ATLAS OF COLONIAL WATERBIRDS NESTING ON THE CANADIAN GREAT LAKES, 1989-1991. PART 3. CORMORANTS, GULLS AND ISLAND-NESTING TERNS ON THE LOWER GREAT LAKES SYSTEM IN 1990

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NOTE

The Atlas is to consist of five parts as follows:

Part 1. Cormorants, gulls and island-nesting terns on Lake Superior in 1989 (CWS Technical Report 181).

Part 2. Cormorants, gulls and island-nesting terns on Lake Huron in 1989 (In preparation).

Part 3. Cormorants, gulls and island-nesting terns on the lower Great Lakes system in 1990 (This report).

Part 4. Marsh-nesting terns on Lake Huron and the lower Great Lakes system in 1991 (In preparation).

Part 5. Herons and egrets in the Great Lakes system during 1989-1991 (In preparation).

ABSTRACT

During the 1990 breeding season, an inventory was made of Double-crested Cormorants (Phalacrocorax auritus), Ring-billed Gull (Larus delawarensis), Herring Gull (L. argentatus), Great Black-backed Gulls (L. marinus), Common Terns (Sterna hirundo), and Caspian Terns (S. caspia) that nested in the Canadian portions of the lower Great Lakes system (i.e. Detroit River, Lake Erie, Niagara River, Lake Ontario, and the St-Lawrence River downstream to Cornwall, Ontario; Fig. 1).

The field work was a cooperative effort by the Canadian Wildlife Service, the Ontario Ministry of Natural Resources, St. Lawrence Islands National Park and contractors hired and trained by CWS. Islands were visited by boat and all active nests were counted using hand counters.

There was in 1990 a total of 60 colony sites that held a total of 12 colonies of Double-crested Cormorant (with a total of 4,701 nests), 34 colonies of Ring-billed Gull (282,405 nests), 45 colonies of Herring Gull (5,507 nests), 3 colonies of Great Black-backed Gull (8 nests), 15 colonies of Common Tern (2,359 nests), and 3 colonies of Caspian Terns (765 nests).

The Double-crested Cormorant colonies were largely restricted to Lake Erie (4 colonies) and Lake Ontario (8 colonies). From 1977 to 1990 the nesting population increased from 57 to 4,701 nests which represents an average annual growth rate of 40.0%.

The Ring-billed Gull colonies were scattered throughout the study area. The nesting population increased from 60,834 nests during 1976/77 to 282,405 nests in 1990, which corresponds to an average annual growth rate between 11.6% and 12.6%.

The Herring Gull colonies were widely spread throughout the study area. Overall, the nesting population increased from 1,525 nests in 1976/77 to 5,507 nests in 1990, which represents an average annual growth rate between 8.1% and 8.7%.

The Great Black-backed Gull nested at only 3 colonies, all located in Lake Ontario. This essentially marine species recently became a regular, but rare, nester in the freshwater environment of the Great Lakes.

The Common Tern colonies were located in Lake Erie, Lake Ontario and the St. Lawrence River. The population declined from 3,170 pairs at 17 colonies in 1976/77 to 2,359 pairs at 15 colonies in 1990, which corresponds to a mean annual rate of decline between 2.1% and 2.3%.

All 3 Caspian Tern colonies were located in Lake Ontario. The population increased from 47 pairs at 2 colonies in 1976 to 765 pairs at 3 colonies in 1990, which corresponds to a mean annual rate of increase of 22.1%.

The 1990 survey results (together with those for 1976 /77) are presented in detail in Appendix 3, the organization of which is explained in Appendix 2.

In addition to being listed, the 1990 colony sites (together with those for 1976/77) are also plotted, by the nine 1:250,000 Topo Maps that cover the study area, in Appendices 5-13. The colony sites are plotted both on 1:250,000 maps (to provide overviews) and on 1:50,000 maps (to provide details of location). The organization of these maps is explained in Appendix 4.

RÉSUMÉ

Pendant la période de nidification de 1989, on a inventorié le Cormoran à aigrettes (Phalacrocorax auritus), le Goéland à bec cerclé (Larus delawarensis), le Goéland argenté (L. argentatus), le Goéland à manteau noir (L. marinus), la Sterne commune (Sterna hirundo) et la Sterne caspienne (S. caspia), lesquels nichent dans la partie canadienne des grands lacs inférieurs (la rivière Détroit, le lac Erie, la rivière Niagara, le lac Ontario et la rivière St. Laurent jusqu' à Cornwall, Ontario; Fig. 1).

Le travail sur le terrain à été un effort coopératif du Service canadien de la faune, du ministère des richesses naturelles de l'Ontario, du parc national des îles du St. Laurent et d'entrepreneurs embauchés et entraînés par le S.c.f. Les îles ont été visitées par bateau et tous les nids occupés ont été comptés manuellement.

Il y avait en 1990 un total de 60 emplacements où nichaient 12 colonies de Cormoran à aigrettes (4,701 nids), 34 colonies de Goéland à bec cerclé (282,405 nids), 45 colonies de Goéland argenté (5,507 nids), 3 colonies de Goéland à manteau noir (8 nids), 15 colonies de Sterne commune (2,359 nids) et 3 colonies de Sterne caspienne (765 nids).

Les colonies de Cormoran à aigrettes se trouvaient surtout dans les lac Erie (4 colonies) et Ontario (8 colonies). De 1977 à 1990, la population nichante a augmenté de 57 à 4,701 nids, ce qui représente une moyenne annuelle de croissance de 40.0%.

On a retrouvé des colonies de Goéland à bec cerclé un peu partout à travers les régions inventoriées. La population nichante a augmenté de 60,834 nids en 1976/77 à 282,405 nids en 1990, ce qui représente une moyenne annuelle de croissance de 11.6% à 12.6%.

Les colonies de Goéland argenté étaient répandues sur tout l'aire inventoriée. Cette population nichante a augmenté de 1,525 nids en 1976/77 à 5,507 nids en 1990, ce qui représente une moyenne annuelle de croissance de 8.1% à 8.7%.

Le Goeland à manteau noir nichait à seulement 3 colonies, toutes en Ontario. Cette espèce plutôt maritime est récemment devenue régulière mais rare, nichant dans les eaux fraîches des grands lacs.

Les colonies de Sterne commune ont été trouvées au lacs Erie et Ontario ainsi que sur la rivière St. Laurent. La population a diminué de 3,170 couples dans 17 colonies en 1976/77 à 2,359 couples dans 15 colonies en 1990, ce qui représente une moyenne annuelle de déclin de 2.1% à 2.3%.

Les 3 colonies de Sterne caspienne étaient situées sur le lac Ontario. La population a augmenté de 47 couples dans 2 colonies en 1976 à 765 couples dans 3 colonies en 1990, ce qui représente une moyenne annuelle de croissance de 22.1%.

Les résultats des relevés de 1990 (ainsi que ceux de 1976/77) sont présentés en détail à l' annexe 3. C'est à l'annexe 2 que se trouve les détails relatifs à l'organisation de l'annexe 3.

En plus de paraître sur une liste nominative, le site des colonies de 1990 (de même que celles de 1976/77) est aussi relevé graphiquement aux annexes 5 à 13, d'après les neuf cartes topographiques à l'échelle de 1:250,000 couvrant l'aire d'étude. On peut retrouver la localité des colonies sur les cartes à l'échelle de 1:250,000 (lesquelles donnent un aperçu général) ainsi que sur les cartes à l'échelle de 1:50,000 (pour une localité plus précise). On explique à l'annexe 4, l'organisation de ces cartes.

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1. INTRODUCTION

Birds that breed in a colony and that breed or feed in association with water are referred to as colonial waterbirds (Maehr and Rodgers 1985). Colonial waterbirds are of special concern to the Canadian Wildlife Service (CWS) because during the nesting season they are concentrated on their colony sites and are then highly vulnerable to predation and disturbance. In addition, as top predators in the food web, they may bio-accumulate contaminants that are present in their environment, and, therefore, they can be used to monitor contaminant levels and their bio-effects. In the Great Lakes, contaminant levels in Herring Gulls eggs have been monitored routinely since the early 1970s (Mineau et al. 1984), Bishop et al. 1992). Furthermore, when gulls nest at large colonies in urban or industrial sites they may cause various problems to people (Blokpoel and Tessier 1985). An additional concern is that nesting gulls may encroach on the nesting habitat of other species (Courtney and Blokpoel 1983, Blokpoel and Tessier 1985).

Large-scale inventories of colonial waterbirds nesting on the Great Lakes did not begin until 1976. In 1976, and again in 1977, the US portions of the Great Lakes were surveyed under contract for the US Fish and Wildlife Service (USFWS) (Scharf et al. 1978). The Canadian portions of the Great Lakes were surveyed and censused in a more gradual fashion: Lake Ontario and the upper St. Lawrence River in 1976 (Blokpoel 1977), Lake Erie and adjacent water bodies in 1977 (Blokpoel and McKeating 1978), Lake Superior in 1978 (Blokpoel et al. 1980) and Lake Huron, including Georgian Bay and the North Channel, in 1980 (Weseloh et al. 1986). During 1981-1988 certain areas were re-inventoried during one or more years (e.g. Blokpoel and Harfenist 1986, Weseloh et al. 1988).

A lakes-wide inventory of all colonial waterbird species on both sides of the Canada/US border was carried out during 1989-91. The inventory was done in close cooperation between CWS and USFWS. In Canada the fieldwork was coordinated by CWS (Ontario Region) and was largely carried out by contractors with substantial assistance from the Ontario Ministry of Natural Resources and Parks Canada. Because of the large amount of work and cost involved in making an inventory of all the Great Lakes it was decided to attempt a 3-year effort with fieldwork as follows:

1989 -all "primary" species in the upper Great Lakes;
1990 -all "primary" species in the lower Great Lakes; and
1991 -all "secondary" species in all Lakes.

For the purpose of the inventory, "primary" species are species that nest primarily (or originally) on sparsely vegetated islands and off-shore structures, i.e. Double-crested Cormorant (Phalacrocorax auritus), Ring-billed Gull (Larus delawarensis), Herring Gull (L. argentatus), Great Black-backed Gull (L. marinus), Common Tern (Sterna hirundo) and Caspian Tern (S. caspia). "Secondary" species are species that nest primarily in marshes and on densely vegetated islands, i.e. Great Blue Heron (Ardea herodias), Great Egret

(Casmerodius albus), Cattle Egret (Bubulcus ibis), Little Blue Heron (Egretta caerulea), Snowy Egret (E. thula), Black-crowned Night-Heron (Nycticorax nycticorax), Forster's Tern (Sterna forsteri) and Black Tern (Chlidonias niger).

During the inventories of the "primary" species in 1989 and 1990, any colony of "secondary" species would be noted and recorded but in most cases no effort was made to count the number of nests. In 1991, when the "secondary" species were surveyed, it was impractical to re-survey Lake Superior again, except for the coast of Pukaskwa National Park.

We originally had planned to produce a detailed comprehensive atlas of Great Lakes colonial waterbirds jointly with our USFWS colleagues (Blokpoel and Tessier, 1991). However, given the large number of colonies on both sides of the international border the planned atlas was likely to become an unwieldy and expensive set of reports. In addition, we felt that many of the Canadian users would not be very interested in information for the US side and vice versa. Thus, the idea of an atlas with detailed information for both sides of the border was modified, as follows. Detailed reports with complete information on colony locations are to be prepared by CWS for the Canadian portions of the Great Lakes and by the USFWS for the US portions. In Canada these reports will be published as CWS Technical Reports and the five planned Technical Report listed on the Title Page will together constitute the "Atlas of Colonial Waterbirds Nesting in the Canadian Great Lakes, 1989-1991". A somewhat similar process is envisaged by USFWS for the data collected in the US waters of the Great Lakes.

This report constitutes Part 3 of the "Atlas of Colonial Waterbirds Nesting on the Canadian Great Lakes, 1989-1991". It has the following three purposes:

(1) to present the results of the 1990 inventory using the format that has been used by USFWS for several other atlases of colonial waterbirds,

(2) to present the results of the 1976 and 1977 inventories using the USFWS format,

(3) to compare the 1990 results with the 1976 and 1977 results and discuss any changes, and

(4) to provide some general comments on each species.

Our intended readership consists of managers, planners, developers, park naturalists, and various other "users" of the Great Lakes and their natural resources, as well as biologists and interested lay people. We tried to present a large amount of information in a concise format and we recommend that readers read the following Methods section in order to access the information quickly. This report supercedes the previous report of the 1990 data, i.e. Blokpoel and Tessier 1991.

2. STUDY AREA

For the purpose of this report, the lower Great Lakes system consists of all the islands and the mainland shoreline of the Canadian portions of the Detroit River, Lake Erie, Niagara River, Lake Ontario and the St. Lawrence River downstream to Cornwall (Fig. 1) .

Going from west to east and north to south the area is covered by the following nine 1:250,000 Topographical Map Sheets: 40J, 40G, 40I, 30L, 30M, 30N, 31C, 31B and 31G (Fig. 2).

3. DEFINITIONS

Definitions -For the purpose of this report, a colony consists of one or more breeding pairs of a species that usually nests in groups. Thus we consider a single Herring Gull nest as a colony in this report. We refer to the place where a colony is located as the colony site. It is often difficult to determine the extent of a colony and thus that of a colony site. For example, if two small, bare, rocky islands, separated by only a few metres of water, are each covered by Herring Gulls nests one could argue that they form, biologically, one colony and that, therefore, the two islets constitute one colony site. Nevertheless, in this report we generally report our findings for the smallest possible geographical unit (i.e. island,shoal, rock or peninsula) for the benefit of future workers.

4. METHODS

Nest counts -Mainland colonies were reached by car. Islands were reached by boat, examined from the boat and, if nesting was evident or likely, field workers would go ashore and count all nests by searching the entire island. We refer to this method as Ground Count. To facilitate the counting of nests, colonies were temporarily sub-divided in parallel "strips" using smooth, brightly-coloured, plastic tapes. Width of the strips varied according to nest-density and degree of vegetation cover. Nest counters walked down the "strips" and counted nests using hand counters. All nests that had eggs and/or chicks or that were clearly attended but held no eggs or chicks were counted. In addition, contents of nests, including empty ones, were recorded for small sample areas to provide an idea of the phase of nesting. Nests of tree-nesting cormorants were counted by marking the nesting trees with individually numbered tapes and counting all nests in all marked trees. In addition, the geographical extent of nesting by the different species was indicated on simple sketch maps of the colony sites.

In some cases birds were obviously nesting but local conditions did not permit landing. In those cases the number of nests would be counted from the boat. We refer to these counts as Boat Estimates.

Survey dates and survey participants -The time for the fieldwork is short: colonies of the different species should be visited late in incubation (to ensure that most birds are on eggs) but

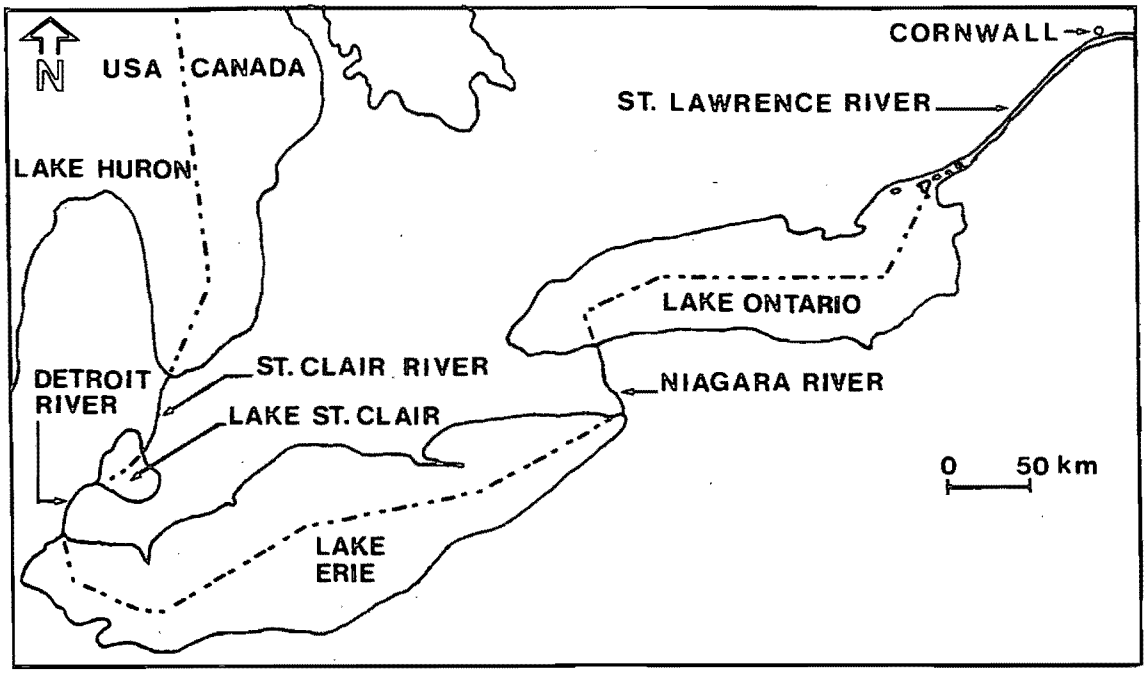

Fig. 1. The Canadian lower Great Lakes system (i.e. our study area) extends from the north end of the Detroit River to Cornwall on the St. Lawrence River.

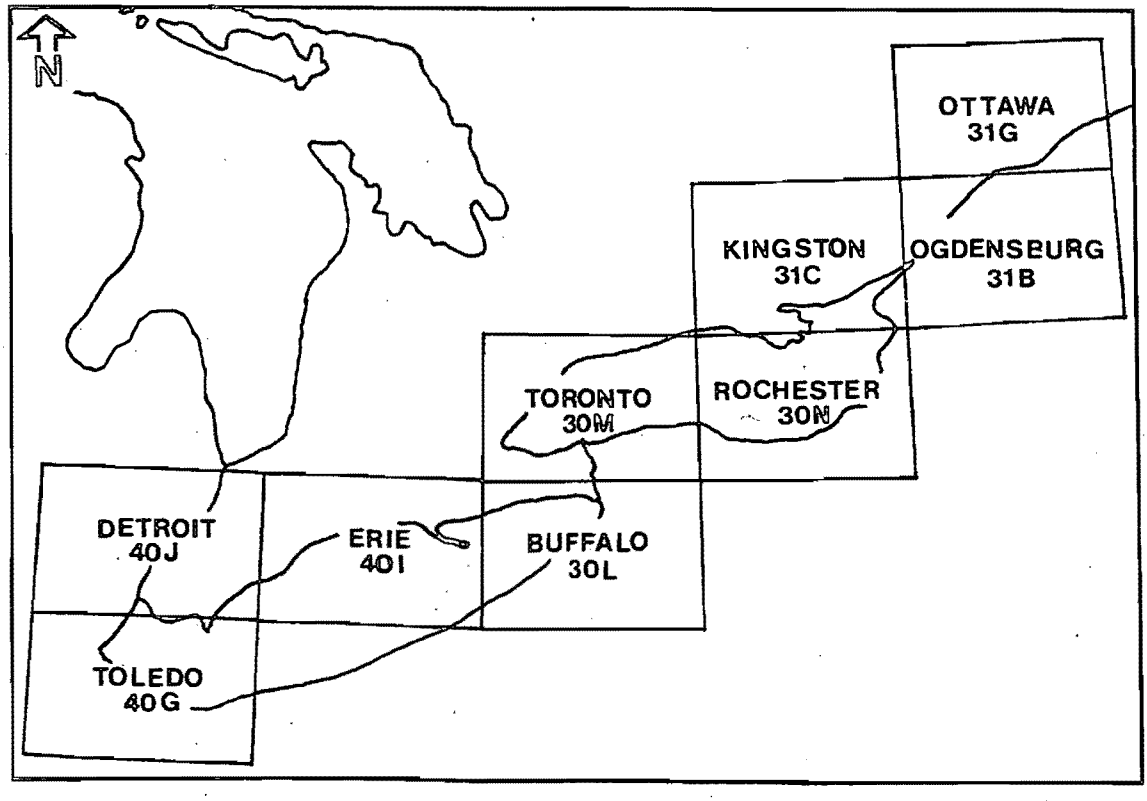

Fig. 2. Coverage of the Canadian lower Great Lakes system by 1:250,000 Topographical Maps.

before hatching (to prevent chick mortality). In order to cover the entire lower Great Lakes system we divided it in four sections. Each section was covered by one team of two people (to make nest counts) and one boat handler (who might help with the nest count depending on weather conditions, etc.). The sections were surveyed by boat, except for part of the Detroit River which was surveyed from shore. Colonies in the Niagara River were visited by a helicopter early in the season and observed from shore later on. Appendix 1 lists the field workers and dates of fieldwork.

Field instructions -Before the start of the fieldwork, we met with the contractors to discuss the project, to provide written and oral instructions, and to issue navigation charts, field notebooks, data sheets, logbooks, hand counters, hard hats and earplugs.

Preparation of maps. As mentioned in the Introduction, we follow the format used by the USFWS to present the results of waterbird inventories in the USA (e.g. Erwin 1979, Speich and Wahl 1989).

The key elements of the format of USFWS atlases are: listing all colony sites by 1:250,000 map sheet, giving each colony site a unique identification number, plotting all colony sites on a 1:250,000 map (to provide overviews of colony distribution, and plotting colony sites on 1:20,000 USGS maps (to provide detailed colony locations). In this report we use 1:250,000 and 1:50,000 maps prepared by the Geological Survey of Canada.

Because the USFWS format was not used when presenting the 1976 and 1977 data for Canadian lower Great Lakes system (Blokpoel 1977, Blokpoel and McKeating 1978) and because we want to compare the 1990 data with the 1976/77 material, we decided to republish the 1976/77 results in this report so that they conform to the format used for this atlas.

The unique identification numbers for the individual colony sites consist of a prefix (which is the number of the 1:250,000 topographical map that covers the area where the colony site is located) and a 3-digit number. For example, Big Chicken Island is covered by the 1:250,000 map 40G-Toledo and we assigned to it number 40G004 as its identification number (see Appendix 3). When assigning identification numbers we combined all the 1990 and 1976/77 colony sites and then worked our way from west to east and north to south, along the shore of the study area. All 1990 and 1976/77 sites are listed in Appendix 3. Further details on the organization of Appendix 3 is provided in Appendix 2.

