5	24.7
Fredericton, N.B.	-2.4	+4.6	90.8	79.6	39.8	15.2
Chatham, N.B.	-3.4	+3.2	83.8	88.7	56.7	27.1
Bathurst, N.B.	-3.8	+2.6	81.8	87.0	52.4	30.6

Geese continue to move south(west)ward across the Maritimes through the fall months, most of those movements having no apparent correlation with seasonal changes in climate. Only the final departures, from areas where geese do not winter, clearly are driven by the onset of winter, when decreasing temperatures accompanied by increasing snow- and ice-cover make those areas inaccessible to geese. December temperatures in areas where geese do not winter (Table XX-1) average colder than in areas where wintering is regular.

4. Climatic change in the Maritime Provinces

4.1 Impressions vs. statistics on climatic change

General consensus among people in the Maritimes holds that winters here are now less cold and less snowy than in the not-very-distant past, and that spring comes earlier in the year now. As noted earlier (Erskine, this volume), such impressions may be very recently based, for example, on the last winter (or this past week!) vs. the previous winter or two. It seems possible that reduced time

spent out-of-doors rather than in a heated car, and the relative effectiveness of snow-removal from streets and highways, during the last 25 years, have as much or more effect on such impressions than winter severity. Personally, I have similar impressions of milder winters and earlier springs recently, but the weather data I myself recorded over the last 40 years provided no obvious support for that impression.

One hypothesis about winter climate change argues that recent temperatures may be more variable rather than significantly milder. Frequent thaws, even when separated by short spells of extreme cold, reduce accumulated snow-cover, and give more of an impression of milder climate than is conveyed by sustained but more moderately cold temperatures. Exploring variability in winter temperatures is a major study in itself, and was not attempted in the context of this compilation.

4.2 Correlating climatic changes with Canada Goose occurrences

Erskine (this volume) and Martell (this volume) assembled some climatic data for comparison with Canada Goose occurrence near Port Joli in the 1950s and 1960s, but found few convincing correlations. There were difficulties in choosing appropriate suites of climatic data and appropriate methods for correlation, and in selecting appropriate periods over which to apply those methods. As geese use relatively few areas here in winter, and are geographically restricted at other seasons too, not all weather stations in the Maritimes provide climatic data suitable for correlations with goose occurrences.

Long-term trend data (1911–93) from all stations in Atlantic Canada (including Newfoundland and Labrador), assembled by Atmospheric Environment Service, Environment Canada (Mekis and Hogg, unpubl. MS), suggested small overall increases both in mean temperature and total precipitation in winter over that period. Mean monthly temperature may not be an appropriate measure of winter severity, perceived by people or geese, although it is a convenient one. Some different measure of winter precipitation seems most desirable. Snowfall totals are extremely variable, reflecting often only the relative proportions of snow vs. rain, which arise from current temperatures rather than from anything inherent in the precipitation. As winter ice-cover effectively excludes geese from most parts of the Maritimes, probably temperatures below some threshold level have more predictive value than overall means. Erskine (this volume) suggested that general freezing of sea-waters around the goose sanctuary at Port Joli occurred only in months with mean temperature (at Halifax) below –2°C (+28°F).

Two impressions of changes in climate seemed to be correlated with obvious changes in goose occurrence patterns in the Maritimes. As summarized in Chapters II–VI, the impression of milder winters recently agreed with a shift involving several thousand geese from wintering in the Port Joli area to Halifax County, around 1975, wintering in the latter area formerly occurring only in relatively mild winters. Chapters IX and XI–XV showed that the impression of earlier (i.e. warmer) springs recently agreed with geese abandoning spring stopover areas around Chignecto Bay and on the St. John River, with earlier and much larger concentrations resulting in Prince Edward Island. Again, that shift centred around 1975, though it began several years before and continued after that date.

The observed shift in wintering geese leads to an hypothesis that temperatures in winter (Dec., Jan., Feb.) averaged warmer in coastal Halifax County after 1975 than before. Temperatures in coastal areas on the South Shore need not have changed in parallel. Warmer temperatures there, leading to less ice-cover, might improve wintering conditions, but such a gain might be over-ridden by the long-recognized advantages of wintering closer to breeding areas. Temperatures in Cape Breton County might also have increased, but presumably did not reach the threshold level for regular wintering, as that had not occurred there.

The shift in spring staging of geese suggested an hypothesis that temperatures both in the former staging areas and in Prince Edward Island averaged warmer in early spring (Mar. and/or Apr.) after 1975 than before. Probably data from the first half of March might be excluded, as very little migration occurred then in any known time-period, and conditions then often are better described as winter than spring; for convenience, only monthly means were used. Increased recent goose staging in Minas Basin and Cobequid Bay suggested parallel warming in those areas, no matter by what route the extra geese in recent years arrived there.

5. Results

5.1 Winter

Mean monthly temperatures in winter, in Maritimes goose wintering areas, were consistently warmer in 1941 to 1970 than in 1911 to 1940. Mean temperatures in those areas in 1975 to 1994 were generally cooler than in 1941 to 1970, and little warmer than in 1911 to 1940 (Table XX-3(a)). Extreme minimum temperatures recorded during the same periods (Table XX-3(b)) were often lower since 1975 than earlier, suggesting greater variation in winter temperatures recently.

Similar comparisons of long-term precipitation means (Table XX-4) suggested higher total precipitation but with unchanged (Dec., Jan.) or less snowfall (Feb.) since 1975 than earlier.

5.2 Spring

Comparison of long-term mean monthly temperatures revealed few increases in March after 1975, compared to earlier years, whereas increases in April were general except in the cooler localities (Sydney, Chatham, Bathurst) (Table XX-5). Long-term means for total precipitation were generally higher in both spring months after 1975 than before, but total April snowfall was consistently less except at the three cooler stations (Table XX-6).

Table XX-3. Long-term mean monthly temperature and extreme minimum temperature at selected stations in areas used by wintering Canada Geese, Maritime Provinces, December–February, 1911–40, 1941–70, 1975–94. Data extracted from "Monthly record of meteorological observations in Canada", Atmospheric Environment Service, Environment Canada.