Calculation of growth rate - The average annual rate of change (r) in a nesting population during the period year 0 to year 0 +t was calculated using the following formula:

$$r = \left(\sqrt[t]{\frac{N_t}{N_o}} - 1 \right) \times 100\%,$$

where N_t and N_0 are the numbers of nests in years t and 0, respectively.

To determine rates of change in population size in recent years, we used the data from the 1990 inventory and those from the inventories carried out in 1976 (Lake Ontario) and 1977 (Lake Erie). Because the earlier data were gathered over a 2-year period it is impossible to calculate the exact annual growth rate for the entire study area during the period 1976/77 to 1990. However, we combined the totals for the 1976 and 1977 inventories and used that figure to calculate average annual growth rates during 1976-1990 (yielding minimum estimates) and during 1977-1990 (yielding maximum estimates).

5. RESULTS AND DISCUSSION

Middle Sister Island was not visited in 1990 because of weather conditions. Based on visits during earlier years, it is virtually certain that Herring Gulls nested there in 1990, but Ring-billed Gulls and terns most likely did not, nor, to the best of our knowledge, did cormorants (Weseloh et al. 1988 and unpublished data).

5.1 Overall numbers of colony sites and nesting pairs in 1990

There was a total of 60 active colony sites in the study area (Table 1). These colony sites held a total of 12 colonies of Double-crested Cormorant (with a total of 4,701 nests), 34 colonies of Ring-billed Gull (282,405 nests), 45 colonies of Herring Gull (5,507 nests), 3 colonies of Great Black-backed Gull (8 nests), 15 colonies of Common Tern (2,359 nests) and 3 colonies of Caspian Terns (765 nests).

At 25 of the 60 colony sites there were colonies of only one species. At the other 35 colony sites, the breeding site was shared by 2 species (23 colony sites), 3 species (9 sites), 4 species (1 site) and 5 species (2 sites).

The 1990 survey results are presented in detail in Appendix 3 and the organization of Appendix 3 is explained in Appendix 2. In addition to being listed in Appendix 3, the 1990 colony sites (together with those for 1976/77) are also plotted in App. 5-13, by the nine 1:250,000 Map sheets that cover the study area. The colony sites maps are plotted both on 1:250,000 maps (to provide overviews) and on 1:50,000 maps to provide details of location. The organization of these maps is explained in Appendix 4.

As mentioned above, Middle Sister Island was not visited in 1990. Thus that colony site is marked NV ("not visited") in App. 3 and on the maps of App. 6.

5.2 Comparability of the 1990 and the 1976/77 data in general

Comparisons of sets of census data collected over a large area during 2 different breeding

Table 1. Number of colony sites with nesting by one or more colonial waterbird species in the Canadian lower Great Lakes system in 1990.

Species[a]	Number of Colony Sites
DCCO	1
RBGU	5
HERG	12
COTE	7
RBGU, COTE	2
HERG, RBGU	15
HERG, DCCO	3
HERG, COTE	3
HERG, RBGU, COTE	3
HERG, RBGU, GBBG	1
HERG, RBGU, DCCO	5
HERG, RBGU, DCCO, CATE	1
HERG, RBGU, DCCO, CATE, GBBG	2
Lower Great Lakes system	60

[a] DCCO - Double-crested Cormorant, RBGU - Ring-billed Gull, HERG - Herring Gull, GBBG - Great Black-backed Gull, COTE - Common Tern, CATE - Caspian Tern.

seasons several years apart are likely to be hampered or biased by differences in degree of coverage of the area involved, differences in timing (relative to the breeding cycle of the different species involved), and differences in census technique and in observational abilities of field workers.

As mentioned, Middle Sister Island was not visited in 1990 due to bad weather. However, based on visits before and after 1990 and the habitat at Middle Sister Island, it is virtually certain (and for the comparisons below we assume) that in 1990 Herring Gulls were nesting whereas cormorants, ring-bills and terns were not (D.V. Weseloh and P.J. Ewins unpub. data).

In 1977, Middle Island, North Harbour Island and Hen Island were not visited, but information for 1978 and later years indicates that it is virtually certain (and, again, for the comparisons below we assume) that Herring Gulls were nesting on those three islands in 1977 , but cormorants, ring-bills and terns were not (Weseloh et al.1988).

In 1977, during visits to Middle Sister and East Sister Island, Herring Gulls but no other species were found nesting. However, due to lack of time, the Herring Gull colonies were only partially censused.

We made efforts in 1976/77 and again in 1990 to carry out the nest counts late in incubation for each of the different species. However, due to logistical problems (caused by bad weather, etc.), it was not always possible to adhere to the planned census schedule.

Census techniques in 1976/77 and 1990 were essentially the same : visit each colony site and count all nests (see Section 4. Methods). However in 1976, three colonies were censused using air photography and in 1976, 1977 and 1990 at a few colonies nests were not counted but nest numbers were estimated. In 1990 virtually all the field workers were different individuals than those who participated in the 1976/77 field work.

When comparing the 1990 and 1976/77 data , we excluded areas for which data were lacking or incomplete in 1990 and/or 1976/77.

5.3 DOUBLE-CRESTED CORMORANT

The situation in 1990

Excluding Middle Sister Island, there were 12 cormorant colonies in the study area with a total of 4,701 nests (Table 2). The colonies were restricted to Lake Erie (4 colonies; 1,956 nests) and Lake Ontario (8 colonies; 2,745 nests), as shown in Table 3 and Fig. 3.

Nesting was primarily on islands, but there were two mainland colonies: one at Eastport and the other at Tommy Thomson Park, Table 4 . The latter colony started late in 1990 and was not included in Blokpoel and Tessier 1991. Two of the 12 colonies were on artificial habitat .

Table 2. Double-crested Cormorant colony sites in the Canadian lower Great Lakes system in 1990 and numbers of nests of cormorants and other colonial waterbirds.

Colony Site	Name of Colony Site	DCCO[a]	RBGU	HERG	GBBG	CATE
40G003	East Sister I.	1,715	0	1,556	0	0
40G006	Middle I.	237	0	1,981	0	0
40G007	Pelee I.	2	0	0	0	0
30L001	Mohawk I.	2	2,068	204	0	0
30M008	Eastport	250	38,773	297	0	184
30M014	T.T. Park, Pen. B	3	26,185	22	0	0
30N001	High Bluff I.	888	31,805	4	0	0
30N002	Gull I.	704	37,612	85	2	102
30N004	False Ducks I.	137	6,581	45	0	0
31C001	Pigeon I.	638	5,017	55	5	479
31C003	Salmon I.	14	119	17	0	0
31C004	Snake I.	111	0	92	0	0
Lower Great Lakes system		4,701	---	---	---	---

[a] DCCO - Double-crested Cormorant, RBGU - Ring-billed Gull, HERG - Herring Gull, GBBG - Great Black-backed Gull, COTE - Common Tern, CATE - Caspian Tern.

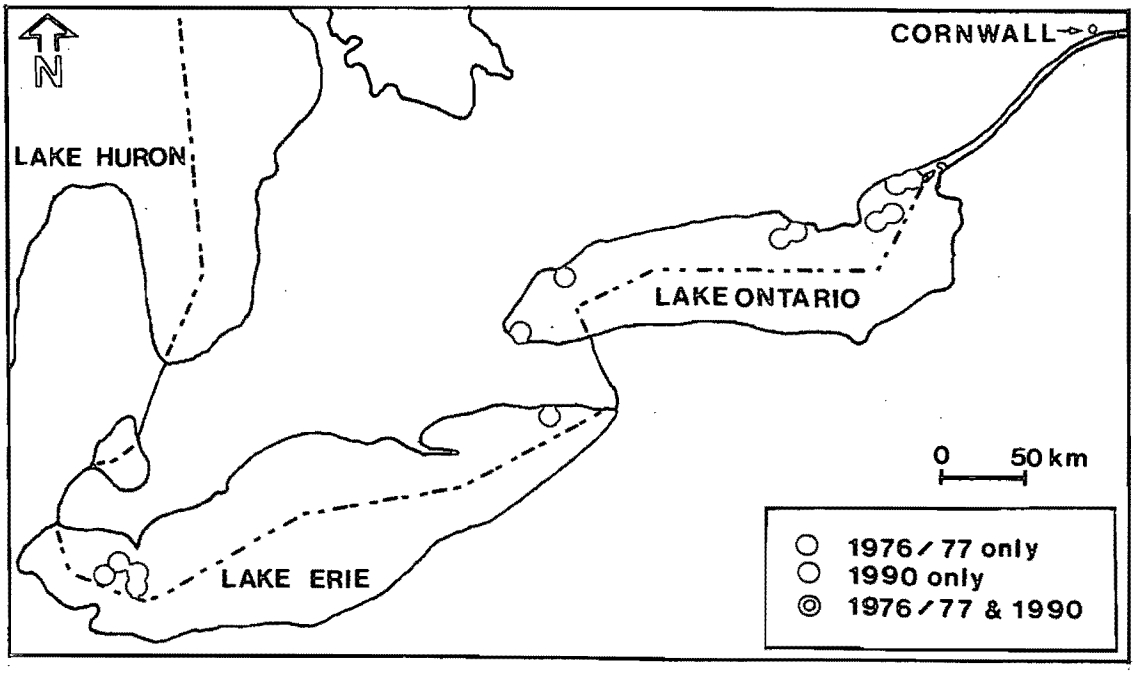

Fig. 3. Distribution of Double-crested Cormorant colonies in the Canadian lower Great Lakes system in 1990 and 1976/77.

Table 3. Number of colonies and nests of Double-crested Cormorants in the Canadian lower Great Lakes system in 1990 and 1976/77 by main water body.

Water body	1990		1976/77[a]	
	colonies	nests	colonies	nests
Detroit R.	0	0	0	0
Lake Erie	4	1,956	1	57
Niagara R.	0	0	0	0
Lake Ontario	8	2,745	0	0
Upper St. Lawrence. R.	0	0	0	0
Lower Great Lakes system	12	4,701	1	57

[a] Data for Lake Ontario and upper St. Lawrence River are for 1976 (Blokpoel 1977); data for Lake Erie and adjacent waters are for 1977 (Blokpoel and McKeating 1978).

Table 4. Double-crested Cormorant colonies present in 1990 the Canadian lower Great Lakes system by habitat type, habitat category and main waterbody.

Water body	Habitat Type		Habitat Category	
	Mainland	Insular	Artificial[a]	Natural
Detroit River	0	0	0	0
Lake Erie	0	4	0	4
Niagara River	0	0	0	0
Lake Ontario	2	6	2	6
St. Lawrence River	0	0	0	0
Lower Gr. Lakes system	2	10	2	10

[a] Directly created or almost totally modified by humans.

(Table 4) and they held only 5% of the nests (Table 5). On sites where no trees were available (Mohawk Island and Pigeon Island), the cormorants nested on the ground. On the other 10 sites trees were available for nesting. The cormorants nested primarily in the trees at those sites, except for False Duck Island where their nests were on the ground.

With one exception (Pelee Island) cormorants shared the colony sites with other colonial waterbirds, especially Herring Gulls and Ring-billed Gulls (Table 2).

Colony sizes ranged from 2 to 1,715 nests with an average colony size of 392 nests (Table 2). These nest numbers have to be treated carefully because cormorants have nested rather asynchronously in the Canadian Great Lakes in recent years making it difficult to get valid nest numbers (Ewins et al. 1995). This asynchrony is probably at least in part due to the enormous population increase (reported below) which results in the presence of relatively large numbers of first breeders and prebreeders in the colonies. These younger birds tend to nest later in the season, thus causing nesting asynchrony and making it impossible to determine the total nesting population in one visit.

The 4 largest colonies had a combined total of 3,945 nests or 84% of the total population.

Comparison of the 1990 and 1976/77 data

The cormorant nesting population in the study area grew from one colony (with 57 nests in 1977) to 12 colonies (with 4,701 nests) in 1990, or an average annual growth rate of 40.0% (Table 3). This rate of increase is in general agreement with the 38.4% average annual growth rate reported by Blokpoel and Scharf (1991) for Great Lakes cormorants in general during 1980-1987.

The single colony that existed in 1976/77, i.e. the one on Big Chicken Island in Lake Erie did not exist in 1990, presumably because the birds had relocated to nearby islands, especially East Sister Island.

Despite the general reservations about the 1990 vs. 1976/77 comparability of the data and the difficulties associated with nesting asynchrony, it is likely that the data are reasonably comparable. Cormorants are big black birds and they build large nests out in the open. They are therefore hard to miss from an aircraft, a boat or on the ground. In both years the colonies were visited when the majority of the birds were well into incubation.

Additional comments

On the lower Great Lakes cormorants are increasing rapidly (Price and Weseloh 1986, Weseloh and Ewins 1994, this report), as is the case on the upper Great Lakes (Scharf and Shugart 1981, Ludwig 1984). During the 1960s and early 1970s the nesting population declined steadily. The decline was associated with poor reproductive success and toxic

Table 5. Numbers of nests of the six colonial waterbird species in the Canadian lower Great Lakes system in 1990 by habitat category.

Species [a]	Nests on Natural Habitat		Nests on Artificial Habitat	
	#	%	#	%
DCCO	4,448	95	253	5
RBGU	114,023	40	168,382	60
HERG	4,686	85	821	15
GBBG	8	100	0	0
COTE	262	11	2,097	89
CATE	581	76	184	24

[a] DCCO - Double-crested Cormorant, RBGU - Ring-billed Gull, HERG - Herring Gull, GBBG - Great Black-backed Gull, COTE - Common Tern, CATE - Caspian Tern

contamination (Postupalski 1978, Weseloh et al. 1983, Ludwig 1984). The current population increase is probably the result of a combination of factors including reductions in contaminant levels and in human persecution, immigration, early age of first breeding and low annual mortality, and the abundance of prey fish (Blokpoel et al. 1980, Ludwig 1984, Price and Weseloh 1986, Weseloh and Ewins 1994).

The colony in Hamilton Harbour, which started in 1984 (Dobos et al. 1988), is noteworthy in that it represents the first site where the cormorants nested on human-made habitat in an urbanized area. A second colony on artificial habitat in an urbanized area (3 nests at Tommy Thompson Park) was started in 1990.

In the upper Great Lakes cormorants have become a nuisance to fishermen (Craven & Lev 1985, 1987) and in US Lake Ontario cormorants are creating concern among fishermen as well (Carroll 1988). However, cormorants in the upper Great Lakes do not eat significant amounts of fish of commercial value (Ludwig et al. 1989), as is the case on Lake Ontario (Karwowski 1994).

We expect further expansion of the breeding range and a further increase in population size.

5.4 RING-BILLED GULL

The situation in 1990

There were 34 Ring-billed Gull colonies with a total of more than 280,000 nests (Table 6). The colonies were located throughout the study area (Fig. 4).

Nesting was primarily (24 out of 34 colonies, 71%) on islands, but the remaining 10 colonies (29%) were on the mainland (Table 7). Of the 34 colonies, 15 were on artificial habitat (Table 7) and they held 60% of all nests (Table 5). Of the 8 insular colony sites on Lake Ontario, 2 (i.e. Farre Island and Neare Island in Hamilton Harbour) were man-made as well.

Ring-billed Gulls were found nesting as the only species at only 5 colony sites; at the other 29 colony sites the Ring-bills shared the nesting area with other species, especially Herring Gulls (Table 1).

The Ring-billed Gulls were by far the most numerous species with a total of more than 280,000 nests for the 34 colonies (Table 6). The colonies ranged in size from 31 to 43,590 nests with an average of 1,281 nests. Ring-bills are highly gregarious and nest densely in sometimes very large colonies. In fact, the 7 largest colonies, each with more than 19,000 nests, accounted for a total of 231,030 nests or 82% of the total population.

Comparison of the 1990 and 1976/77 data

Table 6. Number of colonies and nests of Ring-billed Gulls in the Canadian lower Great Lakes system in 1990 and 1976/77 by main water body.

Water body	1990		1976/77[a]	
	colonies	nests	colonies	nests
Detroit R.	1	34,021	0	0
Lake Erie	4	48,208	4	14,730
Niagara R.	1	400	1	400
Lake Ontario	17	171,712	7	40,787
Upper St. Lawrence R.	11	28,064	8	4,918
Lower Great Lakes system	34	282,405	20	60,835

[a] Data for Lake Ontario and upper St. Lawrence River are for 1976 (Blokpoel 1977); data for Lake Erie and adjacent waters are for 1977 (Blokpoel and McKeating 1978).

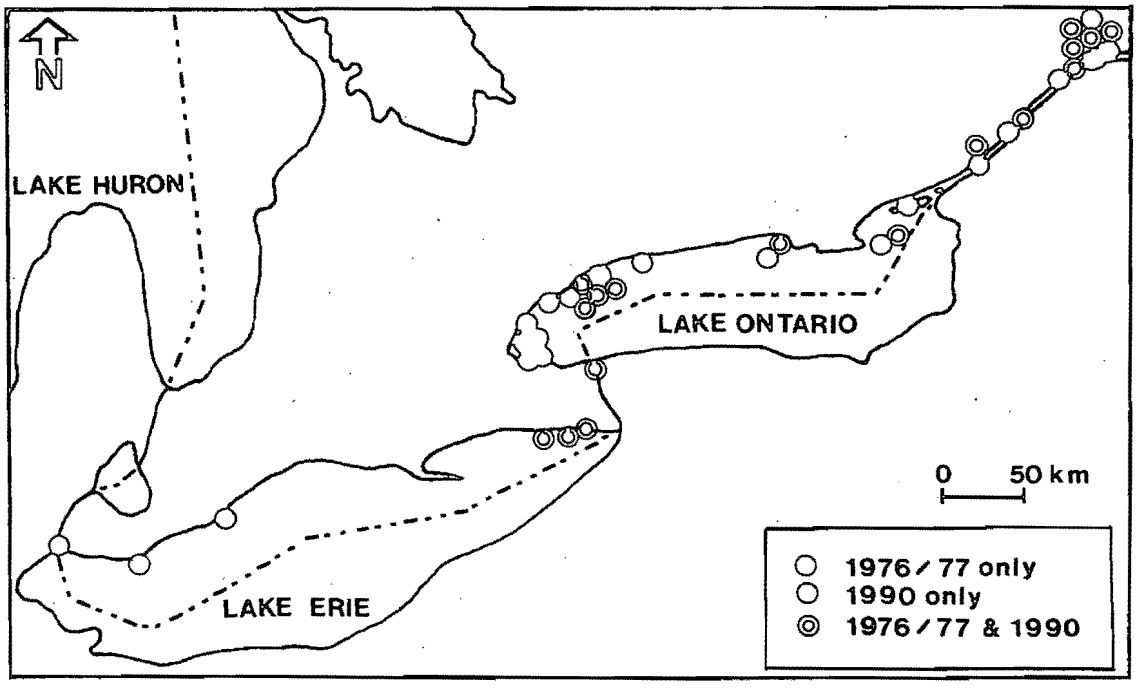

Fig. 4. Distribution of Ring-billed Gull colonies in the Canadian lower Great Lakes system in 1990 and 1976/77.

Table 7. Ring-billed Gull colonies present in the Canadian lower Great Lakes system in 1990 by habitat type, habitat category and main water body.

Water body	Habitat Type		Habitat Category	
	Mainland	Insular	Artificial[a]	Natural[a]
Detroit River	0	1	1	0
Lake Erie	1	3	2	2
Niagara River	0	1	0	1
Lake Ontario	9	8	11	6
Upper St. Lawrence R.	0	11	0	11[b]
Lower Gr. Lakes system	10	24	15	19

[a] Directly created or almost totally modified by humans.

[b] Includes all islands near Cornwall (31G001-31G009) most or all which were created indirectly, i.e.were the result of higher river levels after the Cornwall dam was created.

The population increased from 60,835 nests at 20 colonies in 1976/77 to 282,405 nests at 34 colonies in 1990 (Table 6). This overall increase of more than 450% represents an average annual rate of growth between 11.6% and 12.6%.

Of the 20 colonies present in 1976/77, 15 increased in size but the 5 remaining ceased to exist. The reasons for the demise of 4 of these 5 colonies are obvious: gull control (Mugg's Island and Ice Island), encroachment by vegetation (Peninsula D, Tommy Thomson Park), and take-over by a Herring Gull pair (Shoal east of Sheek Island). The colony at Point Pelee National Park had only one nest in 1977, which was probably depredated and deserted.

Additional comments

As adaptable generalists, ring-bills have learned to thrive in the human landscape. Many gulls have become urbanized in that they feed, nest and rest in or near urban and suburban areas. The increasing gull numbers are creating conflicts with a variety of human interests (Blokpoel and Tessier 1986, Blokpoel et al. 1990). When gulls nest in very large numbers on urban or industrial sites, conflicts between the interests of people and gulls become pronounced. At several colony sites affected landowners have carried out gull control operations under special permits issued by CWS (Blokpoel and Tessier 1987 and 1992). These operations consisted of scaring and occasional egg collecting, but did not involve the killing of adults or chicks. Even in situations where local gull control solves a local gull problem, the problem is usually shifted rather than eradicated.

Ring-billed Gulls also cause concern because they out-compete Common Terns for nesting space (Courtney and Blokpoel 1983) and it is difficult to prevent this encroachment on traditional tern nesting habitat by the earlier nesting ring-bills (Morris et al. 1992, Tessier et al. in prep.).

We expect that the ring-bill population will not decline and we predict more gull problems both with humans and with Common Terns.

5.5 HERRING GULL

The Situation in 1990

Excluding Middle Sister Island, there were 45 colonies in the study area with 5,507 nests (Table 8). The Herring Gulls nested throughout the study area. With their 45 colonies the Herring Gulls were more widespread than the other species (Fig.5).

Of the 45 colonies, 37 (82%) were on insular sites with the remainder on mainland sites (Table 9). The majority of the colonies (71%) was on natural habitat and the remainder on human-made habitat (Table 9). In total, 85% of the nests were on natural habitat (Table 5).

Table 8. Number of colonies and nests of Herring Gull in the Canadian lower Great Lakes system in 1990 and 1976/77, by main water body.

Water body	1990		1976/77 [a]	
	colonies	nests	colonies	nests
Detroit R.	2	195	1	48
Lake Erie	8[b]	4,203[b]	6[c]	1,085[c]
Niagara R.	3	104	4[d]	38
Lake Ontario	16	907	11	309
Upper St. Lawrence R.	16	98	7	45
Lower Gr. Lakes system	45	5,507	-	1,525
Lower Gr. Lakes system excluding Lake Erie	37	1,304	23	440

[a] Data for Lake Ontario and upper St. Lawrence River are for 1976 (Blokpoel 1977); data for Lake Erie and adjacent waters are for 1977 (Blokpoel and McKeating 1978).