	Long-term Mean Monthly Temperature (°C)								
	1911–40			1941–70			1975–94		
Locality	Dec.	Jan.	Feb.	Dec.	Jan.	Feb.	Dec.	Jan.	Feb.
(a) Mean monthly temperature									
Yarmouth, N.S.	-0.6	-3.3	-3.4	-0.2	-2.7	+0.2	-0.5	-3.3	-3.2
Liverpool, N.S.	-1.7	-4.2	-5.2	-1.4	-4.0	-4.2	-1.6	-4.6	-4.3
Halifax, N.S.	-2.2	-5.1	-5.4	-0.9	-3.3	-2.4	-1.7	-4.7	-4.4
Sydney, N.S.	-1.8	-5.4	-6.8	-1.5	-4.4	-5.5	-2.4	-5.9	-6.9
(b) Extreme lowest temperature (see NOTE, below, re: comparisons)									
Yarmouth, N.S.	-15	-17	-23	-15	-16	-19	-19	-21	-24
Liverpool, N.S.	-18	-22	-30	-16	-25	-27	-26	-31	-34
Halifax, N.S.	-19	-21	-26	-17	-21	-20	-23	-26	-25
Sydney, N.S.	-14	-23	-32	-16	-23	-24	-22	-26	-27

Table XX-4. Long-term monthly mean total precipitation and snowfall at selected stations in areas used by wintering Canada Geese, Maritime Provinces, December–February, 1911–40, 1941–70, 1975–94. Data extracted from "Monthly record of meteorological observations in Canada", Atmospheric Environment Service, Environment Canada.

	Long-term Monthly Mean Precipitation (mm)								
	1911–40			1941–70			1975–94		
Locality	Dec.	Jan.	Feb.	Dec.	Jan.	Feb.	Dec.	Jan.	Feb.
(a) Total precipitation									
Yarmouth	123.9	114.0	107.7	134.1	140.7	115.8	140.9	138.9	96.4
Liverpool	147.8	144.3	142.5	144.3	148.8	132.1	162.4	167.6	113.3
Halifax	138.3	141.1	109.7	126.0	140.5	118.6	170.4	158.5	105.7
Sydney	138.4	131.1	112.3	139.7	137.2	118.6	172.2	153.2	124.7
(b) Total snowfall (See NOTE below, re: comparisons.)									
Yarmouth	44.3	70.0	68.8	40.0	55.7	64.4	45.1	70.2	44.7
Liverpool	38.8	50.1	87.2	40.4	55.4	59.7	34.9	54.5	40.5
Halifax	19.2	54.8	72.6	31.2	49.4	68.7	31.5	39.6	38.3
Sydney	40.8	54.4	75.6	43.9	63.6	59.7	66.6	71.2	71.5

[NOTE: For minimum temperatures and total snowfall, the long-term mean values for 1911 to 1940 and 1941 to 1970 were not given in my sources, so for now I used data for only three evenly spaced years in each 30-year period for comparison with the 20-year means I compiled for 1975 to 1994. The results of these comparisons did not encourage further effort to extract and recalculate the long-term means.]

Table XX-5. Long-term mean monthly temperature at selected stations in areas used by spring-staging Canada Geese, Maritime Provinces, March–April, 1911–40, 1941–70, 1975–94. Data extracted from "Monthly record of meteorological observations in Canada", Atmospheric Environment Service, Environment Canada

	Long-term Mean Monthly Temperature (°C)					
	1911–40		1941–70		1975–94	
Locality	Mar.	Apr.	Mar.	Apr.	Mar.	Apr.
(a) Areas now favoured for prolonged spring staging by geese						
Charlottetown, P.E.I.	-3.2	+2.4	-2.7	+2.9	-2.9	+3.4
Truro, N.S.	-2.2	+3.3	-2.3	+3.1	-2.3	+4.0
Sydney, N.S.	-2.6	+2.4	-2.4	+2.1	-3.0	+2.2
(b) Areas now less used for spring staging by geese						
Yarmouth, N.S.	0.0	+4.4	+0.2	+4.6	+0.2	+5.1
Liverpool, N.S.	-0.9	+4.1	-0.2	+5.0	+0.2	+5.7
Halifax, N.S.	-0.9	+4.1	-0.1	+4.8	-0.5	+4.7
Nappan, N.S.	-2.9	+3.2	-2.4	+3.3	-2.2	+4.0
Fredericton, N.B.	-3.0	+3.9	-2.6	+4.0	-2.4	+4.6
Chatham, N.B.	-3.8	+3.0	-3.5	+2.9	-3.4	+3.2
Bathurst, N.B.	-4.6	+2.4	-4.7	+2.6	-3.8	+2.6

6. Discussion

6.1 Use of wintering areas vs. climate change

The climatic data examined here provided little support for the hypothesis that climate change in winter was a (or the) major factor in the observed shift of goose wintering on the Atlantic coast of Nova Scotia. Although some warming was evident prior to 1975, that trend seemed to have been reversed since that date. Although traditions in use might slow a shift to areas newly available for winter use, one would not expect a shift thus delayed to persist long after the initial stimulus (warming) ceased to operate. The data (only partly extracted as yet) for extreme minimum temperatures, and for snowfall as a proportion of total precipitation, supported the idea that winter climate may have become more variable recently, but that alone seemed unlikely to have triggered a shift in wintering area. The creation of a refuge from hunting, the Martinique Game Sanctuary, in Halifax County may have been more important to the shift in wintering of geese than the rather minor and uncertain changes in winter climate thus far detected. A more exhaustive and probably much more costly examination of the climatic data by computer might produce more convincing results, but the evidence used here suggests that climate change was at most a minor factor in causing the observed shifts in winter distribution of geese in the Maritimes.

6.2 Use of spring-staging areas vs. climate change

The climatic data for April, but not March, lent support to the impression of warmer springs since 1975, hypothesized to allow geese to move directly into the best feeding areas in Prince Edward Island without intermediate stops farther (south) west. This kind of correlation does not prove causation, of course. That spring feeding for geese in Prince Edward Island really is better than in the former staging areas around Chignecto Bay and along the Saint John River is still an untested assumption, even though present use-patterns suggest that geese think it is a valid one.

Table XX-6. Long-term monthly mean total precipitation and snowfall at selected stations in areas used by spring-staging Canada Geese, Maritime Provinces, March–April, 1911–40, 1941–70, 1975–94. Data extracted from "Monthly record of meteorological observations in Canada", Atmospheric Environment Service, Environment Canada.

Locality	Long-term Monthly Mean Total Precipitation (mm)					
	1911–40		1941–70		1975–94	
	Mar.	Apr.	Mar.	Apr.	Mar.	Apr.
(a) Total precipitation						
Charlottetown, P.E.I.	90.2	70.6	76.5	74.7	79.1	87.1
Truro, N.S.	78.5	70.1	73.7	79.8	107.2	87.5
Sydney, N.S.	113.0	102.4	119.4	95.2	137.5	136.2
Yarmouth, N.S.	105.9	87.4	101.9	98.6	115.3	102.8
Liverpool, N.S.	116.8	128.0	110.7	103.9	153.1	135.7
Halifax, N.S.	121.4	115.3	112.5	112.3	135.7	129.9
Nappan, N.S.	97.5	67.1	78.7	73.2	99.3	90.1
Fredericton, N.B.	75.2	74.7	73.4	80.8	90.8	79.6
Chatham, N.B.	83.3	76.7	83.8	75.7	83.8	88.7
Bathurst, N.B.	57.9	50.8	72.1	65.0	81.8	87.0
(b) Total snowfall						
Charlottetown, P.E.I.	50.5	43.8	32.3	29.6	40.7	23.9
Truro, N.S.	18.2	21.4	38.3	18.5	43.3	17.6
Sydney, N.S.	50.1	26.9	67.1	23.6	58.7	24.3
Yarmouth, N.S.	70.5	16.9	42.1	14.8	31.1	9.7
Liverpool, N.S.	72.6	18.0	34.1	14.3	36.0	8.6
Halifax, N.S.	38.4	13.0	40.8	22.6	31.1	7.1
Nappan, N.S.	35.6	33.7	39.1	29.6	52.5	24.7
Fredericton, N.B.	37.3	26.2	29.1	24.3	39.8	15.2
Chatham, N.B.	42.9	38.7	35.4	35.7	56.7	27.1
Bathurst, N.B.	34.9	35.3	31.8	26.0	52.4	30.6

F. CONCLUSIONS

XXI. THE DISTRIBUTION PATTERNS, MOVEMENTS, AND AFFINITIES OF CANADA GEESE THAT STAGE OR WINTER IN CANADA'S MARITIME PROVINCES

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1. Abstract

Taxonomists separated the breeding geese of Newfoundland and Labrador (*Branta canadensis canadensis*) from those of Ungava (*B.c. interior*). Waterfowl managers combined the geese from Labrador with those of Ungava (Mid-Atlantic winter population), keeping the geese from Newfoundland separate (North Atlantic winter population). Most data assembled in this volume reinforced the impression of a distinct Newfoundland breeding stock that wintered mainly on the Atlantic coasts of Nova Scotia. That conclusion still relies mainly on correlations and on the continued absence of positive evidence linking these birds to the Labrador-breeding population. Banding recoveries and neck-collar sightings provide no evidence of regular interchange between the geese that breed in Labrador and stage around the southern Gulf of St. Lawrence, on the one hand, and those that breed in Ungava and migrate through Québec on the other, though both share the same general winter range.

Extrapolations from numbers of geese seen in winter and on migration in the Maritime Provinces were compatible with earlier estimates of the Newfoundland and Labrador breeding populations (about 4000 and 20 000 breeding pairs), respectively. The Labrador breeding stock comprises 10–15 per cent of the Mid-Atlantic winter population, and its spring staging in Prince Edward Island, with 35 000 or more geese present at one time, is ecologically comparable to staging in northern agricultural areas in the St. Lawrence and Ottawa valleys and in upstate New York. Total numbers of the insular-Newfoundland breeding stock seemed stable over the last 40 years, but the largest wintering numbers since 1975 were found in Halifax County rather than near Port Joli as in the past. Total numbers of the Labrador breeding stock increased in the 1970s by at least 50 per cent. Spring staging in the St. John River valley and around Chignecto Bay (upper Bay of Fundy) accounted for up to one-third of the total in the 1960s and early 1970s but for less than 5 per cent in recent years, seemingly because earlier spring thawing recently allowed geese to concentrate in Prince Edward Island from the time they first arrived in spring. The available data do not suggest a recent decline in the Maritimes parallelling that reported for the Mid-Atlantic Canada Goose winter population.

2. Introduction

In this chapter, the information assembled in earlier parts of this volume, with other literature on the species, was used to develop a plausible and coherent picture of the Canada Goose stocks that spend parts of their lives in the Maritime Provinces (Fig. XXI-1). With the exception of the (numerically) very small goose stocks that breed in the Maritimes, these geese nearly all breed in Newfoundland or Labrador, for which approximate breeding population and fall flight estimates were already available (Erskine 1987; Goudie, 1987; Goudie and Whitman 1987). Some, apparently 5% of the total or less, breed in adjacent parts of Québec, with possibly a few in Greenland. There is no evidence of substantial interchange with more western breeding stocks, despite their sharing wintering areas in the Atlantic coastal regions of the United States. We are dealing with a reasonably discrete assemblage of geese, the easternmost part of the continent-wide group of stocks that breed across Canada's subarctic and northern boreal regions.

3. Groupings earlier proposed for eastern Canada Geese

Bent (1925) segregated the life history information available at that time under the four subspecies of Canada Goose then accepted, with all geese in eastern Canada south of the Arctic combined under *Branta canadensis canadensis*. The taxonomic recognition of *B.c. interior* from western Ungava (Todd 1938) and the rediscovery of *B.c. maxima* in the mid-western states (Hanson 1965) and southern Ontario largely restricted *B.c. canadensis* to the goose stocks treated in this volume, although their western limits of breeding were and remain poorly defined.

While arguments over Canada Goose taxonomy continued, federal and state biologists in the U.S.A. evolved a system of naming recognizable hunted goose stocks by their (usually winter) ranges (e.g. Hansen and Nelson 1964). Those authors segregated the breeding geese of insular Newfoundland, mapped as occurring also in Nova Scotia and at Cape Cod and Cape Hatteras, as the North Atlantic "population". Geese breeding in Labrador (except its southeast corner) and most of interior Ungava were then assigned to a South Atlantic population, perhaps not separable from the western Ungava birds then assigned to a Southeast population. That system, later somewhat modified, was used in waterfowl management circles, but elsewhere its acceptance was no more general

Figure XXI-1 The Maritime Provinces, in the geographic context of breeding and wintering areas of the Canada Geese that stage there.

nor carried more conviction than the names based on taxonomic work in museums.

Bellrose (1976) distinguished North Atlantic and Mid-Atlantic "populations" but placed the line dividing them farther west, near longitude 65°W in western Labrador. Palmer (1976) drew a line between breeding ranges of *B.c.canadensis* and *B.c.interior* even farther west, near longitude 68°W. Various workers who published on this subject in recent decades used increasing numbers of band recoveries to support their interpretations, but all were handicapped by a near-absence of geese banded in the eastern breeding areas. This problem persists, but recent large-scale goose banding in Ungava, west of Ungava Bay, has produced only two recoveries in the Atlantic Provinces. That tends to confirm that a "migration divide", as well as taxonomy, segregates the Canada Geese that breed in western Ungava and winter in the mid-Atlantic states from those that breed farther east, many of which winter in the same general region. As noted earlier (Chapter XVIII, this volume), neither breeding areas in insular Newfoundland nor wintering areas in Nova Scotia are represented by substantial numbers of recoveries from geese banded in more southern wintering areas. The suggestion (Hansen and Nelson 1964) that those geese constituted a discrete stock still rests mainly on suppositions and negative evidence. I attempted to assemble here evidence that points to a discrete insular-Newfoundland breeding population of Canada Geese, for which much of the pertinent information has not previously been widely available.