[b] Excluding Middle Sister Island which was not visited in 1990.

[c] Excluding North Harbour Island, Hen Island and Middle Island which were not visited in 1977. Including East Sister Island and Middle Sister Island which were not completely counted in 1977.

[d] The four Herring Gull nests found on the cliffs of the Niagara River gorge are considered as one colony.

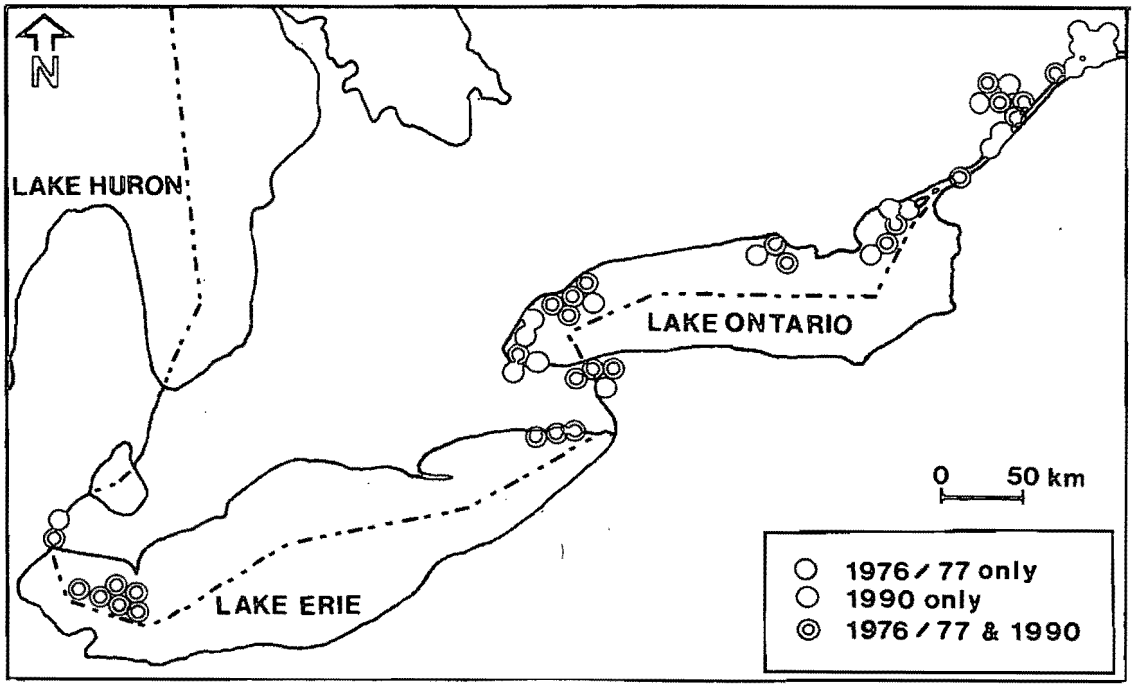

Fig. 5. Distribution of Herring Gull colonies in the Canadian lower Great Lakes system in 1990 and 1976/77.

Table 9. Herring Gull colonies present in the Canadian lower Great Lakes system in 1990 by habitat type, habitat category and main water body.

Water body	Habitat Type		Habitat Category	
	Mainland	Insular	Artificial[a]	Natural
Detroit River	0	1	2	0
Lake Erie	1	7	2	6
Niagara River	0	3	1	2
Lake Ontario	7	9	8	8
Upper St. Lawrence R.	0	16	0	16[b]
Lower Gr. Lakes system	8	37	13	32

[a] Directly created or almost totally modified by humans.

[b] Includes all islands near Cornwall (31G001-31G009) most or all which were created indirectly, i.e. were the result of higher river levels after the Cornwall dam was created.

Although Herring Gulls often shared their colony site with other species, there were 12 (27%) colonies where they were the only species (Table 1).

Colony sizes ranged from 1 to 1981 nests and the 2 largest colonies accounted for 3,537 nests or 64% of the total population.

Comparison of the 1990 and 1976/77 data

Because the data for Lake Erie were lacking or incomplete in 1977 and 1990, Lake Erie can not be not be included in the comparison. For the remainder of the study area, the breeding population grew from 440 pairs at 23 colonies in 1976/77 to 1,304 pairs at 37 colonies in 1990 (Table 8). This almost 3-fold increase corresponds to an average annual growth rate between 8.1% and 8.7%.

We have 1990 data for 28 colonies that were active in 1976/77. Of these 28 colonies, 15 (54%) had increased by 1990, (18%) had remained the same (i.e. 1990 number within plus or minus 10% of 1976/77 number) and the remaining 8 (29%) had declined. Of these 8 colonies, 4 had ceased to exist by 1990, while the others were still active but with reduced nest numbers.

Reasons for the decline at these 8 colonies are obvious for only 4 colonies (gull control at 2 colonies, and encroachment by vegetation at the other 2 colonies), but are unknown for the other 4 colonies.

Additional comments

We can only speculate why the larger Herring Gull increased in numbers at a lower rate than that of the smaller Ring-billed Gull. Although Herring Gulls commonly feed on garbage dumps in the lower Great Lakes area, they have not become urbanized to the same extent as ring-bills. They nest less on artificial habitats as the ring-bills do (Table 5). Thus they may be unable to profit from living in the human landscape to the same extent as ring-bills do. Ring-bills, being smaller, are more maneuverable and it is likely that they forage more successfully in certain situations (e.g. feeding behind the plow, plunge diving for fish, and hawking for insects in the air). Another reason for the comparatively slow increase in the Herring Gull population may be the fact that adult Great Lakes Herring Gulls spend the winter in the lower Great Lakes area (and are thus exposed to severe weather conditions possibly resulting in higher over-winter mortality), whereas most ring-bills migrate from the Great Lakes to the south Atlantic Coast where weather (and thus feeding) conditions are usually better.

Because Herring Gulls breed in much smaller numbers in Ontario than do Ring-billed Gulls, they are much less of a problem than the ring-bills. However, Herring Gulls nesting on roofs can cause considerable inconvenience (Blokpoel and Smith 1988, Blokpoel et al. 1990).

5.6 GREAT BLACK-BACKED GULL

The situation in 1990

There were 3 colonies with a total of 8 pairs (Table 10). Of these 3 colonies, 2 were on Lake Ontario and the third on the St. Lawrence River (Fig. 6). All 3 colonies were on natural islands. At all 3 colony sites the black-backs shared the nesting areas with at least 2 other species (Table 1).

Comparison of the 1990 and 1976/77 data

During the 1976/77 surveys no Great Black-backed Gulls were reported. Because black-backs are large and distinctly colored (especially as breeding adults) it is unlikely that they would have been missed during ground surveys. However, the two bigger colonies (Pigeon Island and Gull Island) were censused in 1976 using air photography and their nests (if any) could have been overlooked when evaluating the air photographs. On the other hand, visits by other workers to the two islands in 1976 and 1977 did not report any Great Black-backed Gulls. It is therefore likely that the 3 Great Black-backed Gull colonies present in 1990 represent the establishment of a small breeding population of the Great Black-backed Gull in the Canadian lower Great Lakes system.

Additional comments

Ludwig wrote in 1968 that this species seemed "poised at the edge of the Great Lakes for an invasion". Although this invasion had not happened by 1979 (Angehrn et al. 1979), nor by 1985 (Blokpoel 1987), the species now has a foothold in Lake Ontario, while it also nests sporadically in Lake Huron (Ewins et al. 1992). We expect that the species will continue to expand its breeding range and population in the Great Lakes.

5.7 COMMON TERN

The situation in 1990

There was a total of 15 colonies with 2,359 nests (Table 11). The colonies were located in Lake Erie, Lake Ontario and the St. Lawrence River (Fig. 7). Twelve colonies (80%) were on islands or insular structures, and the remainder were located on the mainland (Table 12).

Eight colonies (53%) were on natural habitat (Table 12), but the 7 colonies on artificial habitat accounted for 89% of the nests (Table 5). Compared to the other 5 species , Common Terns had by far the largest proportion of nests on artificial habitat (Table 5), which may be a reflection of the fact that they are losing out at many natural sites.

Of the 6 colonial waterbird species, the Common Terns had the highest incidence of single-species colonies: at 7 of their 15 colony sites they were the only species present (Table 1).

Table 10. Number of colonies and nests of Great Black-backed Gulls in the Canadian lower Great Lakes system in 1990 and 1976/77, by main water body.

Water body	1990		1976/77[a]	
	colonies	nests	colonies	nests
Detroit R.	0	0	0	0
Lake Erie	0	0	0	0
Niagara R.	0	0	0	0
Lake Ontario	2	7	0	0
Upper St. Lawrence R.	1	1	0	0
Lower Gr. Lakes system	3	8	0	0

[a] Data for Lake Ontario and upper St. Lawrence River are for 1976 (Blokpoel 1977); data for Lake Erie and adjacent waters are for 1977 (Blokpoel and McKeating 1978).

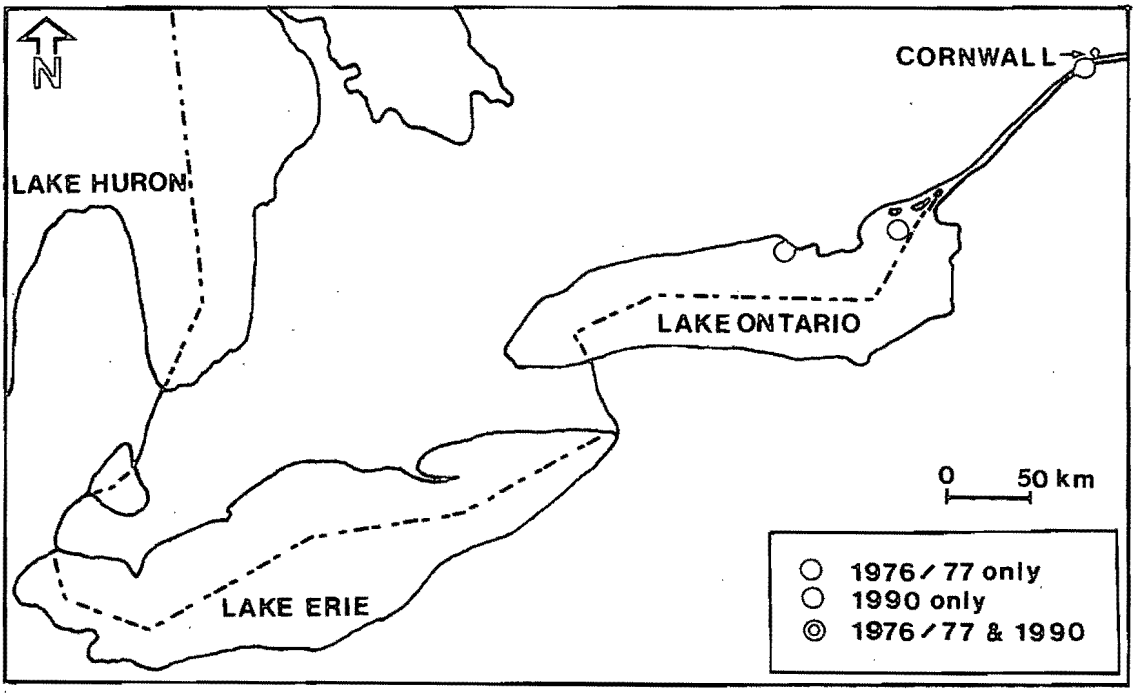

Fig. 6. Distribution of Great Black-backed Gull colonies in the Canadian lower Great Lakes system in 1990 and 1976/77.

Table 11. Number of colonies and nests of Common Terns in the Canadian lower Great Lakes system in 1990 and 1976/77 by main water body.

Water body	1990		1976/77[a]	
	colonies	nests	colonies	nests
Detroit R.	0	0	1	159
Lake Erie	2	1,135	4	1,524
Niagara R.	0	0	0	0
Lake Ontario	6	1,159	5	1,299
Upper St. Lawrence. R.	7	65	7	188
Lower Gr. Lakes system	15	2,359	17	3,170

[a] Data for Lake Ontario and upper St. Lawrence River are for 1976 (Blokpoel 1977); data for Lake Erie and adjacent waters are for 1977 (Blokpoel and McKeating 1978).

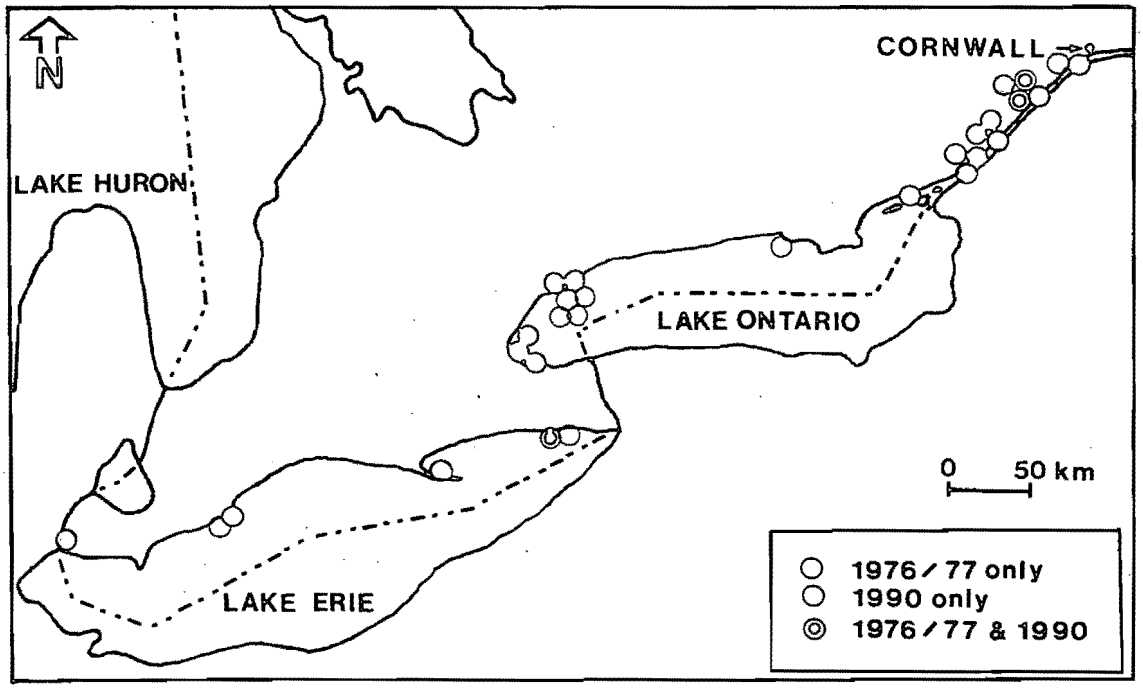

Fig. 7. Distribution of Common Tern colonies in the Canadian lower Great Lakes system in 1990 and 1976/77.

Table 12. Common Tern colonies present in the Canadian lower Great Lakes system in 1990 by habitat type, habitat category and main water body.

Water body	Habitat Type		Habitat Category	
	Mainland	Insular	Artificial[a]	Natural
Detroit River	0	0	0	0
Lake Erie	1	1	1	1
Niagara River	0	0	0	0
Lake Ontario	2	4	5	1
St. Lawr. R.	1	6	1	6
L. Gr. Lakes system	4	11	7	8

[a] Directly created or almost totally modified by humans

Colony sizes ranged from 2 to 935 nests, and the 4 largest colonies held 2,157 nests or 91% of the total population.

Comparison of the 1990 and 1976/77 data

The breeding population declined from 3,170 pairs at 17 colonies in 1976/77 to 2,359 pairs at 15 colonies in 1990. This overall drop in numbers of 26% corresponds to a mean annual rate of decline between 2.1% and 2.3%.

Of the 17 colonies that were active in 1976/77, 14 (82%) had ceased to exist in 1990, 1 (7%) had greatly declined, and 2 had greatly increased. Thus, of the 15 colonies present in 1990, 12 (80%) were newly established colonies. The most likely reasons for the demise of the 14 colonies that no longer existed in 1990 were: encroachment by gulls and/or vegetation (10 colonies), depredations by ground predators (1 colony) and unknown (3 colonies). Encroachment by gulls had caused the serious decline at Ice Island (Tessier et al. in prep.).

Two colonies present in 1976/77 had greatly increased by 1990. The ternery on the Port Colborne Breakwall has been protected for many years (provision of suitable nesting substrate and chick shelters, prevention of encroachment by Ring-billed Gulls, prevention of depredation by Herring Gulls on tern chicks, and discouragement of human disturbance, Morris et al. 1992) and most likely received birds from the nearby Port Colbone Mainland colony, which had disappeared by 1990. The increase at the other colony (on Channel Island) was probably the result of an influx of terns from nearby Ice Island, where an increase in ring-bill numbers had excluded many terns (Tessier et al. in prep.).

Additional comments

Because of the expanding populations of Ring-billed Gulls, Common Tern colonies in the lower Great Lakes are often overrun by the larger and earlier-nesting gulls. This encroachment usually means that the terns are initially forced to nest at the periphery of traditional colony sites, where their nests may be much more prone to inundation by storm waves and/or changing lake levels. At many sites Common Terns are eventually forced to relocate to other locations. Because most natural sites in the lower Great Lakes system are already occupied by gulls, the Common Terns often end up colonizing newly created habitats. As mentioned, of the 6 species, Common Terns nested in greatest proportion on artificial habitats (Table 5).

5.8 CASPIAN TERN

The situation in 1990

There was a total of 3 colonies with 765 nests (Table 13). All three colonies were located on Lake Ontario (Fig. 8). Two colonies were located on natural islands (Pigeon Island and Gull

Table 13. Number of colonies and nests of Caspian Tern in the Canadian lower Great Lakes system in 1990 and 1976/77 by main water body.

Water body	1990		1976/77 [a]	
	colonies	nests	colonies	nests
Detroit R.	0	0	0	0
Lake Erie	0	0	0	0
Niagara R.	0	0	0	0
Lake Ontario	3	765	2	47
Upper St. Lawrence R.	0	0	0	0
Lower Gr.Lakes system	3	765	2	47

[a] Data for Lake Ontario and upper St. Lawrence River are for 1976 (Blokpoel 1977); data for Lake Erie and adjacent waters are for 1977 (Blokpoel and McKeating 1978).

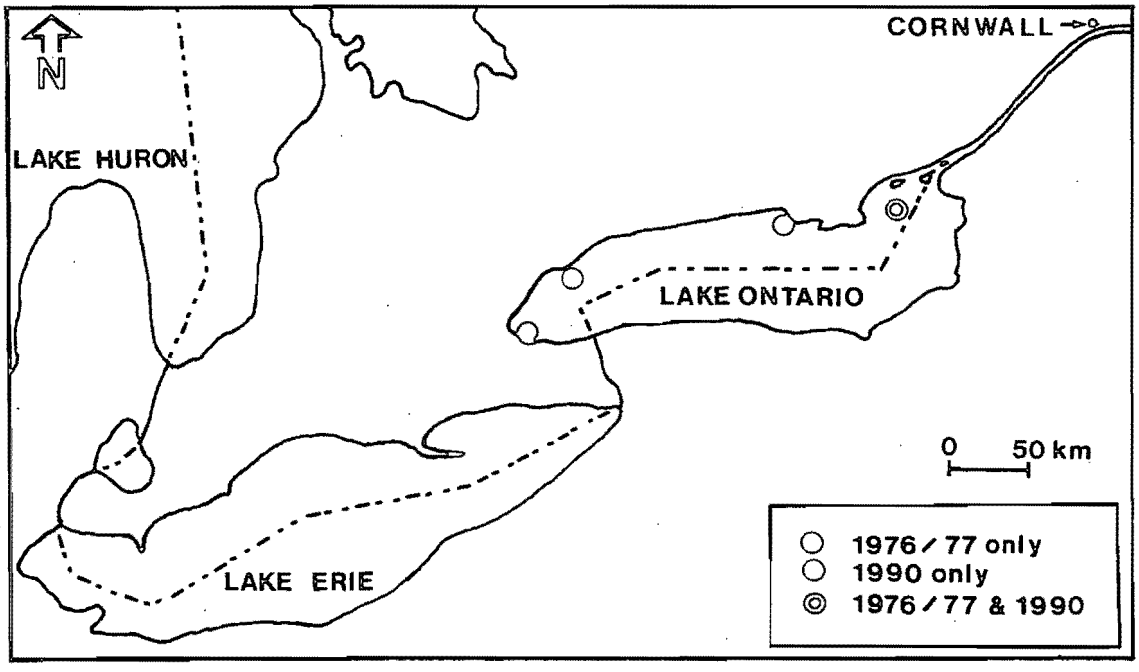

Fig. 8. Distribution of Caspian Tern colonies in the Canadian lower Great Lakes system in 1990 and 1976/77.

Island) where they shared the colony site with 4 other species (Table 1). The third colony was located on an artificial mainland site (Eastport, Hamilton Harbour) and there the Caspian Terns shared the site with 3 other species.

Colony sizes ranged from 102 to 479 nests, and the largest colony (at Pigeon Island) held 64% of the total of 765 nests.

Comparison of the 1990 and 1976 data

Overall the breeding population in the study area grew from 47 nests at 2 colonies in 1976 to 765 nests at 3 colonies in 1990 (Table 13). This enormous increase corresponds to a mean annual rate of increase of 22.1%. A review of population changes for Great Lakes Caspian Terns during 1972-1991 concluded that there had been major increases on Lake Ontario and Lake Michigan, whereas numbers had remained stable on Lake Huron (Ewins et al. 1994).

This high rate of increase may be somewhat inflated due to a possible underestimate of the numbers of Caspian Tern nests at Pigeon Island and Gull Island in 1976. But even assuming 115 nests for Pigeon Island in 1976 (see Blokpoel 1977) and 5 nests for Gull Island (see LaForest 1993) the 1976 Lake Ontario population would have been 127 nests and that number would still have increased 6-fold during 1976-1990 (or a mean annual rate of increase of 13.7%). There can be no doubt that the Lake Ontario population has shown a real and very large increase during 1976-1990.

Two colonies were definitely present in 1976: Tommy Thomson Park and Pigeon Island. The colony at Tommy Thomson Park ceased to exist while a new colony at nearby Eastport became established (Dobos et al. 1988). Increasing vegetation, very high densities of nesting Ring-billed Gulls and human disturbance may have caused the Caspian Terns to relocate from Tommy Thomson Park to Eastport. In contrast, the Pigeon Island colony, which showed great fluctuations during 1961-1975 (Blokpoel 1977), substantially increased during 1976-1990.