4. The insular-Newfoundland Canada Geese as a discrete stock

4.1 Evidence from breeding areas

Breeding of Canada Geese on the island of Newfoundland is dispersed (Fig. XXI-2), with the largest numbers of geese and the most continuous areas of breeding habitat in the Maritime Barrens Ecoregion (Goudie 1987). This lies 500+ km southeast from the nearest breeding areas in mainland Labrador, and relatively few geese breed in the intervening upland areas of the Great Northern Peninsula, where lowland areas presumably were more often visited for hunting from nearby coastal settlements. The one important goose staging area in Newfoundland, at Grand Codroy in the extreme southwest, is nevertheless farther east than most Labrador breeding areas. It seems probable that Grand Codroy is used mainly by geese from insular Newfoundland. Migrating geese from Labrador might follow the west Newfoundland coastline, which trends in a suitable direction, but they also regularly fly over open water. Given the absence of both eelgrass (*Zostera marina*) and salt-marsh-forming cord-grasses (*Spartina* spp.) in Newfoundland, it seems implausible that many geese would fly southeast from Labrador to less productive Newfoundland staging areas before continuing southwest to the Maritimes. They could reach favoured areas in eastern New Brunswick or Prince Edward Island directly from Labrador after flights no longer than to Grand Codroy.

Similar reasoning applies also in spring, with added effects of climate. Goose breeding areas in insular Newfoundland (mostly latitude 47–49°N) are farther south, generally at lower elevations (100–250 m), and subject to milder and more maritime spring climates than those in Labrador and eastern Québec (latitude 51–55°N and elevation 200–400 m). Geese begin breeding in insular Newfoundland by early May, averaging two to four weeks earlier than in Labrador (Goudie 1987; Goudie and Whitman 1987). Geese departing from Cape Breton staging areas, typically in early to mid-April (see Chapter VI, this volume), would then usually find ice and snow in Labrador staging and breeding areas. I infer that most migration then is to (insular) Newfoundland, where breeding would be possible soon after their arrival. The most obvious benefit to geese, of pushing onward that early to less productive feeding areas, seems likely to be earlier breeding opportunities, available then only in insular Newfoundland. Departures onward from Prince Edward Island averaged later, usually after mid-April (Chapter IX, this volume), which is entirely plausible if they are headed for Labrador.

4.2 Evidence from band recoveries and neck-collar sightings

No geese banded on insular Newfoundland breeding areas were recovered elsewhere, but two geese banded during spring staging near Grand Codroy were shot the next winter in the Cape Cod–Long Island area of coastal New England. Only sixteen geese banded in wintering areas along the Atlantic Flyway were recovered on the island of Newfoundland. All were banded at coastal sites from Maryland northward, over half (11) on Cape Cod, Massachusetts. Very few geese were banded in Nova Scotia wintering areas, and none of those was recovered in Newfoundland. Three geese banded during spring staging, one in central Nova Scotia and two in southern Prince Edward Island, were recovered in Newfoundland 18 months to 8 1/2 years later. Four captive-reared geese, banded before release as flightless young in Nova Scotia, were shot later in Newfoundland. Six of these last seven geese banded in the Maritimes were recovered in southwestern Newfoundland in September or October, presumably while staging prior to departure.

The samples from most banding areas provided too few recoveries in Newfoundland to be convincing. Only the geese marked on Cape Cod in 1932 to 1943 provided any pattern, thus: in addition to the 11 geese that moved from Cape Cod to Newfoundland, all retrieved east of longitude 57°W, 13 were recovered on the outer coasts of Nova Scotia from Yarmouth to Sydney, compared to 4 on

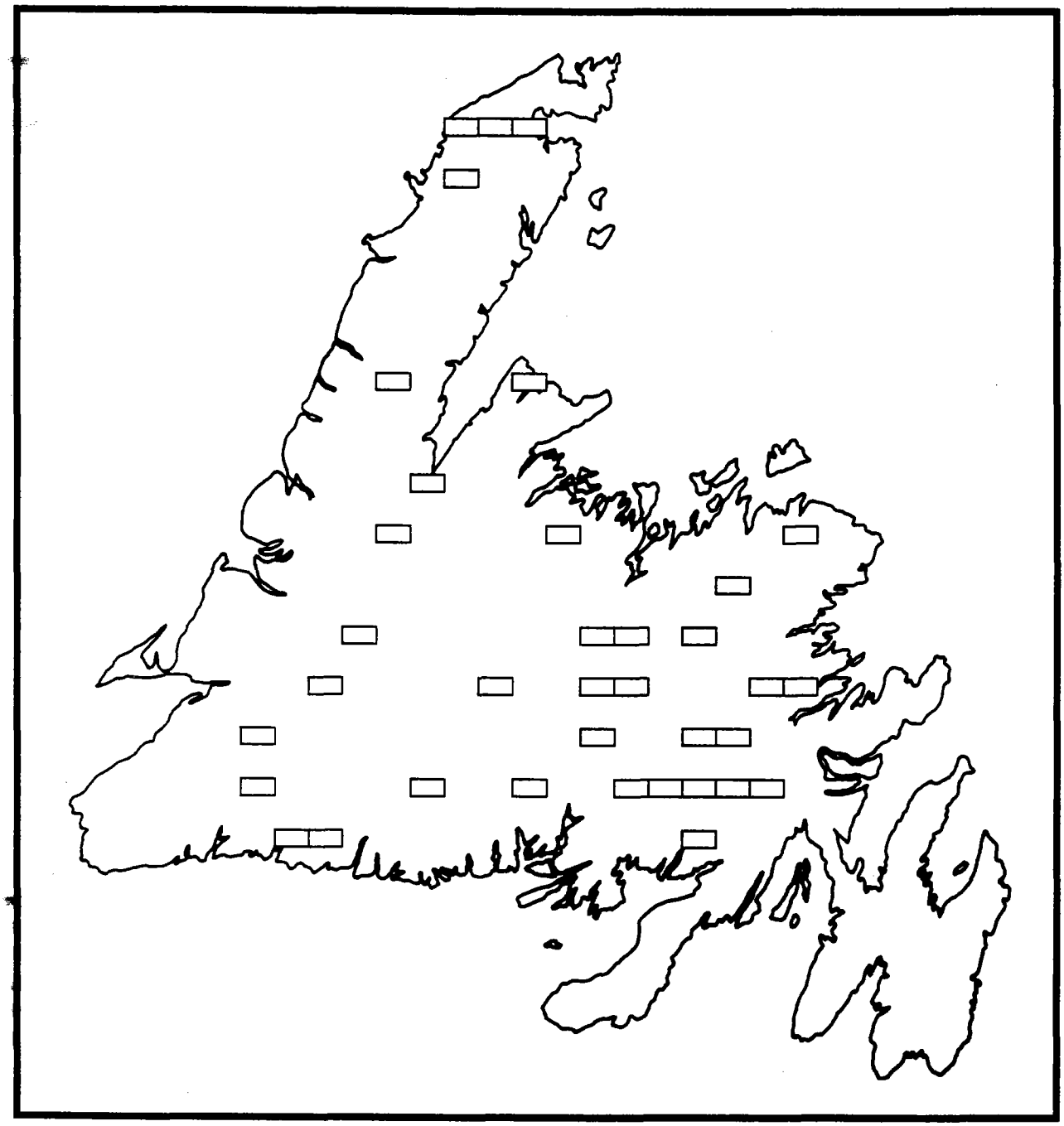

Figure XXI-1 Distribution of aerial survey blocks where Canada Geese were seen in insular Newfoundland (from unpublished C.W.S. report by Gillespie & Roberts, 1968).

the north shore of Nova Scotia, 6 in Prince Edward Island, 3 in New Brunswick, and one in Labrador. Some geese banded on Cape Cod evidently belonged to the stock that traverses New Brunswick, Prince Edward Island, and Labrador, but the majority were associated with the outer coasts of Nova Scotia and the eastern two-thirds of Newfoundland.