Additional comments

Whereas the negative impact of gulls on Common Terns is well known, the relationship between Caspian Terns and Ring-billed and Herring Gulls on shared colony sites is much less understood. It is known that human visits to Caspian Tern colonies often give neighbouring gulls a chance to depredate the tern eggs or chicks (Blokpoel 1981). For the same reason reproductive success is higher when nests are monitored from a distance rather than through frequent, actual nest visits (Fetterolf and Blokpoel 1983).

In order to colonize sites that already support large numbers of gulls, Caspian Terns can gain a foothold by opportunistic timing and placement of their nests. A new colony at Little Galloo Island (in the US part of eastern Lake Ontario) was started by Caspian Terns who laid

their eggs very late in the season at the edge of a shallow pond that had dried out as spring progressed. This area had not been used by the earlier-nesting Ring-billed Gulls because by the time they started nesting there, dry ground was not yet available (Weseloh and Blokpoel 1993). This process probably also took place during the establishment of the new colony at Gull Island where the colonizing Caspian Terns built nests near the edge of an interior pond.

We expect that the Caspian Terns will continue to expand and increase in the lower Great Lakes system.

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8. APPENDICES

Appendix 1: Areas covered and people involved in the fieldwork of the 1990 inventory of the Canadia lower Great Lakes system.

Area	CWS Staff and Contractors	Other Cooperators	Dates of Fieldwork
Detroit River Western Lake Erie	T. Brown S. Polischuck	D. Rawlyk A.Woodliffe	7-14 May
Eastern Lake Erie Niagara River Western Lake Ontario	C. Bishop S. Hayes B. Lee P. Madore L. Primavesi G.D. Tessier	E. Christens S. Johnson R.D. Morris G. Sadowsky	7-14 May
Eastern Lake Ontario	M. Hortiguela S. Kingwell B. Lee D.V. Weseloh		7-16 May
Upper St. Lawrence River	R. Huizer S. Janes B. Lee G.D. Tessier	B.A. Andress	7-22 May

Appendix 2. Explanation of the listing of the colony sites in Appendix 3.

There are nine 1:250,000 Topographical Maps that cover the Canadian lower Great Lakes system. Going from west to east these Maps are 40J, 40G, 40I, 30L, 30M, 30N, 31C, 31B and 31G. The results of the 1990 survey (together with those of 1976/77 surveys) are plotted by Topo Map and are presented in Appendix 3. Appendix 3 runs across opposite pages.

In Appendix 3 we use the following abbreviations for bird species: DCCO - Double-crested Cormorant, RBGU - Ring-billed Gull, HERG - Herring Gull, GBBG - Great Black-backed Gull, COTE - Common Tern and CATE - Caspian Tern. The methods used for the 1990 and 1976/77 inventories are shown on the left hand page and we use the following abbreviations: GC - Ground Count, GE - Ground Estimate, AE - aerial estimate, AP - aerial photography, BE - Boat Estimate.

In Appendix 3 we also present the results of the 1976/77 inventories to facilitate comparisons and to provide the 1976/77 colony sites with the same type of identification number as the one used for 1990. In Appendix 3 we sometimes use names for 1976/77 colony sites that are different from the ones we used in 1990. For example, the "Strachan Island" complex has now been separated in several smaller islands.

In some cases, a small cluster of islets was considered as one colony in 1976/77 and/or 1990. In those cases we use a T (for total) and a bracket to indicate the total number of nests and of colony sites involved (for example, unnamed islands #1 and #2, 30M002 and 30M003).

Appendix 3. Waterbird colonies present in the study area in 1990 and/or 1976/77

Colony Site Ident. #	Lake or river[a]	Name or Description of Colony Site Location	Lat.	Long.	Census Method[b] '90	Census Method '76/77	
40J001	DR	N end of Fighting Island	42°11'54"	83°06'06"	GC	GC	
40J002	DR	S end of Fighting Island	42°14'00"	83°07'12"	GC	GC	
40G001	LE	Middle Sister Island	41°50'48"	83°00'06"	--	GC	
40G002	LE	North Harbour Island	41°49'36"	82°51'42"	GC	--	
40G003	LE	East Sister Island	41°48'48"	82°51'30"	GC	GC	
40G004	LE	Big Chicken Island	41°46'18"	82°49'06"	GC	GC	
40G005	LE	Hen Island	41°47'18"	82°47'48"	GC	--	
40G006	LE	Middle Island	41°40'54"	82°40'54"	GC	--	
40G007	LE	N end of Pelee Island	41°49'42"	82°38'24"	BC	BE	
40G008	LE	Point Pelee N.P.	41°57'18"	82°30'06"	GE	GC	
40I001	LE	Rondeau Provincial Park	42°15'48"	81°53'30"	GE	GC	
40I002	LE	Erieau	42°15'36"	81°55'30"	GE	GC	
40I003	LE	Long Point	42°33'30"	80°16'24"	GE	GC	
30L001	LE	Mohawk Island	42°50'12"	79°31'24"	GC	GC	
30L002	LE	Pt. Colborne, breakwall	42°52'06"	79°15'30"	GC/GE	GC	
30L003	LE	Pt. Colborne, mainland	42°52'12"	79°14'42"	GC	GC	
30M001	NR	Stranded barge	43°04'24"	79°04'36"	GE	GE	
30M002	NR	Unnamed Island #1	43°04'24"	79°04'36"	GE	GE	
30M003	NR	Unnamed Island #2	43°04'24"	79°04'36"	GE	GE	
30M004	NR	Table Rock Island	43°04'30"	79°04'42"	GE	GE	
30M005	NR	Niagara River Gorge	43°05'24"	79°04'06"	GE	GC	
30M006	LO	Windermere Basin	43°15'54"	79°46'42"	GC	GE	
30M007	LO	Stelco	43°16'24"	79°47'36"	GC	GE	
30M008	LO	Eastport	43°16'42"	79°47'24"	GC	GC	
30M009	LO	1st i. N. of CCIW (Neare)	43°18'30"	79°48'18"	GC	GE	
30M010	LO	2nd i. N of CCIW (Farr)	43°18'42"	79°48'42"	GC	GE	
30M011	LO	Lakeview TGS	43°34'18"	79°32'54"	GC	GE	
30M012	LO	Muggs Island	43°37'36"	79°23'12"	GC	GE	
30M013	LO	Tommy Thomson Park, Pen. A	43°37'18"	79°20'36"	GC	GC	
30M014	LO	Tommy Thomson Park, Pen. B	43°37'24"	79°20'30"	GC	GC	

[a] DR - Detroit River, LE - Lake Erie, NR - Niagara River, LO - Lake Ontario, SL - St. Lawrence River
[b] GC - ground count; BE - boat estimate; GE - ground estimate; AP - aerial photograph; AE - aerial estimate
[c] Data for Lake Ontario and upper St. Lawrence River are for 1976; data for Lake Erie and adjacent waters are for 1977
[d] NV - not visited, [e] T-total for the bracketed colonies, f Partial census only

App. 3 (cont'd).

1990						1976/77[c]					
DCCO	RBGU	HERG	GBBG	COTE	CATE	DCCO	RBGU	HERG	GBBG	COTE	CATE
0	34021	64	0	0	0	0	0	0	0	0	0
0	0	131	0	0	0	0	0	48	0	159	0
NV[d]	NV	NV	NV	NV	NV	0	0	303[f]	0	0	0
0	0	41	0	0	0	NV	NV	NV	NV	NV	NV
1715	0	1556	0	0	0	0	0	344[f]	0	0	0
0	0	174	0	0	0	57	0	94	0	0	0
0	0	70	0	0	0	NV	NV	NV	NV	NV	NV
237	0	1981	0	0	0	NV	NV	NV	NV	NV	NV
2	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	0	0	0	0
0	50	0	0	200	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	6	0
0	0	0	0	0	0	0	0	0	0	18	0
2	2068	204	0	0	0	0	520	227	0	0	0
0	2500	145	0	935	0	0	235	60	0	562	0
0	43590	32	0	0	0	0	13974	57	0	938	0
0	0	4	0	0	0	0	0	4	0	0	0
0	0	100T[e]	0	0	0	0	0	30T	0	0	0
0	0	–	0	0	0	0	0	–	0	0	0
0	400	0	0	0	0	0	400	0	0	0	0
0	0	0	0	0	0	0	0	4	0	0	0
0	37	3	0	776	0	0	0	0	0	0	0
0	188	4	0	246	0	0	0	0	0	0	0
250	38773	297	0	0	184	0	0	7	0	0	0
0	457	0	0	6	0	0	0	0	0	0	0
0	166	39	0	0	0	0	0	0	0	0	0
0	876	6	0	0	0	0	0	0	0	0	0
0	2307	7	0	0	0	0	3885	45	0	0	0
0	19044	73	0	0	0	0	5494	1	0	7	0
3	26185	22	0	0	0	0	4495	6	0	262	7

Appendix 3 - Continued

Colony Site Ident. #	Lake or river	Name or Description of Colony Site Location	Lat.	Long.	Method '90	Method 76/77	
30M015	LO	Tommy Thomson Park, Pen. C	43°37'36"	79°20'24"	GC	GC	
30M016	LO	Tommy Thomson Park, Pen. D	43°37'42"	79°20'06"	GC	GC	
30M017	LO	Tommy Thomson Park, Bay D	43°37'48"	79°19'42"	GC	GC	
30M018	LO	Tommy Thomson Park, Cell 1	43°37'54"	79°19'30"	GC	GC	
30M019	LO	Ashbridge's Bay	43°39'24"	79°18'54"	GE	GE	
30M020	LO	St. Marys Cement, Bowmanville	43°52'30"	78°41'42"	GE	GE	
30N001	LO	High Bluff Island	43°58'24"	77°44'54"	GC	AE	
30N002	LO	Gull Island	48°58'54"	77°44'36"	GC	GC/AP	
30N003	LO	Scotch Bonnet Island	43°54'00"	77°32'36"	GC	GC	
30N004	LO	False Ducks Island (= Swetman Island)	43°56'48"	76°48'36"	GC	BE	
31C001	LO	Pigeon Island	44°04'06"	76°32'54"	GC	GC/AP	
31C002	LO	West island of the Brother Islands	44°12'24"	76°38'18"	GC	GC	
31C003	LO	Salmon Island	44°11'48"	76°35'36"	GC	BE	
31C004	LO	Snake Island	44°11'24"	76°32'36"	GC	GC	
31C005	SL	Black Ant Island	44°15'30"	76°11'06"	GC	GC	
31C006	SL	Jackstraw Shoal	44°19'48"	76°06'36"	GC	BE	
31C007	SL	Rk. W of i. WSW of Squaw I. (= Rk. W. of Scorpion I.)	44°19'12"	76°06'42"	GC	GC	
31C008	SL	Shoal SW of Fort Wallace Island	44°18'24"	76°04'48"	GC	BE	
31B001	SL	Channel Island	44°26'24"	75°51'54"	GC	GC	
31B002	SL	NE i. of the Little Corn Islands	44°27'06"	75°49'24"	GC	GC	
31B003	SL	Ice Island	44°27'24"	75°50'12"	GC	GC	
31B004	SL	Gull Island	44°27'30"	75°49'12"	GC	BE	
31B005	SL	Shoal NW of Gull Island	44°27'36"	75°49'18"	GC	GC	
31B006	SL	Griswold Island	44°28'54"	75°49'18"	GC	GC	
31B007	SL	Larger shoal E of Stovin Island	44°33'24"	75°42'42"	GC	GC	
31B008	SL	Smaller shoal E of Stovin Island	44°33'30"	75°42'48"	BC	GC	
31B009	SL	McNair Island	44°35'36"	75°39'48"	GC	GC	
31B010	SL	Murray Island	44°35'30"	75°39'42"	GC	GC	

[a] Inundated in 1976

App. 3 (cont'd).

1990						1976/77					
DCCO	RBGU	HERG	GBBG	COTE	CATE	DCCO	RBGU	HERG	GBBG	COTE	CATE
0	1570	1	0	0	0	0	124	2	0	71	0
0	0	0	0	0	0	0	269	3	0	906	0
0	0	0	0	102	0	0	0	0	0	0	0
0	0	0	0	26	0	0	0	0	0	0	0
0	150	0	0	0	0	0	0	0	0	0	0
0	825	0	0	0	0	0	0	0	0	0	0
888	31805	4	0	0	0	0	0	0	0	0	0
704	37612	85	2	0	102	0	23707	41	0	53	0
0	0	157	0	0	0	0	0	85	0	0	0
137	6581	45	0	0	0	0	0	0	0	0	0
638	5017	55	5	0	479	0	≥ 2813	24	0	0	40
0	0	0	0	3	0	0	0	21	0	0	0
14	119	17	0	0	0	0[a]	0[a]	0[a]	0[a]	0[a]	0[a]
111	0	92	0	0	0	0	0	74	0	0	0
0	639	1	0	0	0	0	0	22	0	0	0
0	0	0	0	9	0	0	O	0	0	0	0
0	0	0	0	0	0	0	0	0	0	6	0
0	0	0	0	9	0	0	0	0	0	0	0
0	0	1	0	30	0	0	0	0	0	16	0
0	0	1	0	3	0	0	0	1	0	0	0
0	0	1	0	2	0	0	5	1	0	121	0
0	0	3	0	0	0	0	0	0	0	0	0
0	0	9	0	0	0	0	0	7	0	0	0
0	0	18	0	0	0	0	0	12	0	1	0
0	0	0	0	6	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	0	0	1	0
0	5768	0	0	0	0	0	0	0	0	0	0
0	607	14	0	0	0	0	13	0	0	13	0

Appendix 3 - Continued

Colony Site Ident. #	Lake or river	Name or Description of Colony Site Location	Lat.	Long.	Method² '90	Method 76/77	
31B011	SL	Spencer Island Pier	44°44'36"	75°27'00"	GC	BE	
31G001	SL	Island .2 km W of Sheek Island	45°00'48"	74°51'36"	GC	GC	
31G002	SL	Bergin Island	45°01'06"	74°51'24"	GC	GE	
31G003	SL	Shoal 1 km. E of Sheek Island	45°01'06"	74°50'06"	GC	GC	
31G004	SL	Strachan Island	45°00'54"	74°48'42"	GC	GC	
31G005	SL	Island SE of Strachan Island	45°01'12"	74°48'36"	GC	GC	
31G006	SL	Island W of Strachan Island	44°01'06"	74°48'36"	GC	GC	
31G007	SL	Island S of 31G006	44°01'06"	74°48'36"	GC	GC	
31G008	SL	Island E of Strachan Island	45°00'54"	74°48'30"	GC	GC	
31G009	SL	Island E of 31G008	45°01'18"	74°48'24"	GC	GC	

App. 3 (cont'd).

	1990						1976/77					
	DCCO	RBGU	HERG	GBBG	COTE	CATE	DCCO	RBGU	HERG	GBBG	COTE	CATE
	0	0	0	0	6	0	0	0	0	0	0	0
	0	1356	1	0	0	0	0	0	1	0	0	0
	0	31	0	0	0	0	0	6	0	0	0	0
	0	0	1	0	0	0	0	1	0	0	30	0
	0	13417T	39T	0	0	0	0	3947	0	0	0	0
	0	–	–	0	0	0	0	748	0	0	0	0
	0	743T	6T	1	0	0	0	149	0	0	0	0
	0	–	–	0	0	0	0	49	0	0	0	0
	0	5094	2	0	0	0	0	0	0	0	0	0
	0	409	1	0	0	0	0	0	0	0	0	0

Appendix 4. Explanation of the mapping of colony sites in Appendices 5-13

Going from west to east the following nine 1:250,000 Maps cover the Canadian lower Great Lakes system : 40J, 40G, 40I, 30L, 30M, 30N, 31C, 31B and 31G.

All colony sites active in 1990 and/or in 1976/77 are plotted in order of the nine 1:250,000 Topo Maps that cover the study area. Thus the colony sites in the area covered by Map 40J (which are listed in App. 3) are plotted on a number of maps, which together form Appendix 5. Similarly, colony sites in the area covered by Map 40G (also listed in Appendix 3) are plotted on the maps of Appendix 6, and so on.

All colony sites are plotted both on 1:250,000 maps and on 1:50,000 maps. For example, Appendix 5 first shows an overview of the locations of all colony sites in the area covered by the 1:250,000 Topo Map 40J and then continues to show their detailed locations on 1:50,000 maps.

To find the colony site identification number of a certain plotted colony, combine the Map number (given at the top of the page in case of 1:250,000 maps and in the boxes for the 1:50,000 maps) and the number in the circle associated with that colony.

When plotting the colony sites, we used 5 different-sized symbols to indicate 5 size classes of the waterbird colonies. These symbols are based on the total of nests of all cormorants, gulls and terns nesting at a colony site. In cases where only totals of nests counts for two or more colony sites were reported (marked by T and a bracket in App. 3), we arbitrarily divided the total number of nests by the number of colony sites to arrive at a colony size (and thus a size symbol) for each colony site.

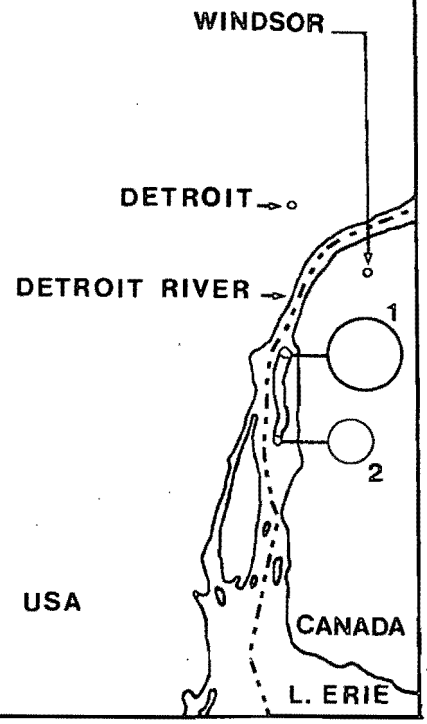
Appendix 5 .

MAP 40J - WEST, DETROIT, 1:250,000

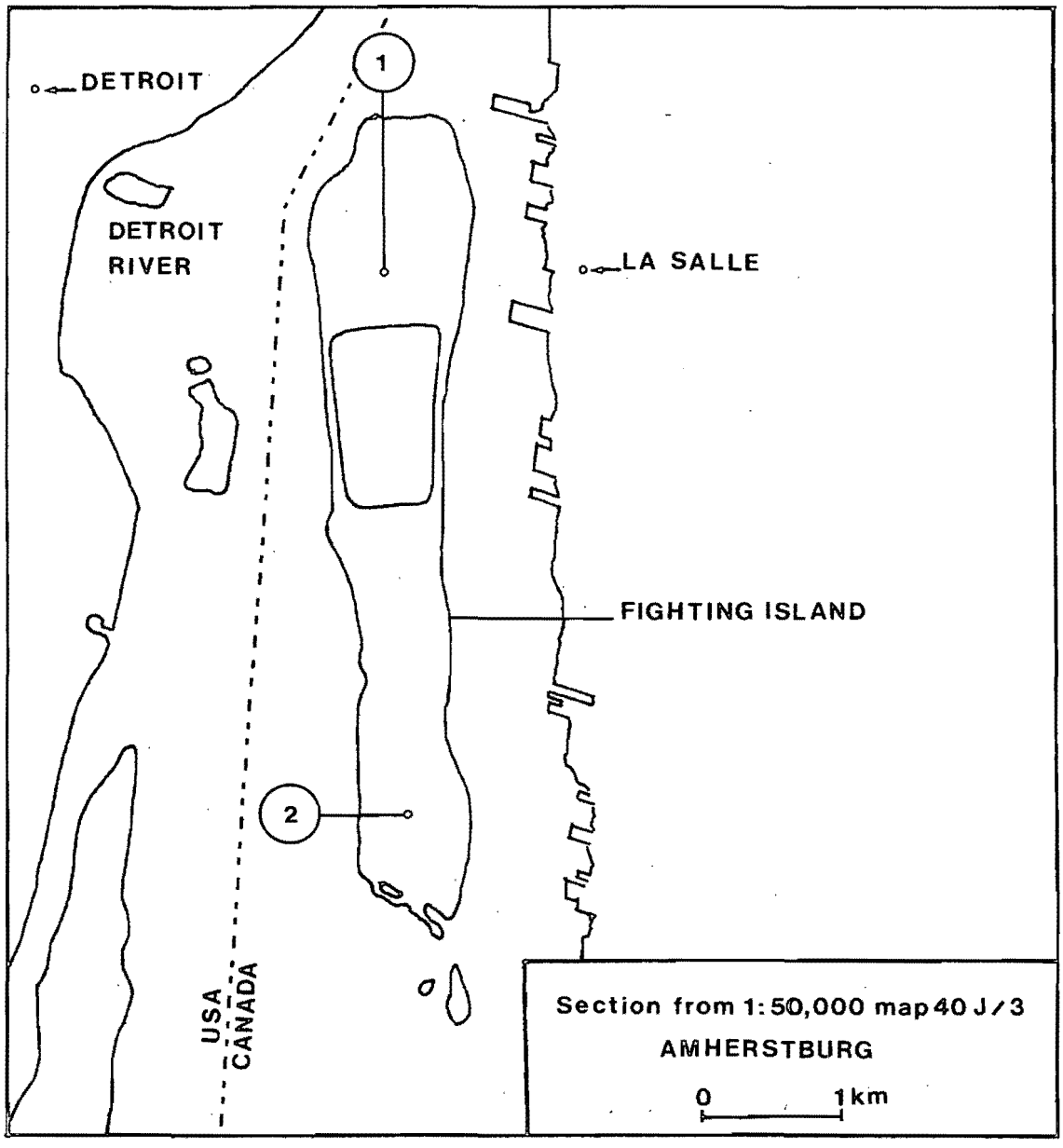
Symbol	Colony present during census years
Solid circle	1989 and 1978
Open circle	1989 only
Asterisk	1978 only

Symbol	No. of nests in 1989
○ ○	1 - 25
○ ○	26 - 250
○ ○	251 - 2500
○ ○	2501 - 25,000
○ ○	> 25,000

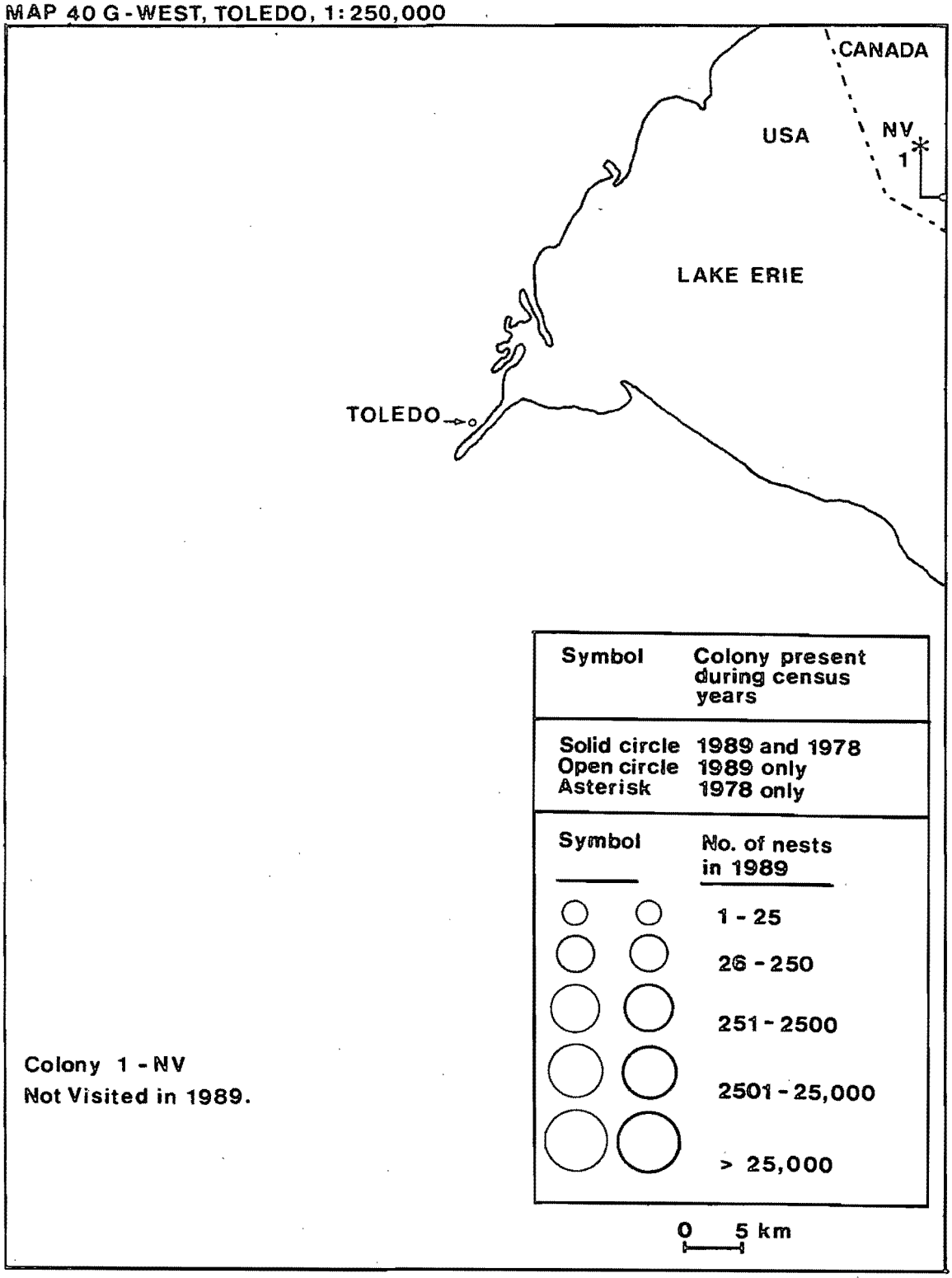
0 5 km



App. 5 (cont'd).

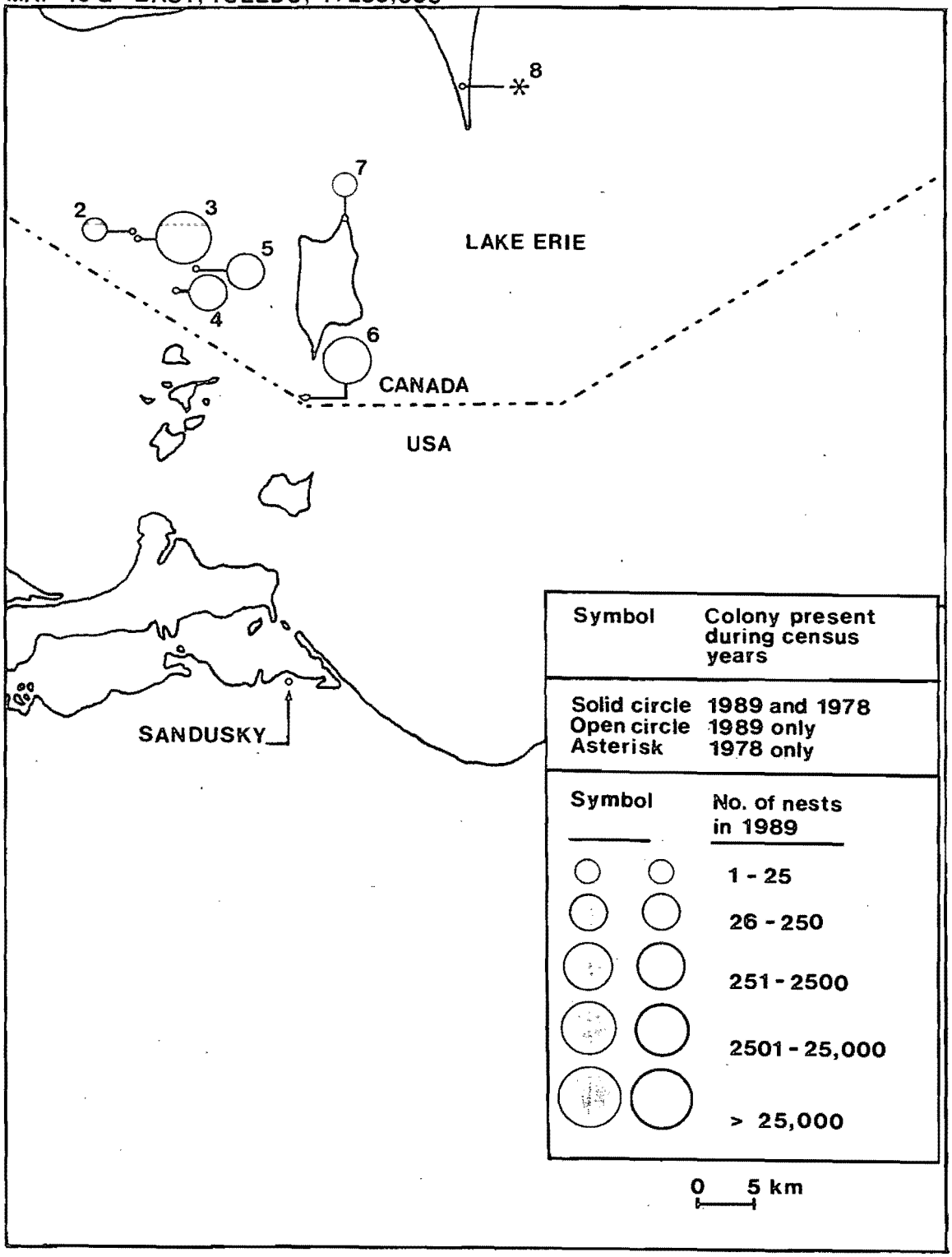

DETROIT
DETROIT RIVER
LA SALLE
FIGHTING ISLAND
1
2
USA
CANADA
Section from 1:50,000 map 40 J/3
AMHERSTBURG
0
1 km

MAP 40 G-WEST, TOLEDO, 1:250,000

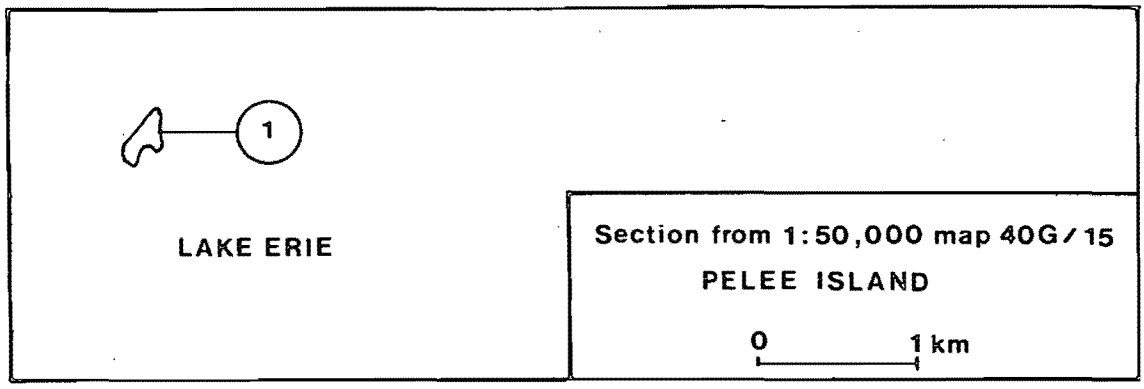


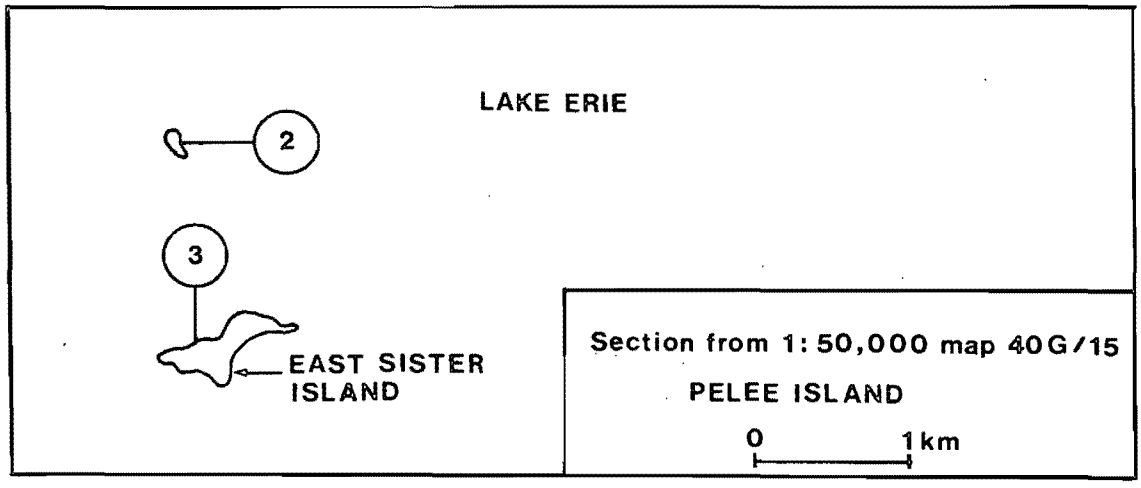
App. 6 (cont'd).

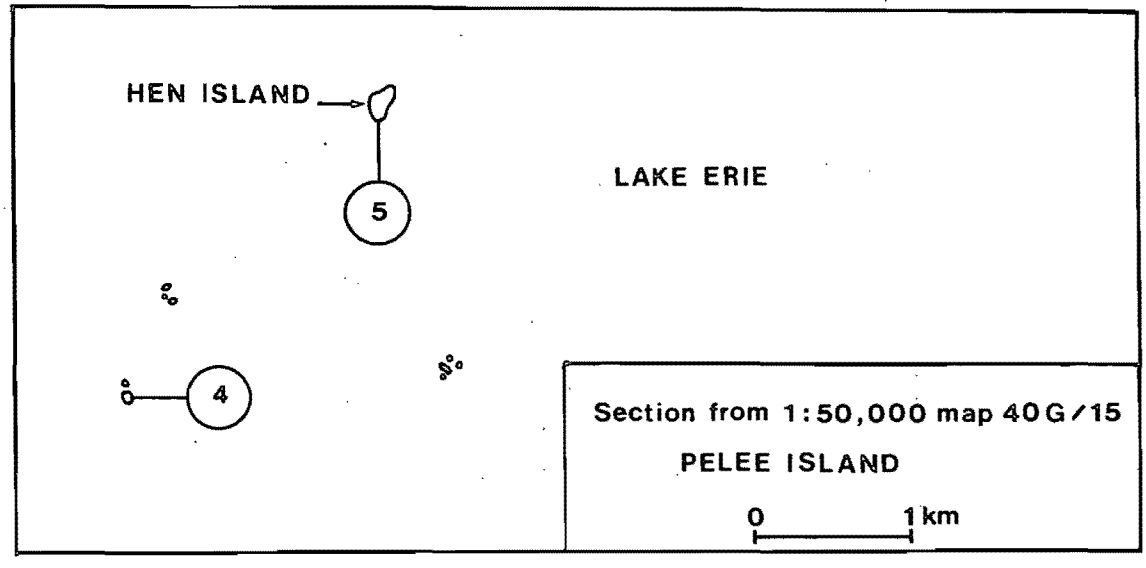
MAP 40 G - EAST, TOLEDO, 1: 250,000



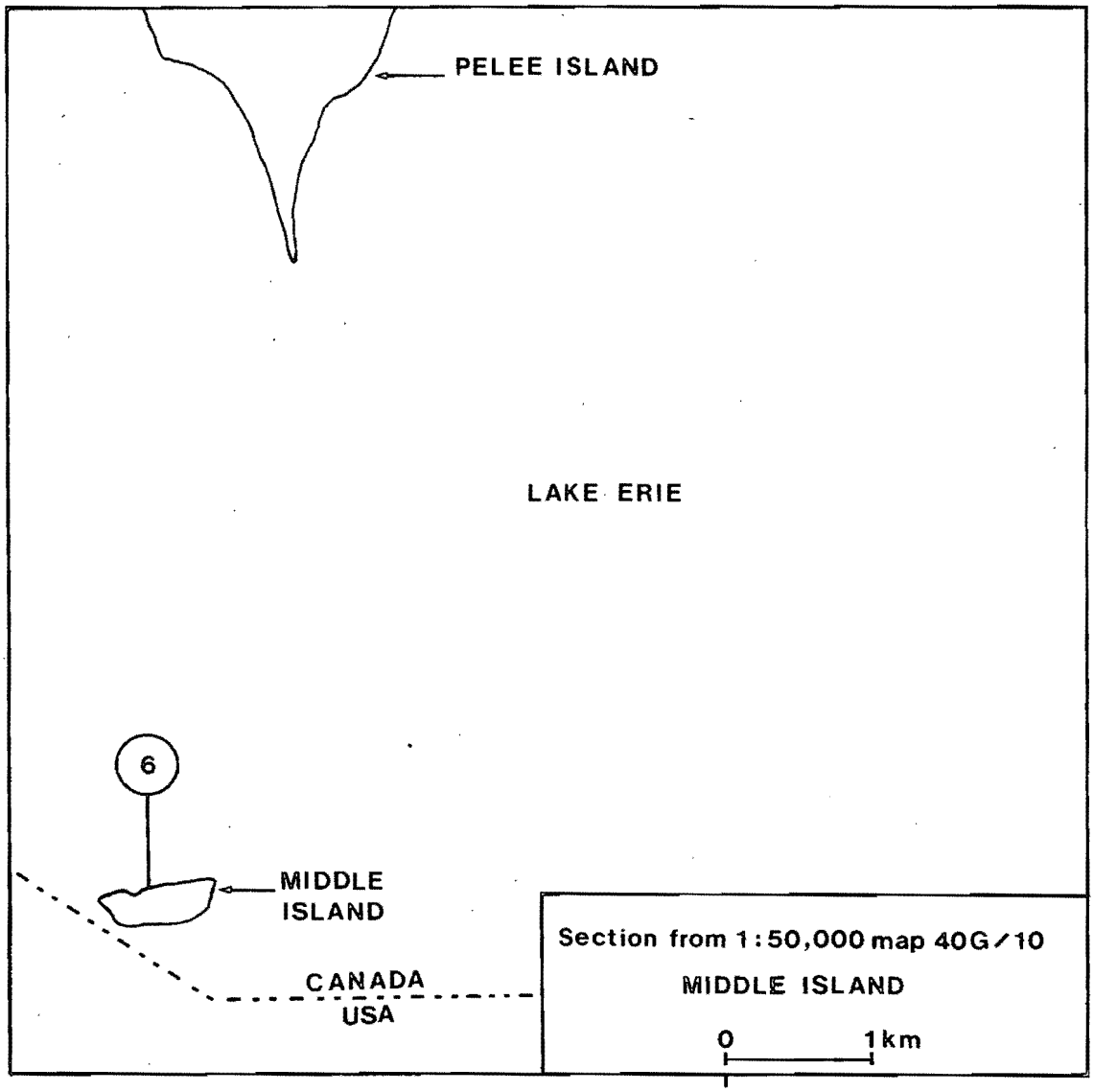
App. 6 (cont'd).

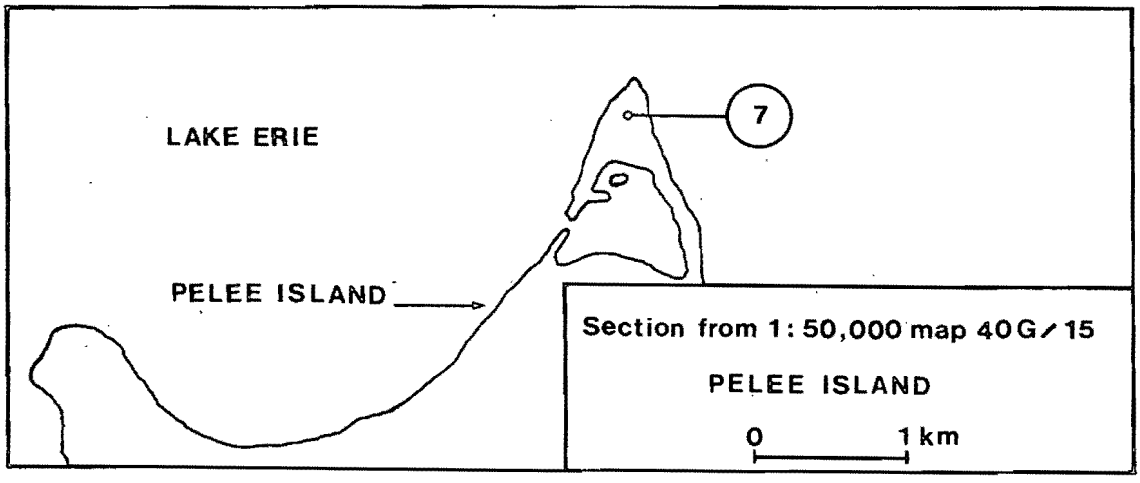

1
LAKE ERIE
Section from 1:50,000 map 40G/15
PELEE ISLAND
0
1 km


LAKE ERIE
2
3
EAST SISTER
ISLAND
Section from 1:50,000 map 40G/15
PELEE ISLAND
0
1 km

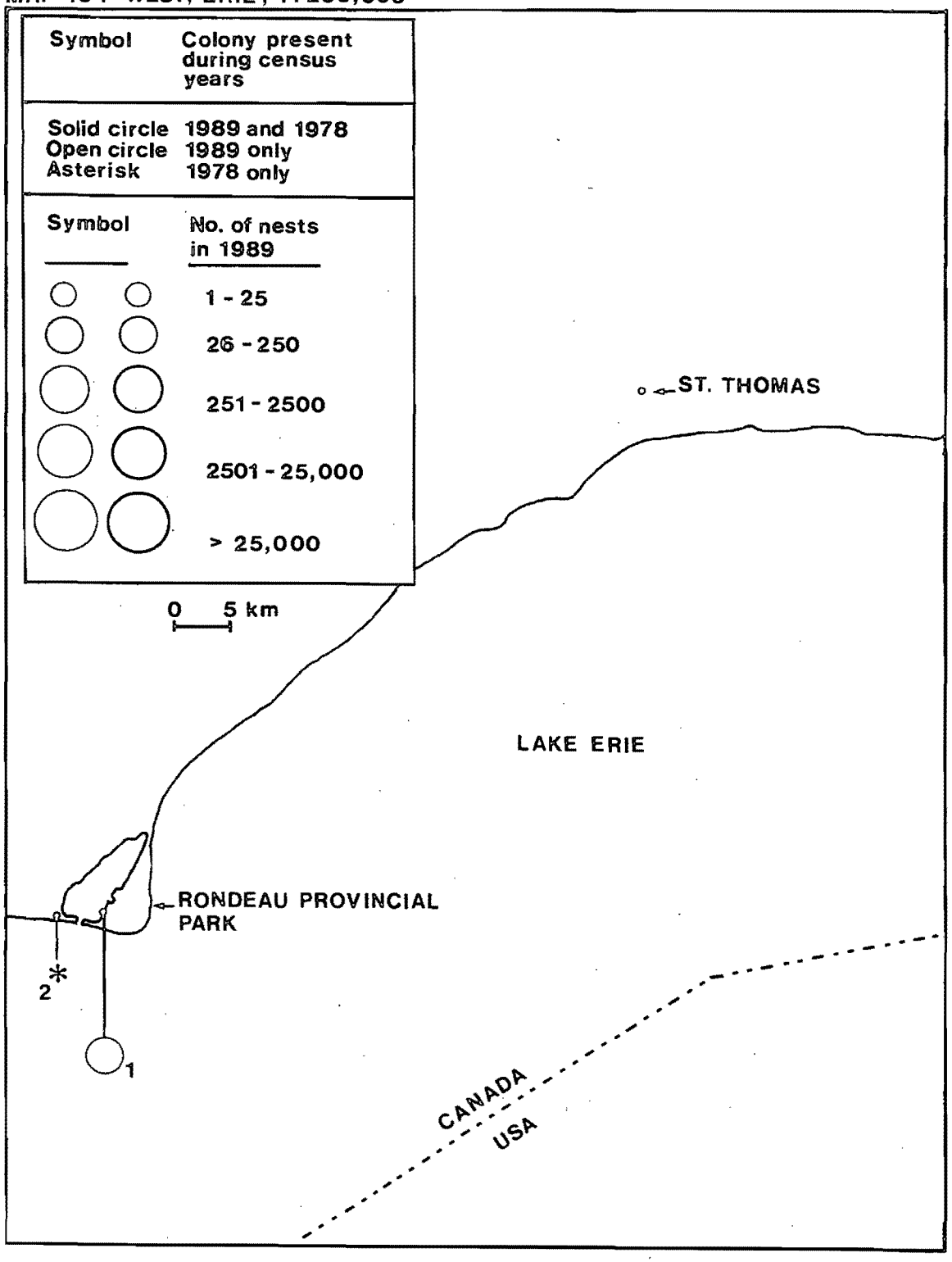

HEN ISLAND
5
LAKE ERIE
4
Section from 1:50,000 map 40G/15
PELEE ISLAND
0
1 km

App. 6 (cont'd).