The only geese neck-collared in insular Newfoundland were the spring sample marked at Grand Codroy in 1989 and 1990. All the four distant re-sightings of those birds were in Prince Edward Island. Only three geese neck-collared elsewhere were re-sighted in Newfoundland: (a) one marked in P.E.I. in spring and found later on a nest in the interior barrens; (b) one marked in winter in North Carolina and sighted in spring on the south Avalon coast; and (c) a remarkable bird that was marked in winter on Long Island, and spent the next summer in P.E.I. and the two following summers in the northern Avalon Peninsula of Newfoundland. The neck-collar sightings alone are unconvincingly few, but with the band recoveries they suggest that geese staging at Grand Codroy are mostly from western Newfoundland (and adjacent parts of Labrador?), and that some of those birds migrate by way of eastern P.E.I. rather than along the Atlantic coast of Nova Scotia. The continuing scarcity of evidence linking Newfoundland-breeding geese with Nova Scotia wintering areas unfortunately is expectable, given the failure to mark useful numbers of geese in either of those areas (small numbers were marked in Nfld., starting in 1993). As geese frequented both those areas for many years, the continuing lack of evidence linking them to the nearby migration corridor (Labrador–P.E.I./N.B.–New England), where many geese have been marked and recovered or re-sighted, increasingly suggests a separate population there.

4.3 Evidence from observations during the migration seasons

4.3.1 Movements connecting Cape Breton and Halifax Counties

Geese that moved through eastern Cape Breton Island in spring reached there either along the Atlantic coast or from the Gulf of St. Lawrence. Few geese reach the major staging areas in the southern Gulf before late March, and it seems implausible that almost immediately they would move onward from preferred habitats in Prince Edward Island to the less frequented, and thus presumably less favourable, areas in Cape Breton. The migration schedule in eastern Cape Breton Island confirmed that geese arrive there as early as in Prince Edward Island.

Few movements of geese have been recorded along the sparsely settled coasts between Cape Breton and Halifax Counties, but some migration occurs there. Spring records included migrating flocks heard at night near St. Esprit 21 March 1978 and 28 March 1980, and 200 seen near Sherbrooke 8 April 1973 (N.S.B.S.), with flocks totalling 210 near Port Bickerton and 130 at Tor Bay 11 April 1975 (CWS aerial survey). I saw 170 geese at the mouth of Grand River 19 April 1967, in a cold spring when the Cape Breton County coast was still ice-bound. In fall, geese were heard (presumably at night) at Wine Harbour 7 September 1977 and 28 August 1980, a few were seen near St. Esprit 21 September 1977, and at Grand River 300–400 were seen 30 September 1984 (N.S.B.S.). Geese flying at 60 to 70 km/h could travel between Glace Bay and Musquodoboit Harbour (300 km) in under five hours. Some geese move by night both in spring and fall, and the locations where geese were heard at night suggested that night migration may be the normal pattern, in which case the scarcity of sightings along those coasts would be expectable. I found no evidence of migration between eastern Cape Breton and mainland Nova Scotia, or Prince Edward Island, by other routes.

4.3.2 Movements connecting Halifax County and the Port Joli area

Most observations of movements between the Port Joli area and Halifax County were interpreted as representing migration parallel to the Atlantic coast (Chapter II, App. 1, this volume). For example, I found 5000–6000 geese at Cole Harbour, Halifax Co., (where only a few hundreds had over-wintered) on 15 March 1957, a few days after the main exodus, in similar numbers, from Port Joli. Geese can traverse the 150 km between those areas in under three hours, with the shortest (air-line) route being offshore much of the way. The only report of visible migration there was nine flocks passing the headland off Kingsburg on 26 September 1976 (N.S.B.S.). There too, much of the movement of geese seems likely to pass unseen.

Staging areas around Minas Basin and Cobequid Bay (Chapter XIV, this volume) plausibly might contribute to geese reaching the Port Joli area in fall. Published evidence that they do so is sparse, but occasional flocks have been seen passing southward over New Ross; Fred Payne (*in litt.*) "left Kentville with a flock, observed high past Gaspereau Lake, that Ed Turner saw land at Port Joli" about an hour before he arrived by road. A major passage on 22 - 23 November 1989 (BNS), with many flocks seen between Truro and Wolfville and continuing "southwest" beyond there, might have involved movement direct to New England (WSW from Wolfville) rather than to Port Joli (SSW from Wolfville). That movement involved "hundreds of flocks" which, if approximated as 30–50 geese/flock and 100–200 flocks, suggests 3000–10 000 birds. Those are larger numbers than any totals seen at one time around Port Joli in recent years, including arrivals from early September (Chapter V, Table V-1, this volume), whereas they would be plausible for a large departure from Prince Edward Island where numbers are much greater (Chapter IX, this volume).

4.3.3 Movements between the Port Joli and Yarmouth areas, and farther southwest

Geese occur at times in most bays along the coast between the Port Joli area and Yarmouth County staging and wintering areas (Chapters I and V, this volume), and there is no question that geese move between those areas.

As late fall staging flocks in the Yarmouth area totalled up to 4000 birds whereas only 1000–1500 over-wintered there, at least 2000–3000 geese and possibly up to twice that number continue to New England in some years. These presumably belong to the stocks that traverse the Atlantic coasts of Nova Scotia, although a small proportion of the geese that pass through Prince Edward Island in fall also visit the southwestern shores of Nova Scotia. Conversely, there are no data suggesting regular direct movements between Yarmouth and Kings Counties or farther northeast, in either direction, and no regular goose staging areas are known in between. Geese following the shortest air route (600 km) between Minas Basin and eastern Massachusetts should pass at least 60 km north of all Yarmouth County staging areas.

4.3.4 Movements involving staging areas between the Atlantic coast and Northumberland Strait

The band recoveries and neck-collar sightings (Chapter XVIII, this volume) left little doubt that most geese that passed through the southern Gulf of St. Lawrence in spring and fall spent their winters in the Mid-Atlantic states. Nothing published suggested that consistent segregation occurs on the wintering areas between these birds and geese from western Ungava. Apparently three migration corridors radiate northward from the shared winter range (North Carolina to Delaware), thus: (a) much the largest group crosses upstate Pennsylvania and New York and eastern Ontario, and follows the east sides of James and Hudson Bays to western Ungava; (b) a second major group diverges northeastward through New Jersey and the Hudson and St. Lawrence River valleys before turning north into central and eastern Ungava; and (c) the third and smallest group also crosses New Jersey en route to New England, the southern Gulf of St. Lawrence, and thence northward into Labrador and eastern Québec. Staging of this last group, in New Brunswick, Prince Edward Island, and the north shore of Nova Scotia, was treated earlier (Chapters VIII–XIII, XV, this volume). Examination of data from two other areas, situated between the southern Gulf and the Atlantic coasts of Nova Scotia, might clarify how much overlap occurs between the stocks that breed in Labrador vs. Newfoundland. These indeterminate areas are near Antigonish and around Minas Basin and Cobequid Bay (Chapters VII and XIV, respectively, this volume).

The question of interchange of geese between Minas Basin (Kings County) and different parts of the Atlantic coast of Nova Scotia was mentioned above. The observational evidence was scanty and inconclusive; interchange seemed not to be frequent or obvious. The few neck-collar sightings, at Lower Onslow near Truro and near Kentville, consistently linked those areas with the Mid-Atlantic winter population. However, no neck-collaring had been done on geese breeding in Newfoundland or wintering on the Atlantic coast of Nova Scotia, the only areas where geese would be unequivocally assignable to the North Atlantic population. It is plausible that the geese in the Minas and Cobequid areas are outliers of the southern Gulf of St. Lawrence (Labrador) stock, but some interchange with the Atlantic coast stocks probably occurs.

The geese in the Antigonish area occupied an isolated group of inlets 75–100 km east or southeast from the regularly used areas in northern Nova Scotia and Prince Edward Island. The Antigonish area also differed somewhat in habitat, with proportionately less farmland than elsewhere in the southern Gulf, so geese there depended largely on eelgrass in the inlets, as on the Atlantic coast. The numbers were not large (maxima in fall 1200, in spring 235). The greater use of that area in fall contrasted with greater spring use in Cape Breton Island, Halifax County, the Bay of Fundy, and Prince Edward Island, but agreed with the pattern elsewhere on the north shore of Nova Scotia. Evidently not all the geese that frequented Antigonish in fall and survived the winter stopped there during spring migration. December departures from Antigonish were reported as westerly; that might mean only that departing birds were skirting the Antigonish–Pictou highlands that dominate the northwestern skyline at Antigonish. If continued, that direction might bring them to staging areas in Halifax County (130 km SW) or Cobequid Bay (120 km WSW), but equally they might continue directly to Massachusetts (800 km WSW). No data clearly linked geese at Antigonish with the southern Gulf (Labrador) rather than the Atlantic coast (Newfoundland); either assignment would be plausible, and the numbers there would comprise only a minor proportion of even the much smaller Newfoundland stock.

4.4 Evidence from numbers of geese

The scarcity of band recoveries in insular Newfoundland from geese banded in the United States suggested that most of that breeding stock wintered elsewhere, probably in Nova Scotia. Goose counts on the Atlantic coasts of Nova Scotia provided a basis for "ball-park estimates" of total numbers in that stock, thus:

(a) The Cape Breton spring-peak counts represented only a part of the total spring flight; we may guess one-third to one-half. With peaks of 5000 to 6000 geese reported there, the spring flight through Cape Breton might total 10 000–18 000 birds, equivalent to 2600 to 4700 breeding pairs (conversion factors from Erskine 1987).

(b) The combined maximum wintering totals in the Yarmouth, Port Joli, Halifax County, and Cape Breton areas added up to 12 000 to 15 000 geese, perhaps including a small proportion (say 10–20%) heading for Labrador. With the latter deducted, and with 2000 to 3000 birds that continued southwestward from Yarmouth County added, the range of 11 600–16 500 geese fell entirely within that derived from Cape Breton spring counts.

Independent estimates based on breeding ground surveys in insular Newfoundland (Goudie 1987) suggested 3000–4000 breeding pairs, and possibly more (5000 – 10 000 pairs?). An earlier survey of Newfoundland (Gillespie and Roberts, unpubl. rpt. in CWS files, 1968) also gave an extrapolated estimate of 3800 pairs plus 4400 non-breeding birds, in the same "ball-park" as the estimates above. These estimates do not prove the distinctness of geese in Newfoundland and Nova Scotia,

but they confirm that the migrant and wintering groups here tentatively identified with that breeding stock included similar numbers of geese.

Similar calculations are possible also for the southern Gulf/Labrador goose stock. Peak spring counts/estimates for geese in the southern Gulf of St. Lawrence were:

(a) north N.S. 1000 (composite of several years);
(b) P.E.I. 32 128 (1983);
(c) east N.B. 1000 (composite of several years).

Assuming again that the total flight was 2–3 times the maximum present at one time, these figures suggested 70 000–100 000 geese returning to Labrador in spring, equivalent to 17 500 to 25 000 breeding pairs (conversion factors from Erskine 1987). The peak fall counts/estimates provided another estimate, thus:

(a) north N.S. 3711 (mid-Nov./74);
(b) P.E.I. 26 336 (late Oct./87);
(c) east N.B. 3393 (mid-Nov./73);
(d) Bathurst 5810 (late Oct./87),

giving a total of 39 250 (unadjusted), representing 80 000–120 000 in the fall flight, equivalent to 12 000 to 18 000 breeding pairs. Goudie and Whitman (1987) estimated a Labrador breeding population of 22 550 + 8900 breeding pairs of Canada Geese, equivalent to a fall flight of 153 000 + 60 300 geese. These (admittedly crude) estimates all were of the same order, which indicated that the hypothesis associating the Labrador breeding stock with staging birds in the southern Gulf was not excluded by the relative numbers in these groupings. Given that none of the parameters used in deriving the factors relating breeding pairs to spring or fall flights were obtained in the Atlantic Region, the agreement between the various estimates for each stock seemed surprisingly good.

5. Variations in goose numbers over time

Canada Geese are long-lived and gregarious birds that move conspicuously over traditional corridors between familiar staging areas (Hochbaum 1955). A recurring and obvious feature of the data series summarized in this volume was how much the numbers in most areas had changed over the last 30–40 years. The changes made better sense if discussed within their respective groupings, hence the rather lengthy consideration above of the discreteness of the insular-Newfoundland stock.

5.1 The Newfoundland–Nova Scotia stock

The Yarmouth County data (Chapter I, this volume) suggested that regular wintering there only began in the 1960s and that winter numbers had not changed since 1970. We have only guesses on the numbers, apparently a few thousand geese, that continue onward to New England or New Jersey (or wherever they end up), and we recognize no consistent variation in such numbers over recent time.