PELEE ISLAND
LAKE ERIE
6
MIDDLE ISLAND
CANADA
USA
Section from 1:50,000 map 40G/10
MIDDLE ISLAND
0
1 km

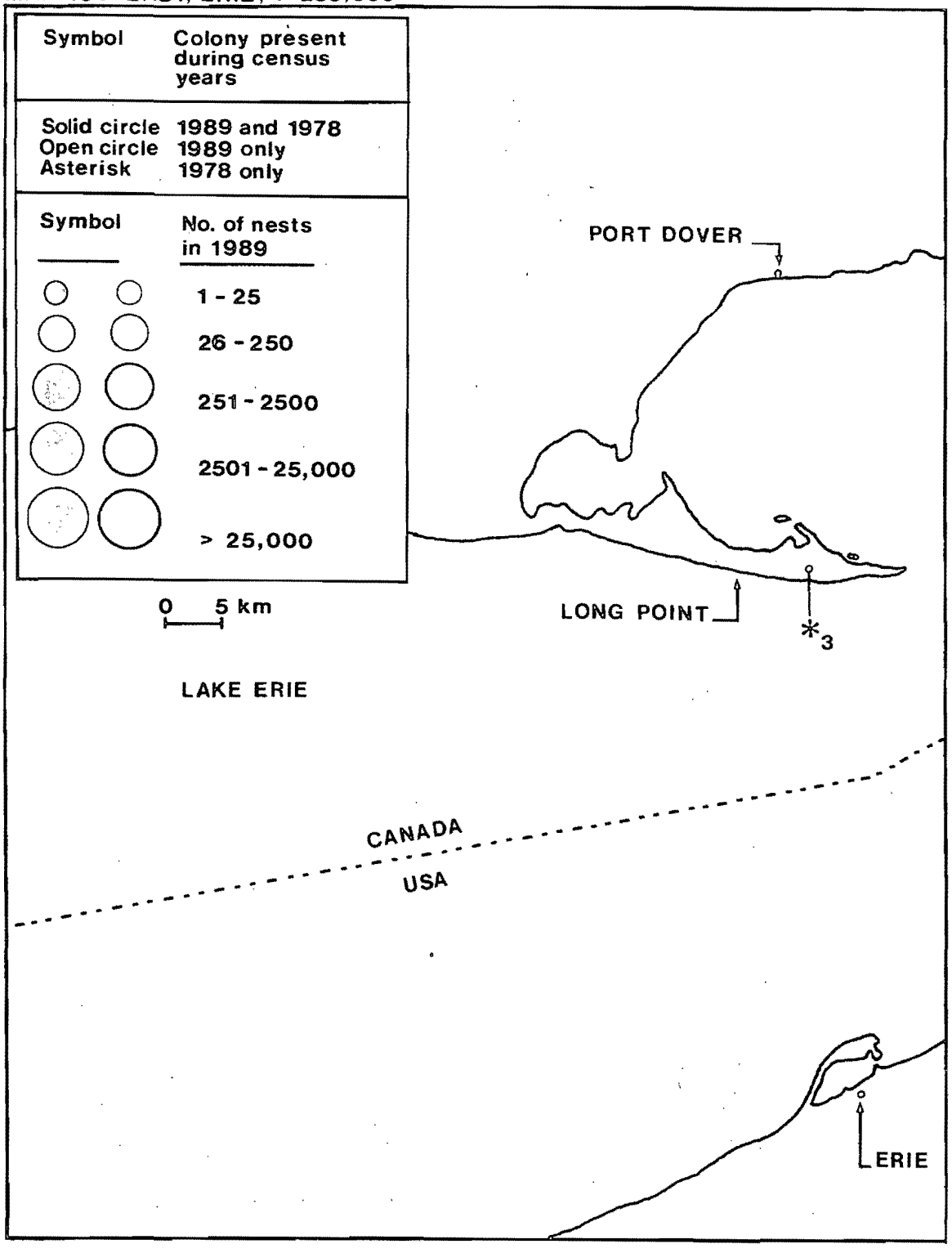

LAKE ERIE
7
PELEE ISLAND
Section from 1:50,000 map 40G/15
PELEE ISLAND
0
1 km

MAP 40 I - WEST, ERIE , 1 : 250,000

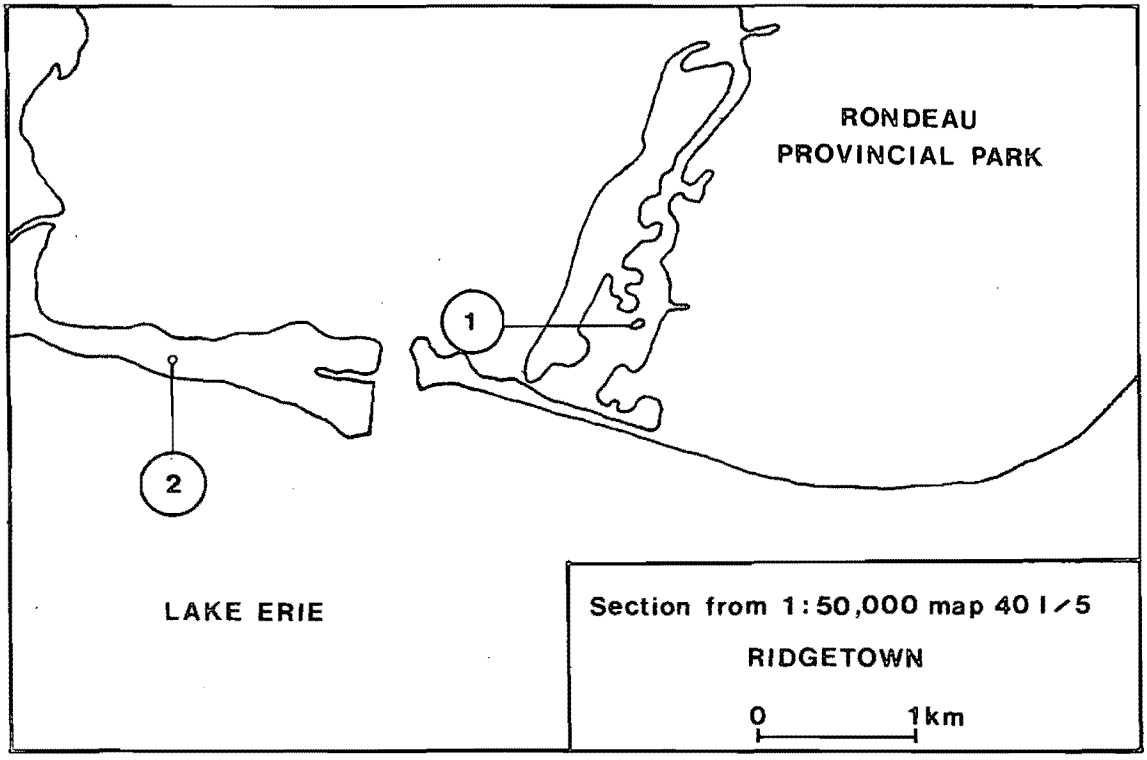


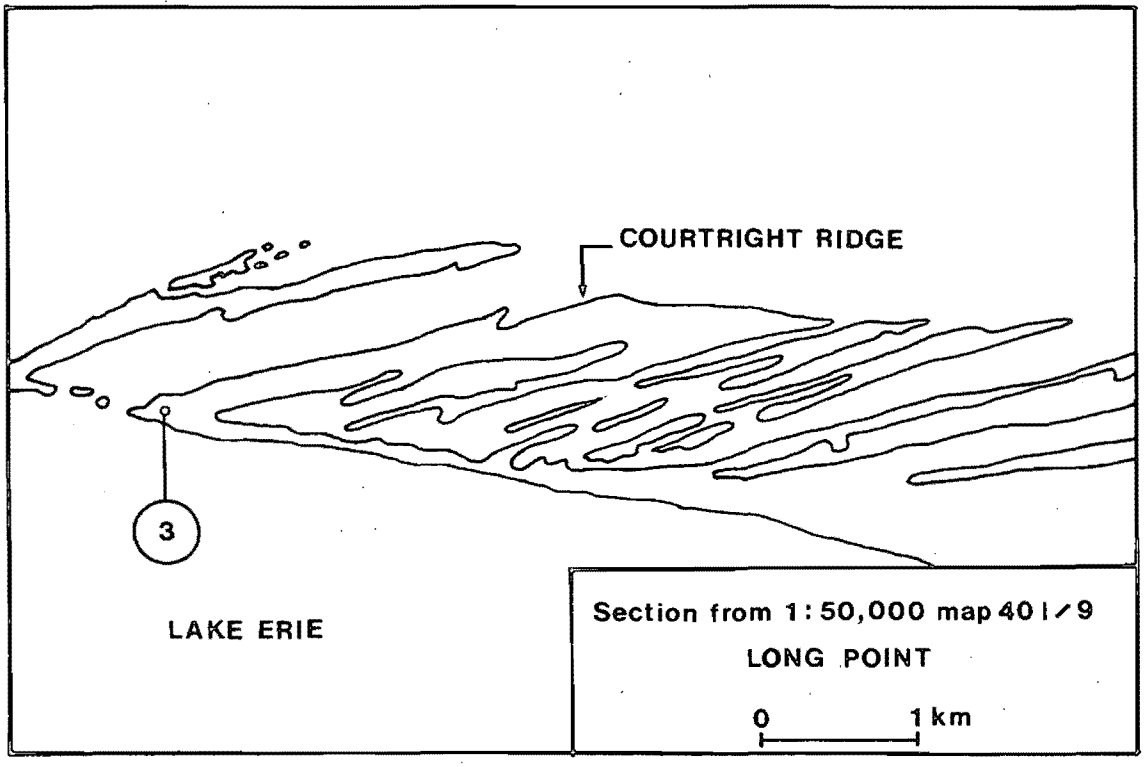
MAP 40 I - EAST, ERIE, 1:250,000

App. 7 (cont'd).



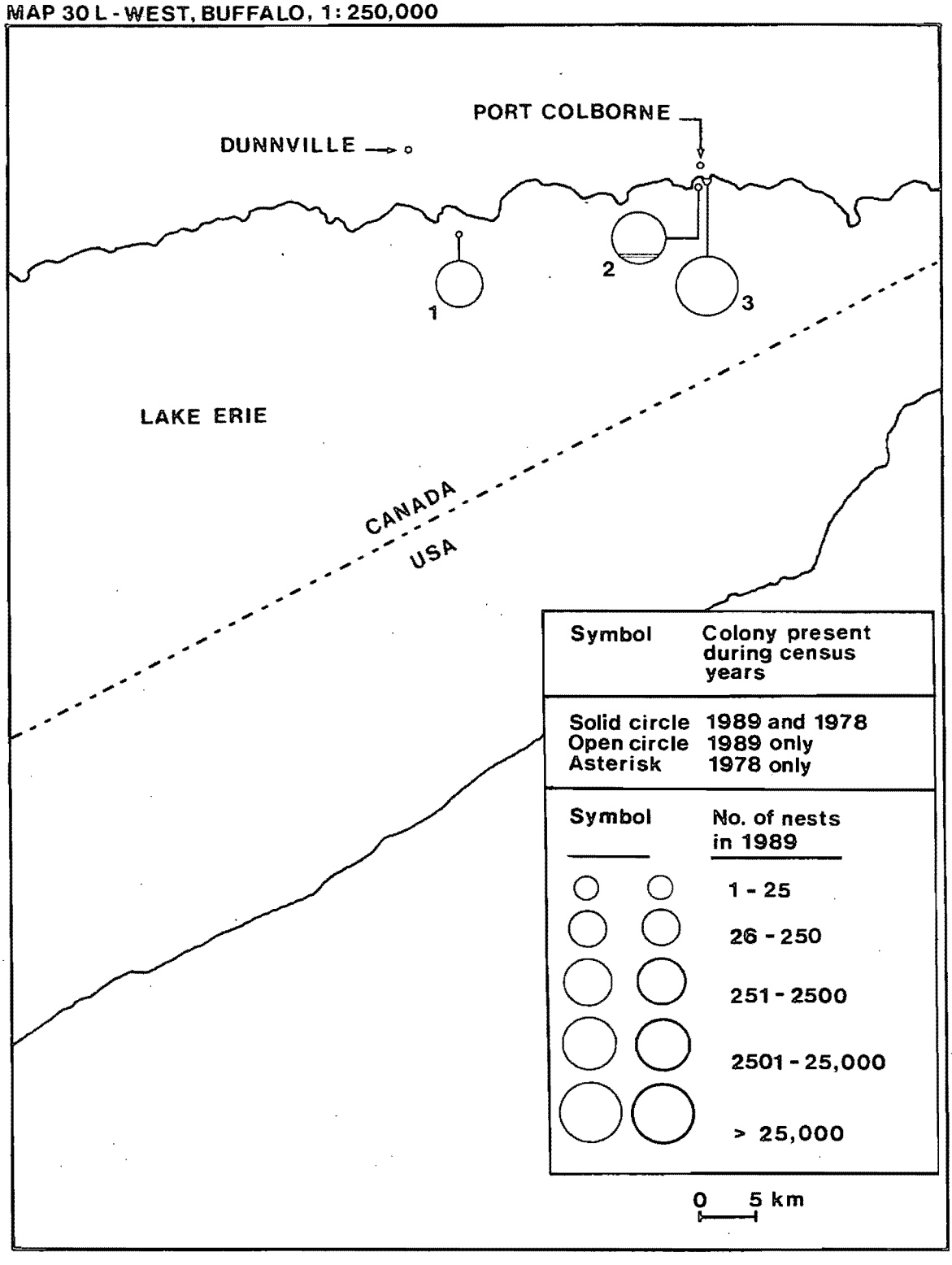
App. 7 (cont'd).


RONDEAU
PROVINCIAL PARK
1
2
LAKE ERIE
Section from 1:50,000 map 40 I/5
RIDGETOWN
0
1km

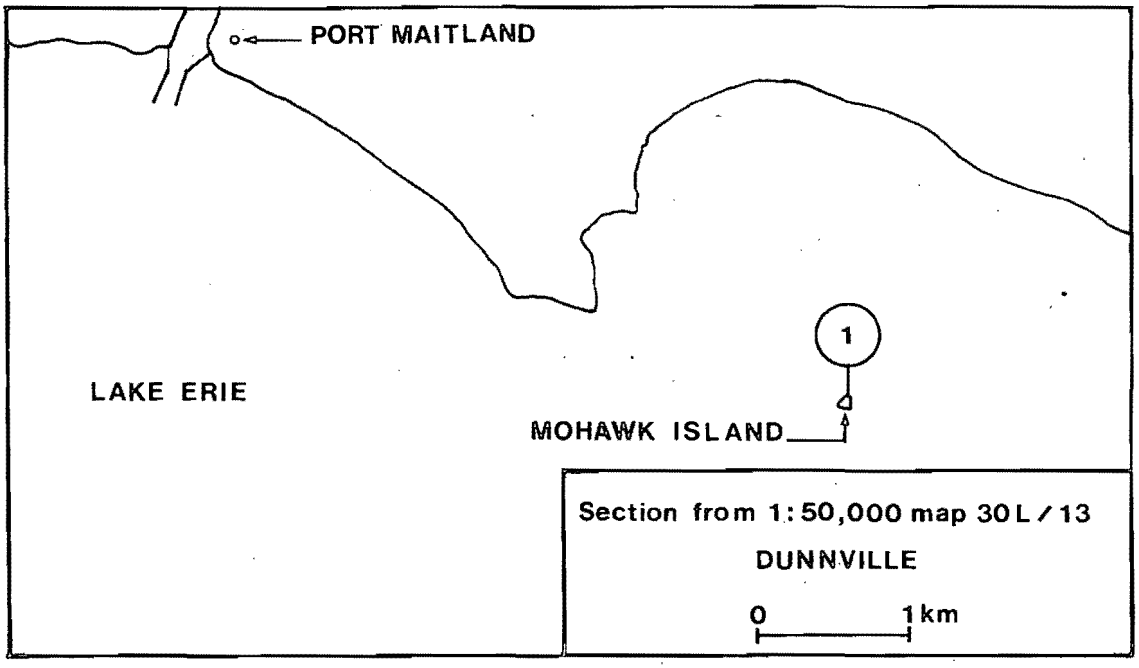

COURTRIGHT RIDGE
3
LAKE ERIE
Section from 1:50,000 map 40 I/9
LONG POINT
0
1 km

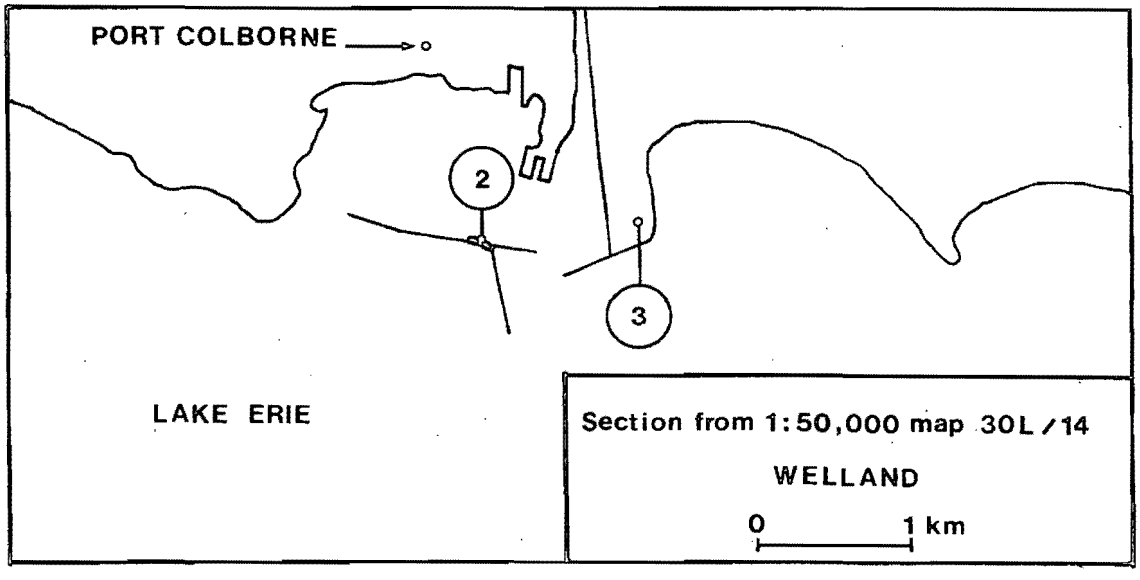
Appendix 8 .

MAP 30 L - WEST, BUFFALO, 1: 250,000



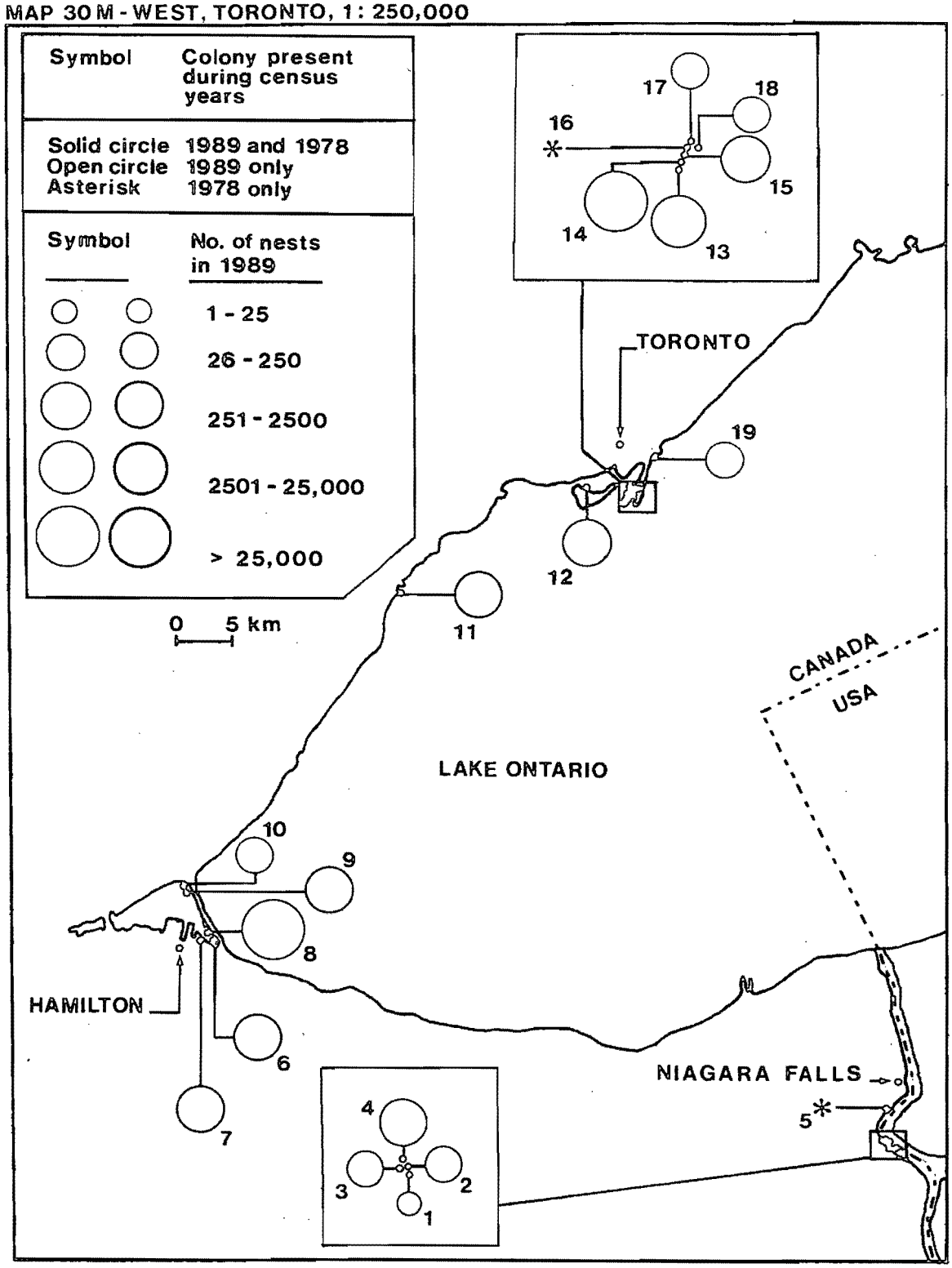
App. 8 (cont'd).