The Port Joli area (Chapters II–V, this volume) had winter numbers that varied in different years from 3000 up to near 10 000 geese through the 1960s, with 6000 a frequently used average total. Since 1975, the peak January estimates scarcely exceeded 4000, with 2500 an average figure, evidently reflecting a substantial decline there from former numbers.

Concurrently, geese wintering in Halifax County (Chapter VI, this volume) increased dramatically, from fewer than 1000 in midwinter prior to 1969 to 4000 to 5000 geese regularly in recent years. The increase in Halifax County winter geese was of the same order as the concurrent decline in the Port Joli area. Given that winters since 1970 seemed generally milder and less snowy than in earlier decades (back through 1870 at least), and that a provincial waterfowl sanctuary (Martinique) in Halifax County became established in that period (informally 1964, officially 1974), it seemed plausible that many geese of that stock now winter farther northeast, i.e. closer to their breeding areas, than was usual 30 years ago.

Data from Cape Breton County were too sparse and irregular to allow detection of trends over time. Wintering seemed not to involve more geese recently than in the past, but more were noted in spring, perhaps only as a result of better reporting.

Over the span of time treated, with few records before 1955, the total numbers of geese staging and wintering in Nova Scotia apparently did not change appreciably. There was a clear tendency for more geese to winter farther north(east) in the last 20 years, when wintering in Yarmouth County also became regular.

5.2 The Labrador–Southern Gulf stock

Prince Edward Island for several decades was the most important staging area in the Maritimes for Canada Geese, but this presumably was a relatively recent phenomenon. The interdigitation of extensive and fairly productive farmlands with shallow inlets and lagoons fringed with salt-marsh is the key to P.E.I. as a goose area, but farmland there is all less than 200 years old. The island was heavily forested when first visited by Europeans, at which period use of its shores by geese may have been no greater than that of the marshes of the N.B.–N.S. border region or the east coast of New Brunswick. Goose numbers in P.E.I. have changed in the recent period too.

The aerial surveys in Prince Edward Island showed a major increase in staging geese starting about the mid-1970s (Chapter IX, this volume). The November surveys seemed to increase quite abruptly, from 8000 to 10 000 geese in 1969 to 1976 to 15 000 to 18 000 in 1977 to 1992. The few April surveys also showed an increase in spring numbers, from 15 000 (1960) to 22 000 (1974) to 32 000 (1983), but did not suggest when the increase occurred. Martin and Guignon (1983) stated that use of their study area (SE of Summerside) by geese was increasing both in spring and fall during 1974-75.

Data from the southern shores of Northumberland Strait in Nova Scotia and New Brunswick (Chapter VIII, this volume) were too scattered to show any trend in numbers over the last 30 years. The total numbers using that area were minor compared to those across the Strait in Prince Edward Island.

Similarly, the data from eastern New Brunswick gave only a partial picture (Chapter X, this volume). Goose numbers around Bathurst increased from 1000 to 3000–5000 between the 1966–75 and 1987–92 periods. There were no aerial data from which to track numbers on the east coast after 1977. Goose kill data in the northeastern half of New Brunswick (zone N.B. 2) were generally higher after 1984 than earlier (Chapter XIX, this volume).

Overall numbers of geese using the dykelands and salt-marshes around Minas Basin and Cobequid Bay in Nova Scotia in spring also increased starting around 1975 (Chapter XIV, this volume). The coverage there was sporadic and uneven, but the increase, from 1000-2000 earlier to 5000-8000 in the last decade, was large enough to be convincing. Numbers were generally much lower in fall, but there was some increase then too, from under 1000 earlier to near 2000 geese recently.

The picture was quite different, but also consistent, in the other staging areas adjoining the Bay of Fundy, which were used mainly in spring. The Cumberland Basin salt-marshes (Chapters XI, XII, this volume) had peak spring numbers of 3000–6000 or more geese in most years 1968–78, but fewer than 1500 visited that area in the 1980s, even including geese frequenting a nearby sod farm established in the 1970s. Similarly, there were 3000–6000 or more geese each spring in 1962 to 1968 on the dyked fields by the Shepody River 30 km to the southwest (Chapter XIII, this volume), with 2000 or more geese still using the area in 1970 to 1975. Recent numbers there were not reported, and regular observations suggested peak numbers of fewer than 500 geese (D. Christie, pers. comm.). Along the St. John River between Hampstead and Sheffield, staging geese totalled several thousands (maximum 8 500+ in 1961) in 1961 to 1966 (Chapter XV, this volume). No reports of more than a few hundreds were made in subsequent years, although the more accessible parts of that area were covered frequently. There were resident observers in two of those areas (none near Shepody) in the 1940s and 1950s, when no concentrations involving thousands of geese were reported although the species was considered "very common" in New Brunswick then (see Squires 1952; Boyer 1966). Thus, the large numbers staging on salt-marshes, dykelands, and riverine marshes of southern New Brunswick and adjacent Nova Scotia in the 1960s, tapering off in the 1970s, were probably a temporary phenomenon. The effects of spring climate and the timing of ice and snow melt from the marshes, later in the 1960s, earlier in more recent years, provided only a partial explanation. Winters and early springs in the 1950s averaged much milder than in the 1960s, comparable to the 1970s and 1980s, whereas the 1940s were as cold as the 1960s. The few observers active in the 1940s (during and just after World War 2) presumably ranged less widely, and could not have made intensive observations in as many places as resulted from the increased effort more recently. Furthermore, dyking of salt-marshes and draining of dykelands was actively pushed in 1948 to 1960, altering habitat and creating disturbance in many of the same areas at that period. Conversely, attempts to maintain dykes on the John Lusby salt-marsh near Amherst (Chapter XI, this volume) were finally abandoned after 1946, and that area underwent ecological changes in the years following, perhaps becoming more suitable for use by geese. Thus, many different factors combined to produce the changes in goose numbers reported around the Bay of Fundy in 1960 to 1975.

Combining all these changes over time into a single picture depends on the assumption (see above) that the same goose stocks were involved in all areas away from the Atlantic coasts of Nova Scotia. The rate of turnover within the flocks differed greatly between seasons, owing to disturbance by hunting in fall, whereas geese cannot usefully move onward in spring until sufficient warming has occurred that more northern staging or breeding areas become snow- and ice-free, and for other reasons, which applied to varying degrees in different areas. The numbers below (Table XXI-1) are crude approximations, but they may provide helpful perspective.

5.3 Canada Geese in the Atlantic Flyway: the wider picture

Recent concern over goose numbers in the Atlantic Flyway, mainly among (U.S.) federal and state biologists, surfaced around 1984, with suggestions that the Mid-Atlantic wintering population was declining. Prior to that time, this population, the largest Canada Goose unit on the continent (Bellrose 1976), had grown almost continuously for over 50 years, in recovery from low numbers early in the 20th Century. Recent intensive banding in Ungava and neck-collaring throughout the Flyway were undertaken in response to that decline, which continued into the 1990s.