PORT MAITLAND
LAKE ERIE
1
MOHAWK ISLAND
Section from 1:50,000 map 30L/13
DUNNVILLE
0
1 km


PORT COLBORNE
2
3
LAKE ERIE
Section from 1:50,000 map 30L/14
WELLAND
0
1 km

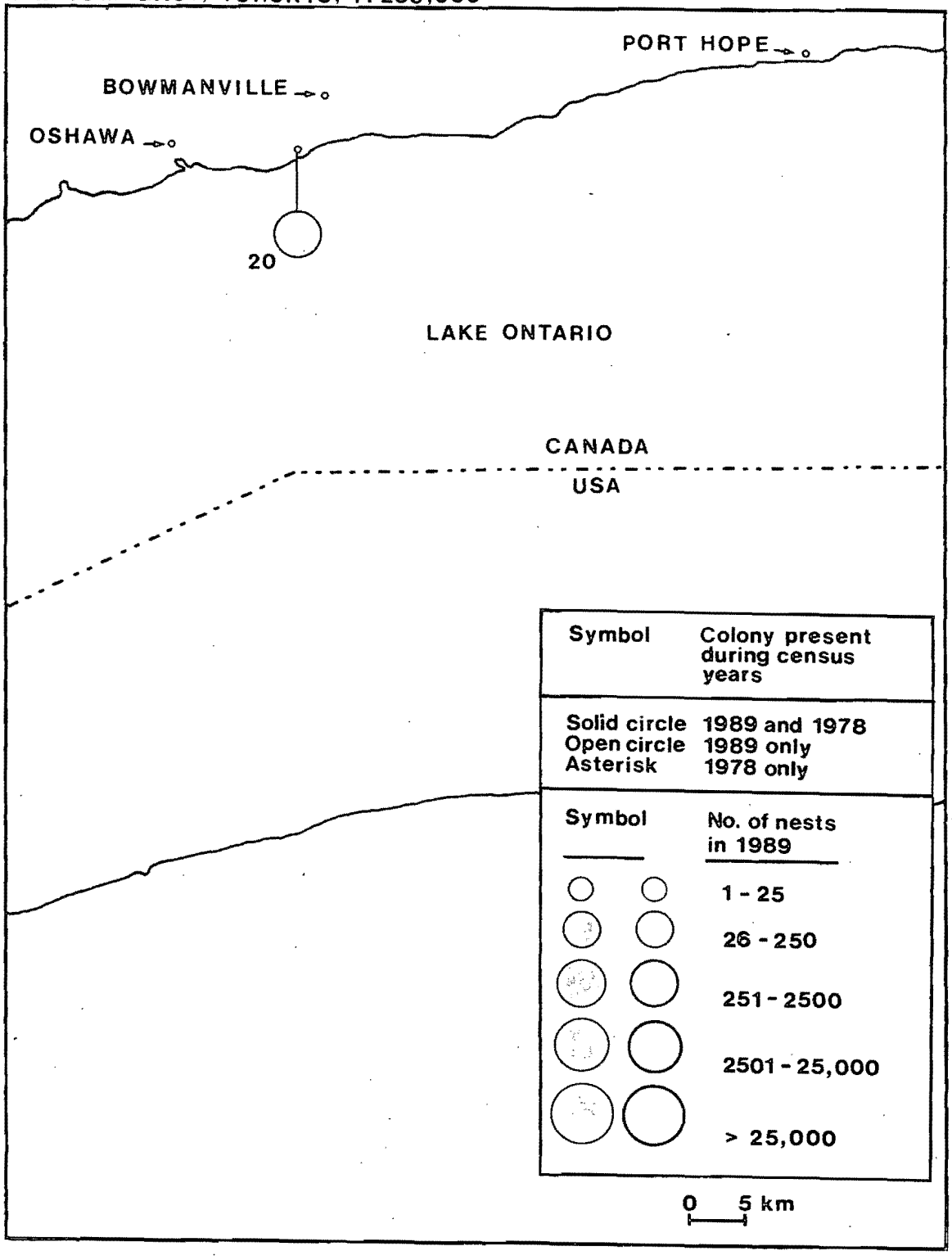
Appendix 9 .

MAP 30 M - WEST, TORONTO, 1 : 250,000

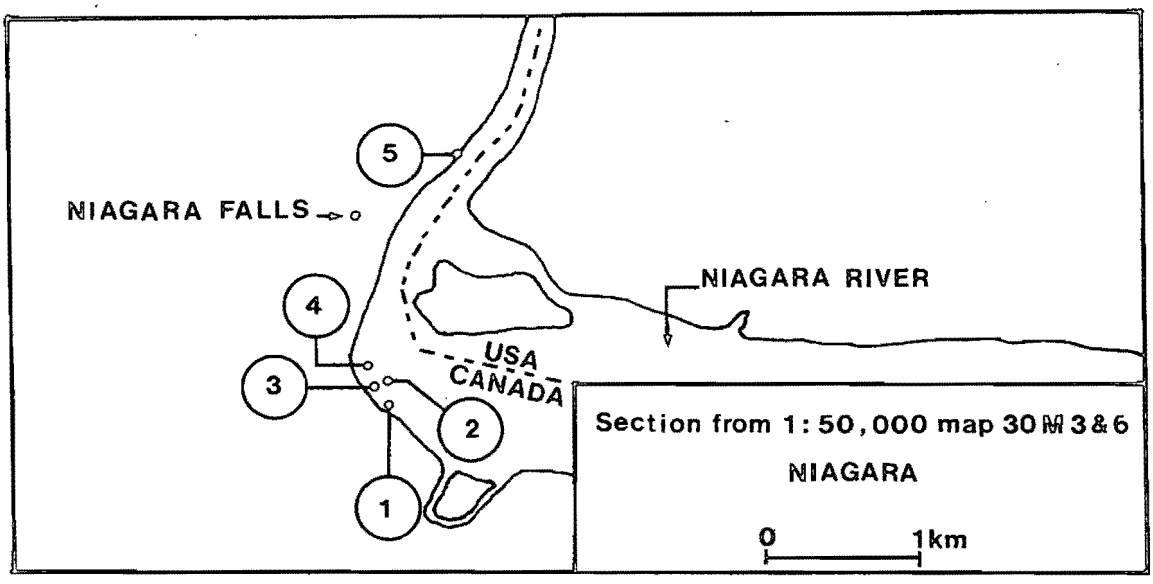


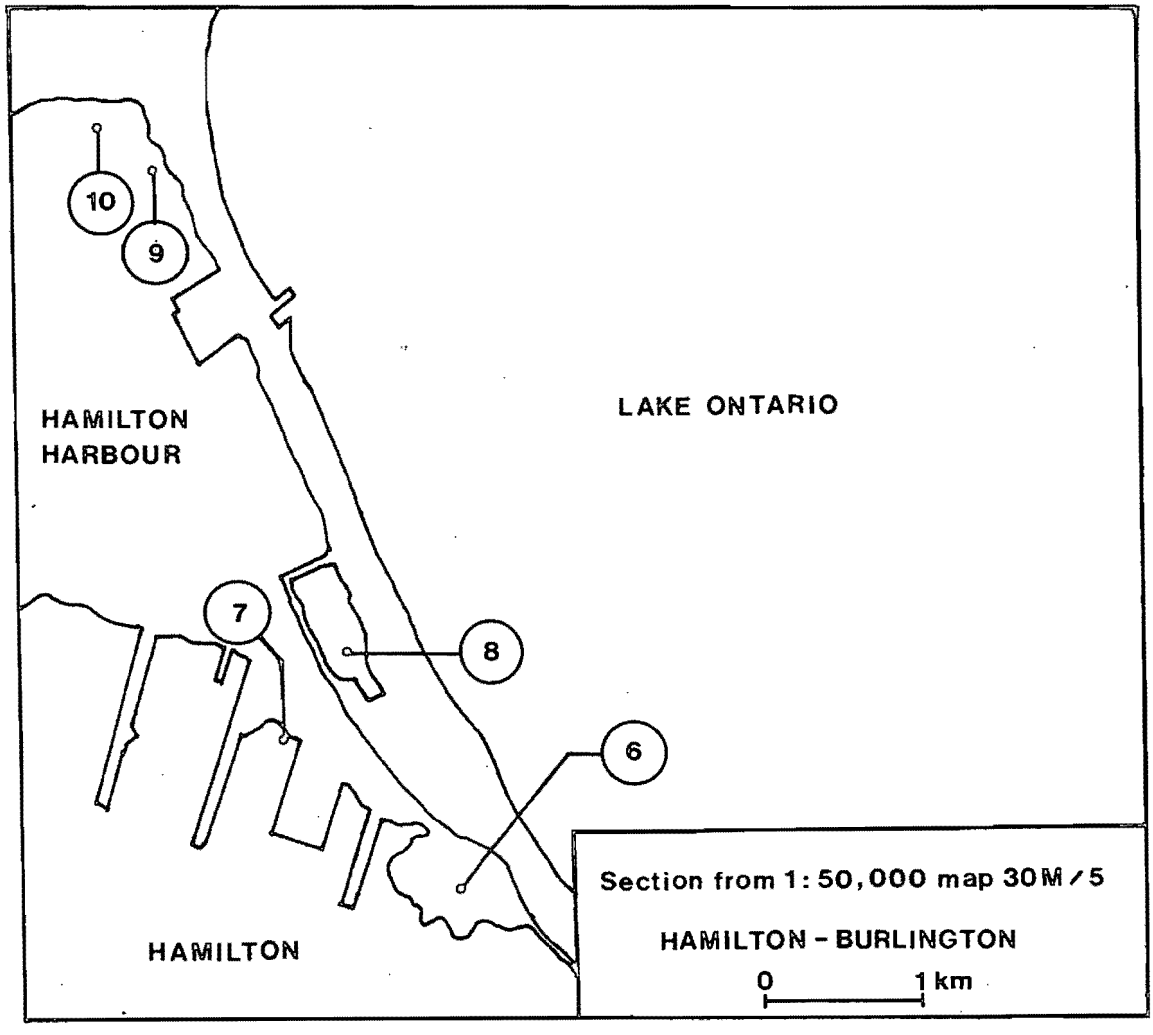
App. 9 (cont'd).

MAP 30 M - EAST, TORONTO, 1: 250,000

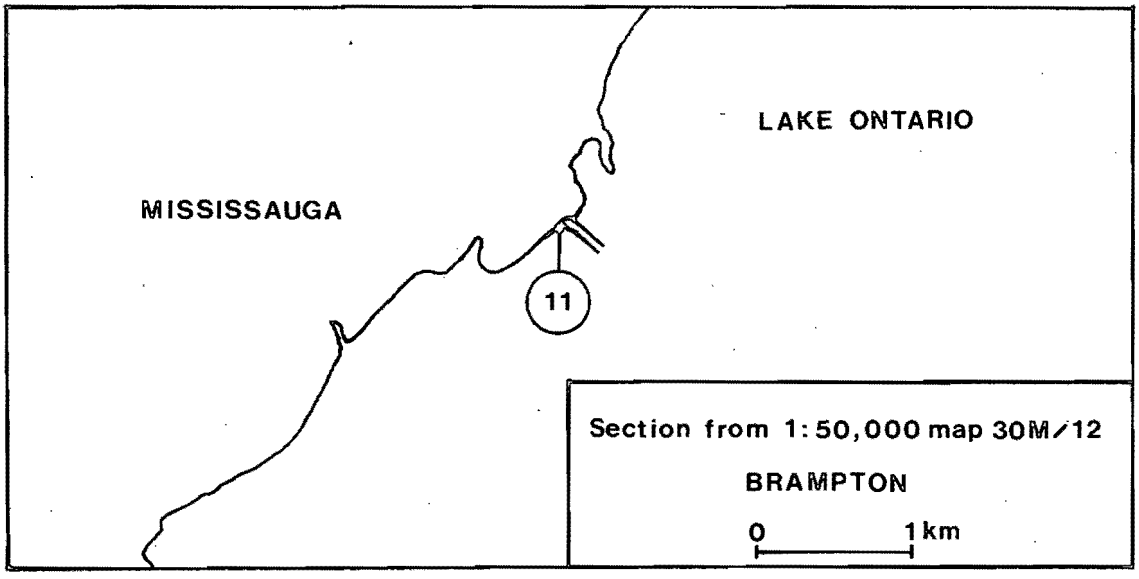


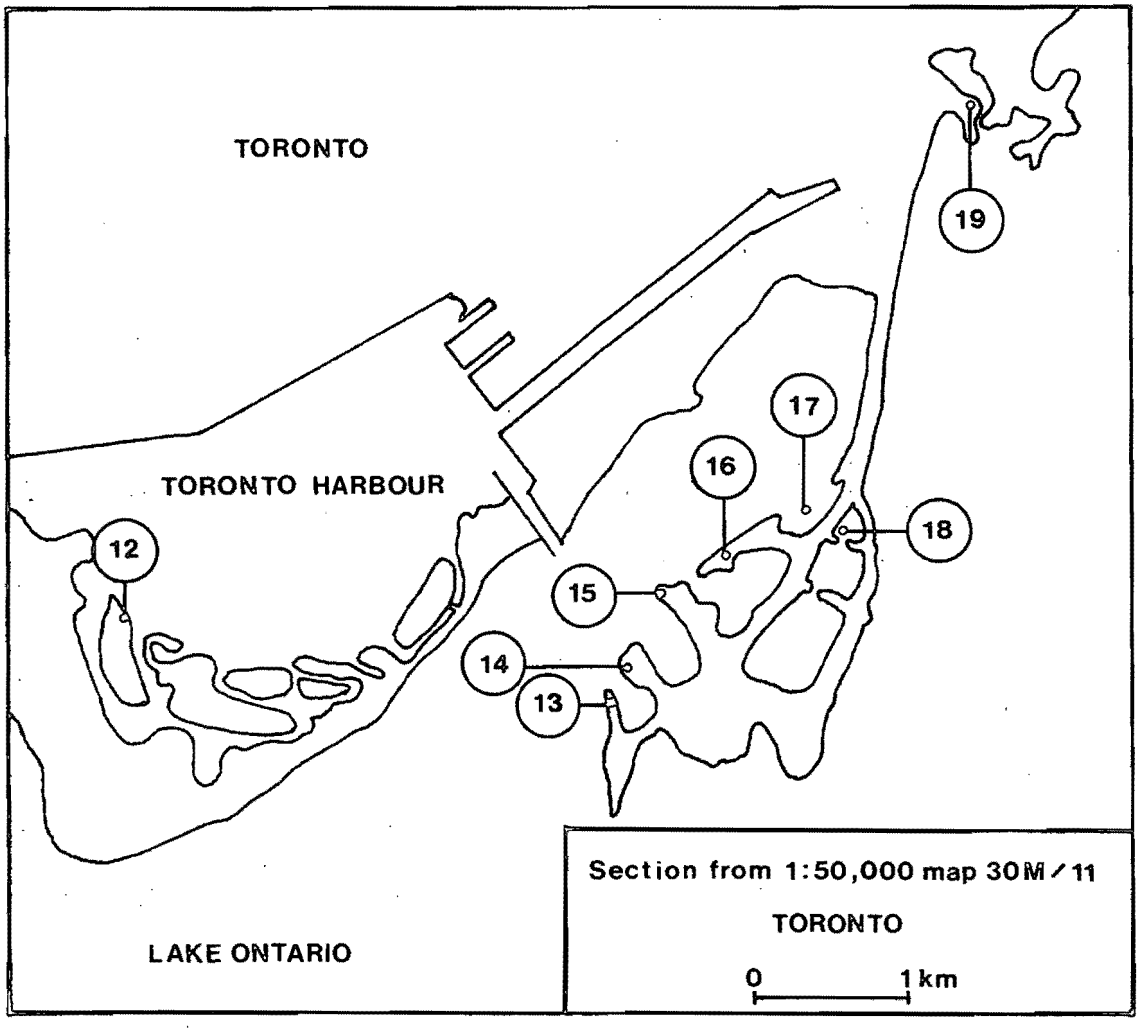
App. 9 (cont'd).


5
NIAGARA FALLS
NIAGARA RIVER
4
USA
CANADA
3
2
1
Section from 1:50,000 map 30M 3&6
NIAGARA
0
1km

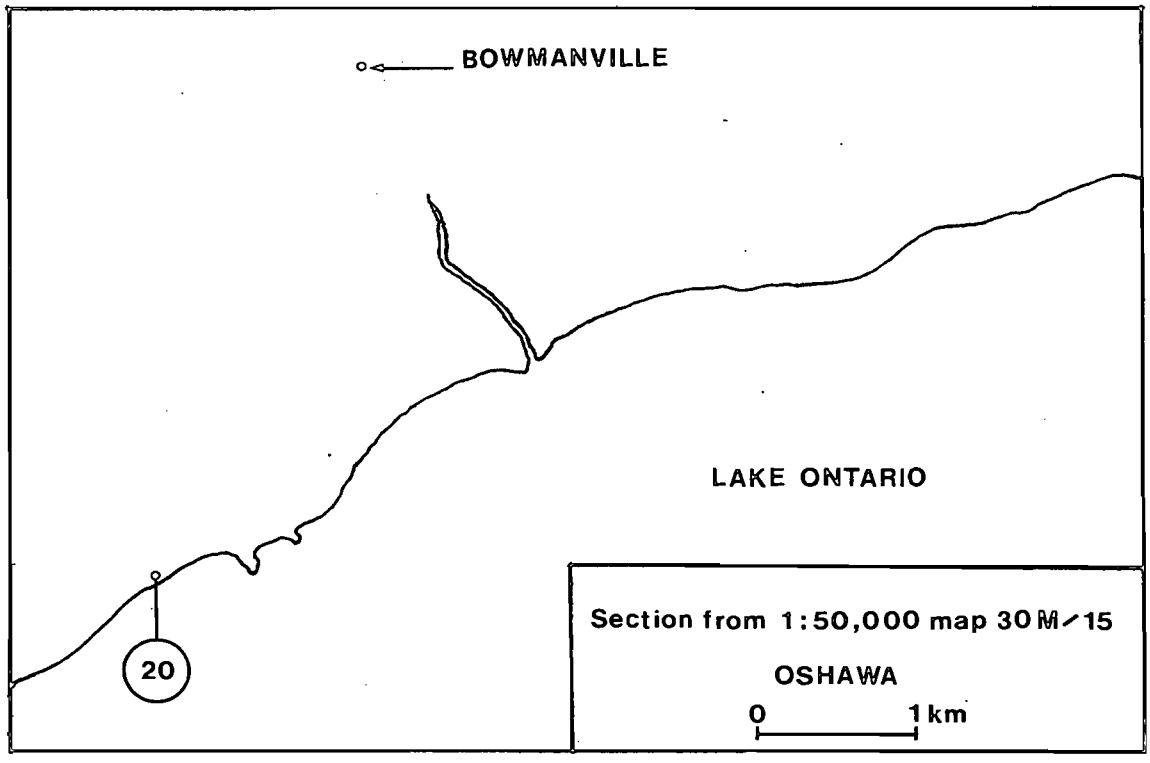

10
9
HAMILTON
HARBOUR
LAKE ONTARIO
7
8
6
HAMILTON
Section from 1:50,000 map 30M/5
HAMILTON - BURLINGTON
0
1 km

App. 9 (cont'd).


LAKE ONTARIO
MISSISSAUGA
11
Section from 1:50,000 map 30M/12
BRAMPTON
0
1 km

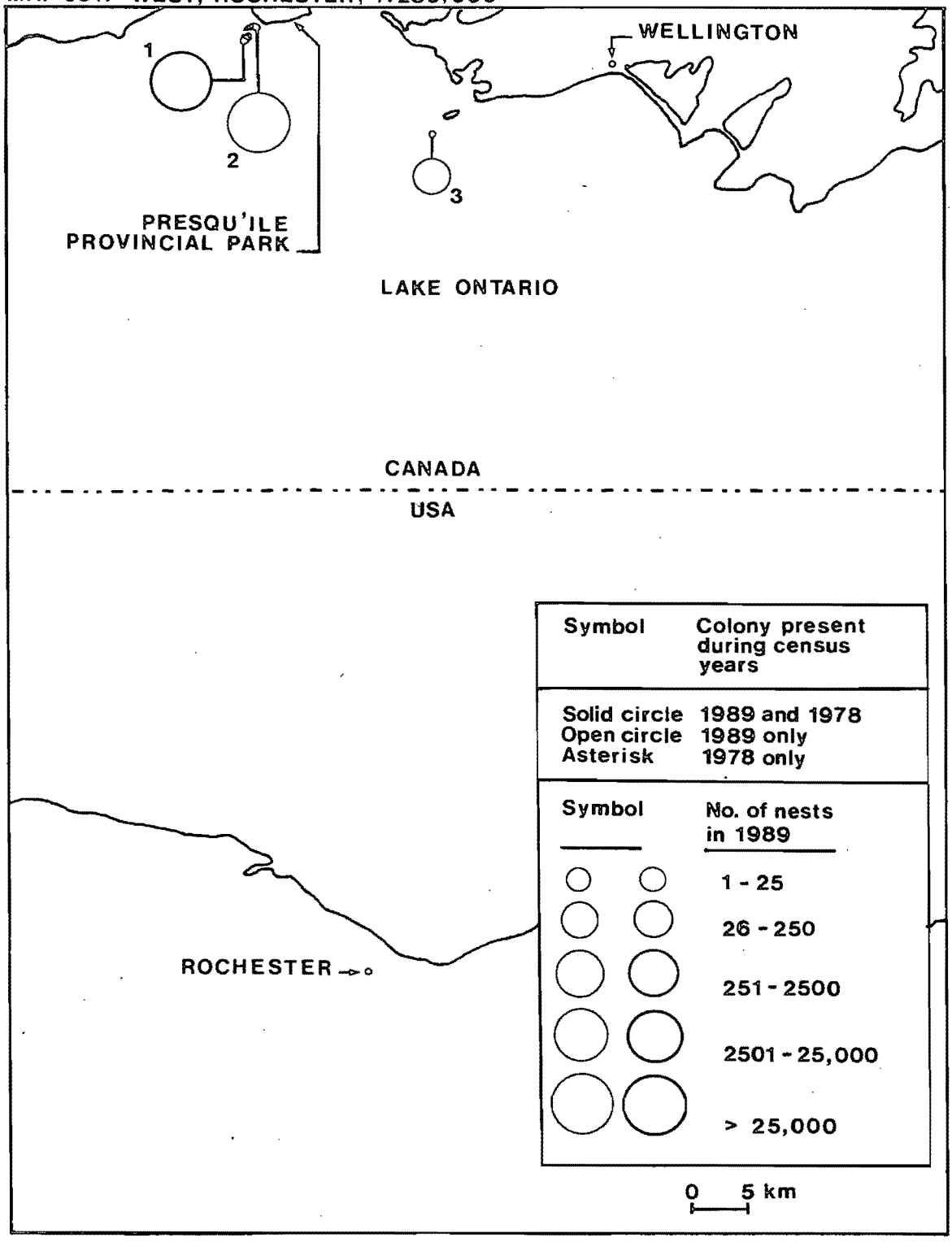

TORONTO
19
17
16
TORONTO HARBOUR
18
12
15
14
13
LAKE ONTARIO
Section from 1:50,000 map 30M/11
TORONTO
0
1 km

App. 9 (cont'd).