The picture presented by U.S. Atlantic Flyway biologists largely ignored Canada Geese breeding in Newfoundland and Labrador. Their omission of the Newfoundland stock was not surprising, in view of evidence here assembled (above) that less than 20 per cent of its small numbers enter the United States. Existence of the Labrador stock was acknowledged, but it was dismissed as a minor element in the Flyway picture. No one seriously disputes that Ungava, and especially western Ungava, produces the majority of the Canada Geese in the Mid-Atlantic population. But neither had anyone until recently estimated its numbers other than on the winter range, where all sub-stocks were commingled. Malecki and Trost (1990), from 1988 aerial transect surveys in northwestern Ungava, estimated a breeding population of 157 122 pairs of Canada Geese, equivalent (by our conversion factors) to a spring flight of 628 488 birds. As they noted, extrapolation from their summer figure to the winter population gave a population size similar to the numbers counted in the Atlantic coast states, after allowing for at least 100,000 birds permanently resident there.

Malecki and Trost's (1990) aerial coverage did not overlap the "North Block" (in eastern Québec) of Gillespie and Wetmore (1974), nor the Labrador surveys of Goudie and Whitman (1987). Data from those surveys may be

extrapolated to spring flights of about 15 000 and 90 000 geese, respectively, which might comprise about 14% of the total from those and Malecki and Trost's (1990) surveys combined. Given the many approximations involved in all these extrapolations, this accords well with Malecki and Trost's belief that close to 90% of the Canada Geese in northern Québec bred in their survey region. The Labrador goose population is minor in the overall picture for the wintering area which it shares. That in no way reduces its substantial importance to Atlantic Canada.

Furthermore, the fact that virtually no geese banded in western Ungava were recovered in the Atlantic Provinces (Chapter XVIII, this volume) supports the taxonomic distinctness of all Atlantic Region geese (Palmer 1976). The Labrador birds behave as a discrete population everywhere except on their wintering grounds. The Newfoundland (island) geese seem to be separate from all other Atlantic Flyway birds except for very limited overlap with Labrador geese in late fall and winter, and they may be taxonomically indistinguishable from the latter.

None of the surveys that sampled the Labrador Canada Geese while they were passing through the Maritimes provided consistent indices to population size. Summaries of those data (Table XXI-1) indicated substantial population increases between the 1960s and 1980s. A subsequent decline, as reported for the Mid-Atlantic population as a whole, was not indicated, but the data available were not sufficiently precise to allow an assertion that a decline here was completely implausible. Goose harvest in Prince Edward Island has been suggested to be excessive, but even a dramatic increase in the goose kill in P.E.I. would hardly be detectable in the total flyway population figures. With a maximum of only 15% of the Mid-Atlantic population passing through the southern Gulf of St. Lawrence (see above), an increase of Maritimes kill from 30% of the fall flight (tolerable) to 50% (excessive) would result in only 3% fewer birds at the Flyway level, and such a change could not be detected reliably in the surveys by which flyway populations are monitored. We have no impression that Canada Goose numbers passing through the Maritimes declined in the last 15 years, whether or not the Atlantic Flyway population as a whole has declined.

Table XX1-1. Approximate peak numbers of Canada Geese staging in different parts of the Maritime Provinces (southern Gulf stock only) in (a) Spring and (b) Fall.

(a) Spring

Area	Peak numbers of geese staging in spring 1960s	1980s
Prince Edward Island	15 000	32 000
Northern Nova Scotia	1000	1000
Eastern New Brunswick	1000	1000
Minas Basin–Cobequid Bay	2000	7000
N.B.–N.S. border area	5000	1000
Shepody area	4000	500
Lower Saint John River	3000	500
Totals	31 000	43 000

(b) Fall

Area	Peak numbers of geese staging in fall 1960s	1980s
Prince Edward Island	8000	26 000
Northern Nova Scotia	5000	5000
Eastern New Brunswick	5000	10 000
Minas Basin–Cobequid Bay	1000	2000
N.B.–N.S. border area	300	300
Shepody area	200	200
Lower Saint John River	1000	1000
Totals	20 500	44 500

6. Literature cited

Bellrose, F.C. 1976. Ducks, geese & swans of North America. 2nd ed. Wildl. Manage, Inst. and Stackpole Books, Harrisburg, Pa. 544 pp.

Bent, A.C. 1925. Life histories of North American wild fowl. vol. 2. U.S. Nat. Mus. Bull. no. 130. 316 pp.

Boyer, G.F. 1966. Birds of the Nova Scotia–New Brunswick border region. Can. Wildl. Serv. Occas. Papers no. 8. 52 pp. (2nd ed., 1971, with addendum).

Erskine, A.J. 1987. A preliminary waterfowl population budget for the Atlantic Provinces, 1978–85. Can. Wildl. Serv. Occas. Paper 60: 65–72.

Gillespie, D.I., Wetmore, S.P. 1974. Waterfowl surveys in Labrador–Ungava, 1970, 1971, 1972. Can. Wildl. Serv. Rep. Ser. 29: 8–18.

Goudie, R.I. 1987. Preliminary estimates of waterfowl breeding populations in Newfoundland, 1978–79. Can. Wildl. Serv. Paper 60: 36–44.

Goudie, R.I. and Whitman, W.R. 1987. Waterfowl populations in Labrador, 1980–82. Can. Wildl. Serv. Occas. Paper no. 60: 45–63.

Hansen, H.A. and Nelson, H.K. 1964. pp. 109–124 *in* Waterfowl tomorrow. (J.P. Linduska, ed.) United States Dept. Int., Fish and Wildl. Serv. 770 pp.

Hanson, H.C. 1965. The Giant Canada Goose. So. Ill. Univ. Press, Carbondale. 226 pp.

Hochbaum, H.A. 1955. Travels and traditions of waterfowl. Univ. Minnesota Press, Minneapolis. 301 pp.

Malecki, R.A. and Trost, R.E. 1990. A breeding ground survey of Atlantic Flyway Canada Geese, *Branta canadensis*, in northern Quebec. Can. Field-Nat., 104: 575–578.

Martin, K. and Guignon, D. 1983. Canada Goose numbers, daily movements and foraging patterns on Prince Edward Island. Proc. N.S. Inst. Sci., 33: 107–114.

Palmer, R.S. ed. 1976. Handbook of North American Birds. vol.2. Waterfowl (part 1). Yale Univ. Press, New Haven and London. 521 pp.

Squires, W.A. 1952. The birds of New Brunswick. The New Brunswick Museum, Monogr. Ser. no.2.

Todd, W.E.C. 1938. A new eastern race of Canada Goose. Auk, 55: 661–662.

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