BOWMANVILLE
LAKE ONTARIO
20
Section from 1:50,000 map 30M/15
OSHAWA
0
1 km

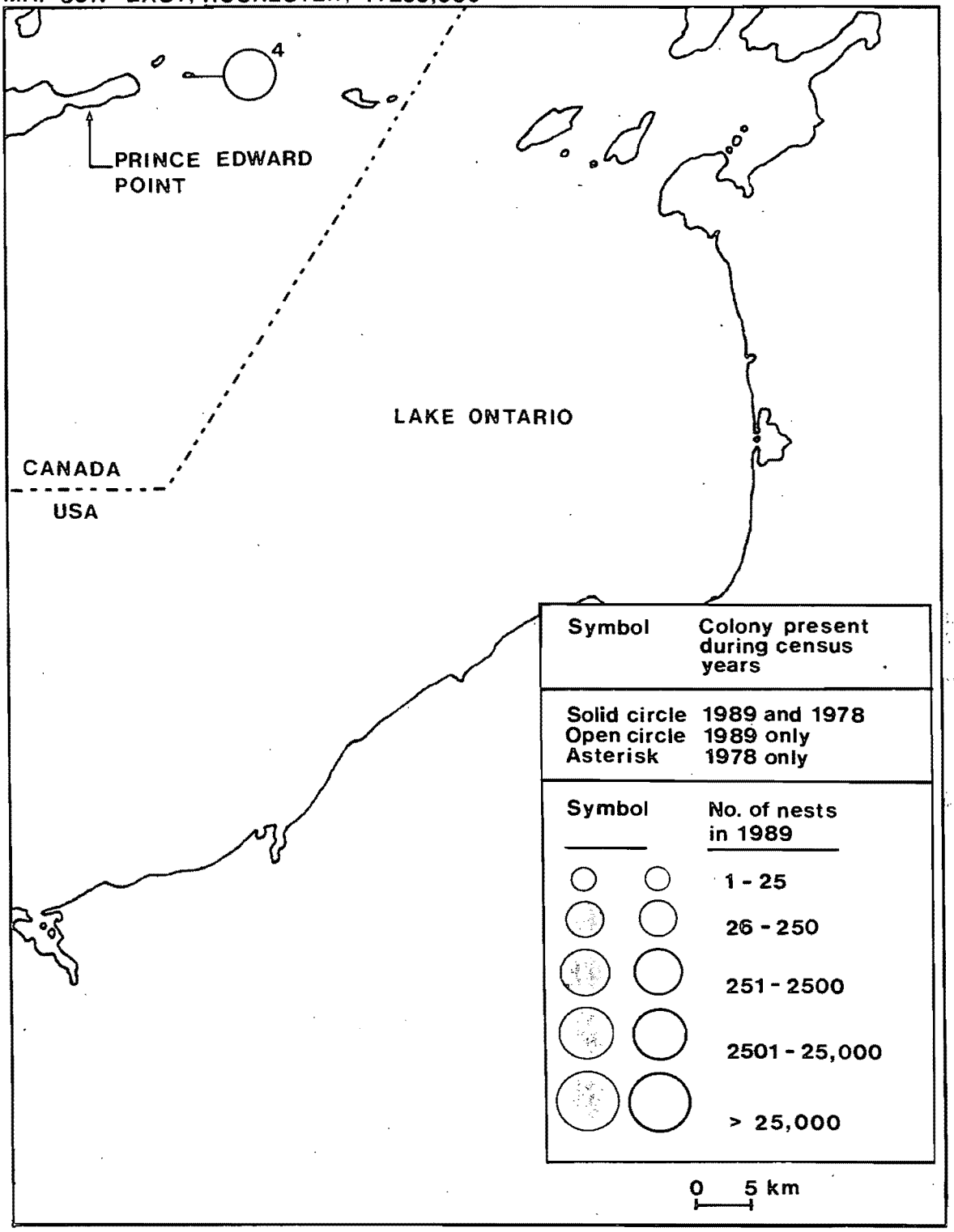
Appendix 10 .

MAP 30N - WEST, ROCHESTER, 1:250,000

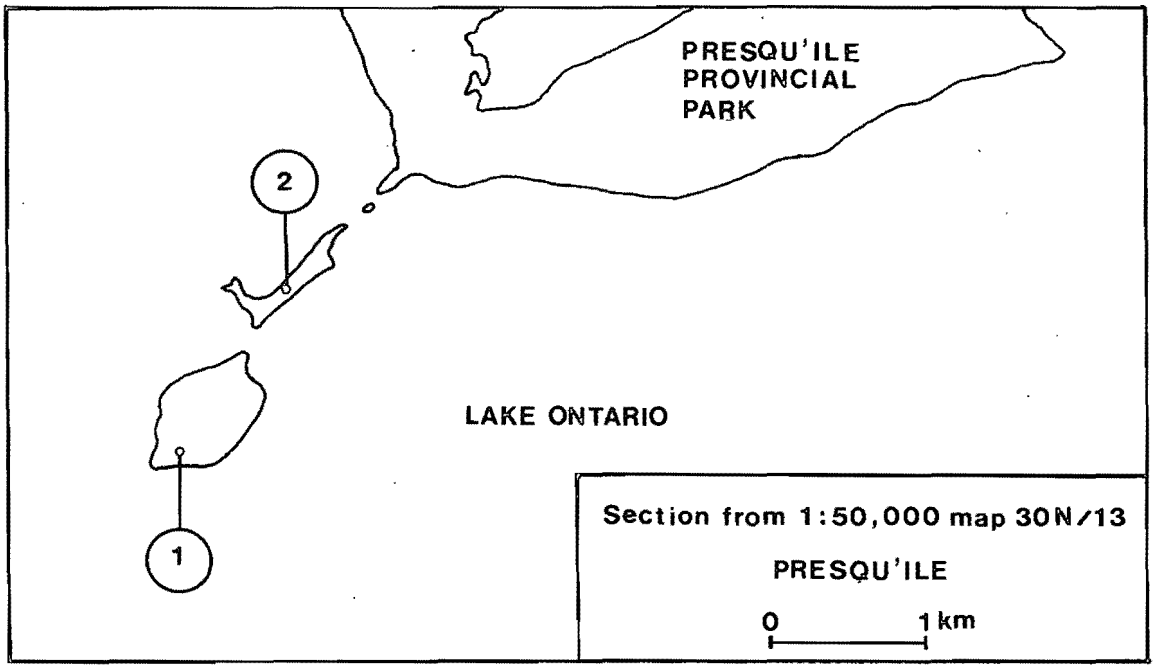


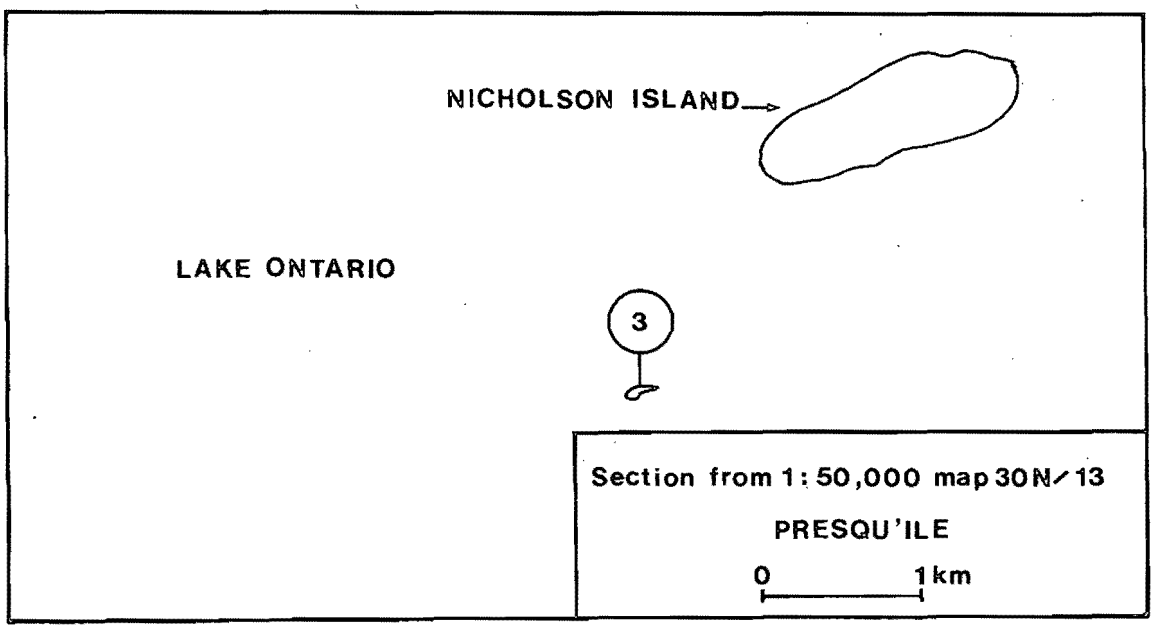
App. 10 (cont'd).

MAP 30N - EAST, ROCHESTER, 1:250,000

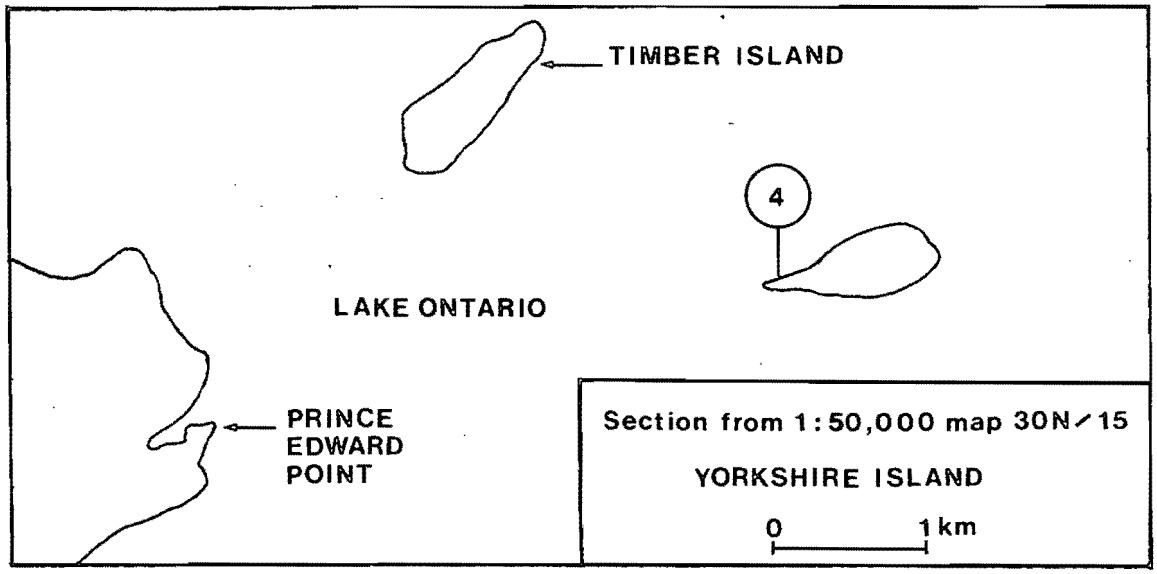


App. 10 (cont'd).


PRESQU'ILE
PROVINCIAL
PARK
2
LAKE ONTARIO
1
Section from 1:50,000 map 30N/13
PRESQU'ILE
0
1 km

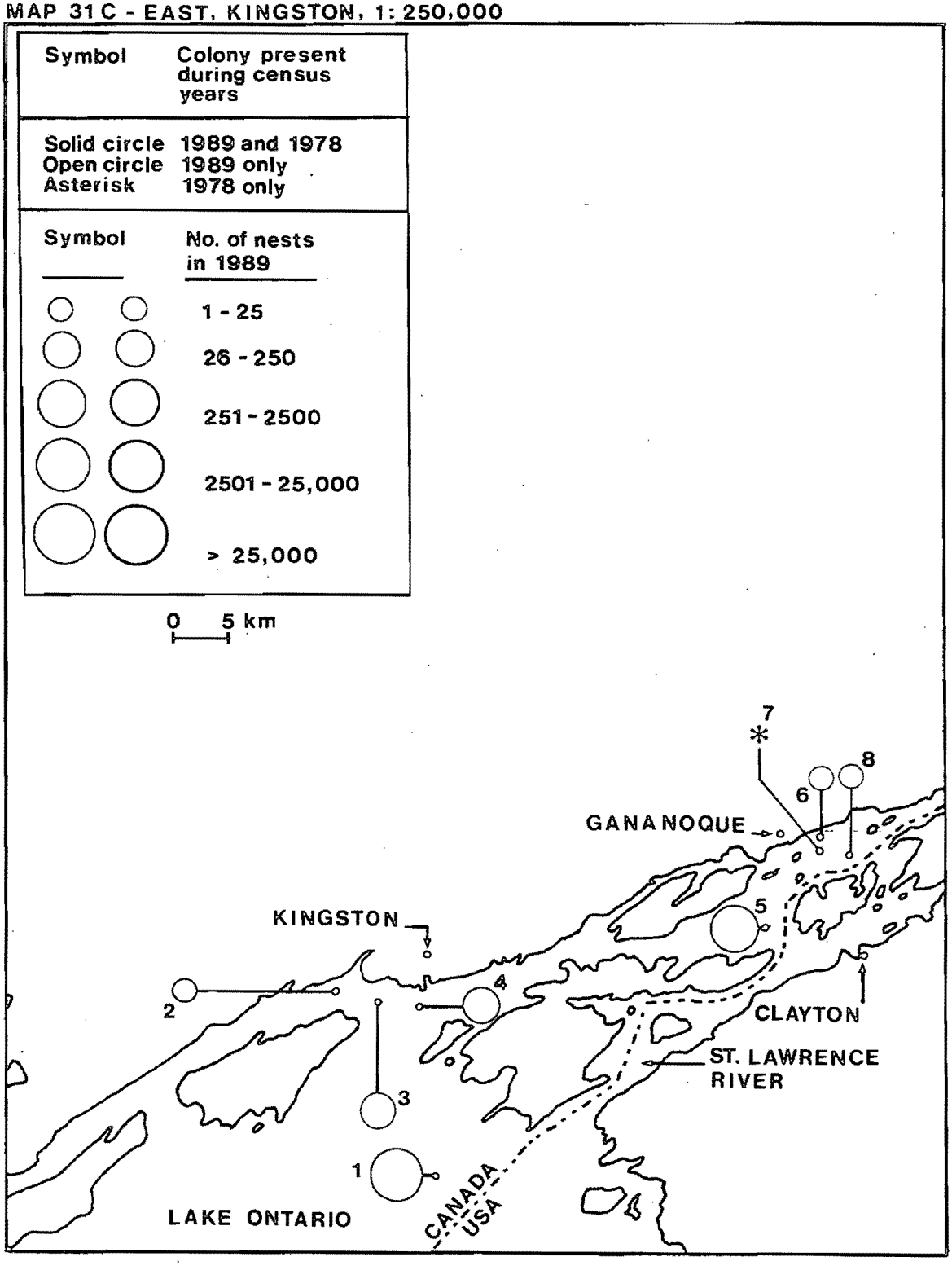

NICHOLSON ISLAND
LAKE ONTARIO
3
Section from 1:50,000 map 30N/13
PRESQU'ILE
0
1 km

App. 10 (cont'd).

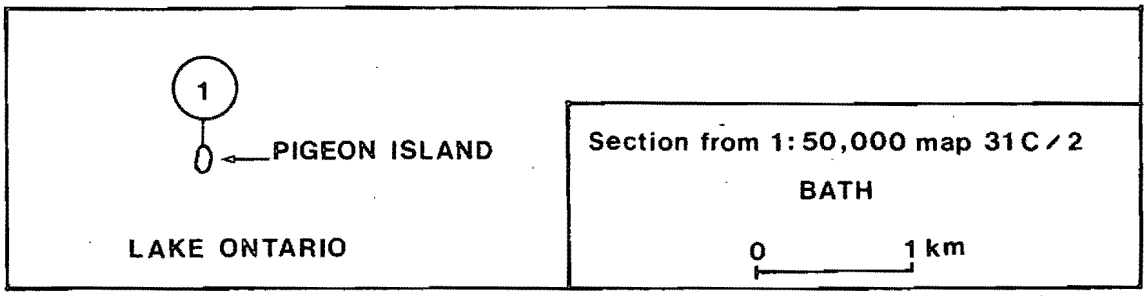

TIMBER ISLAND
4
LAKE ONTARIO
PRINCE
EDWARD
POINT
Section from 1:50,000 map 30N/15
YORKSHIRE ISLAND
0
1 km

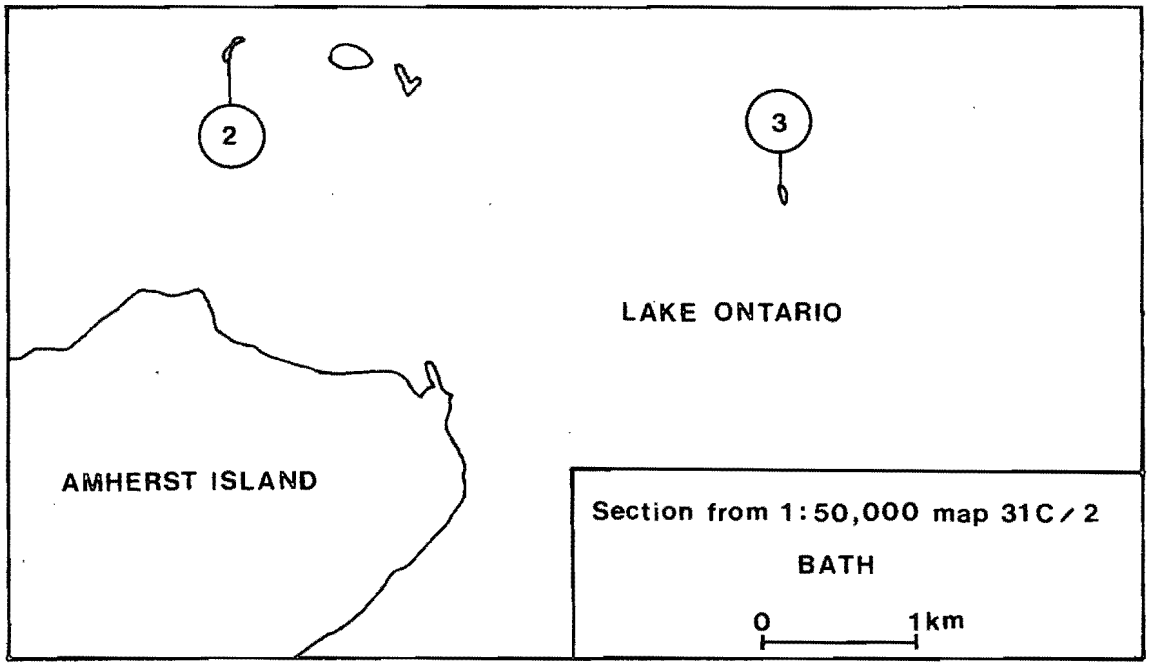
Appendix 11.

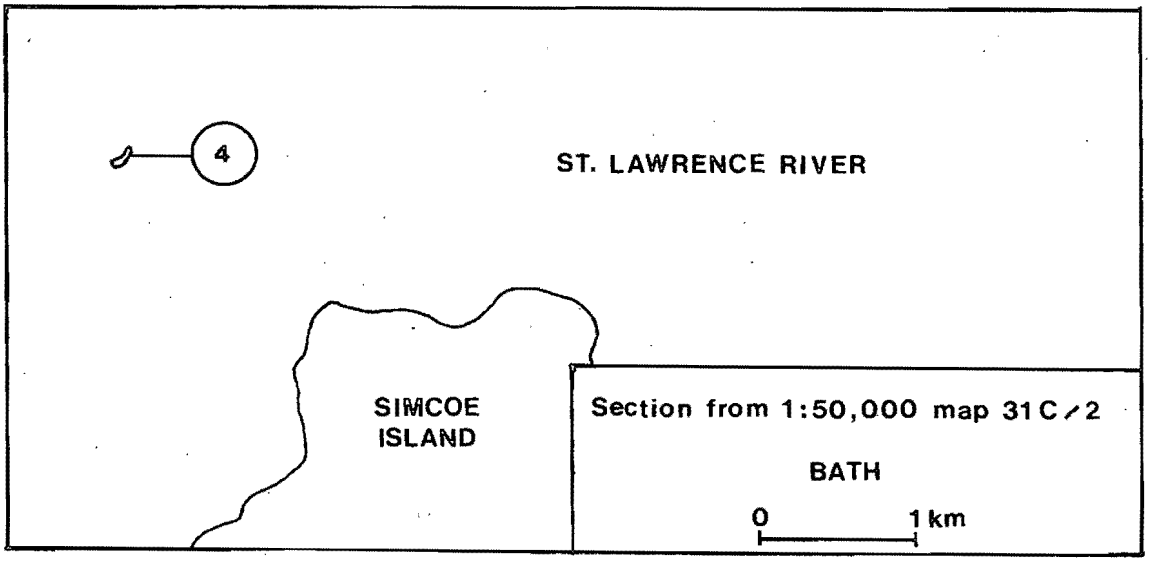
MAP 31C - EAST, KINGSTON, 1:250,000



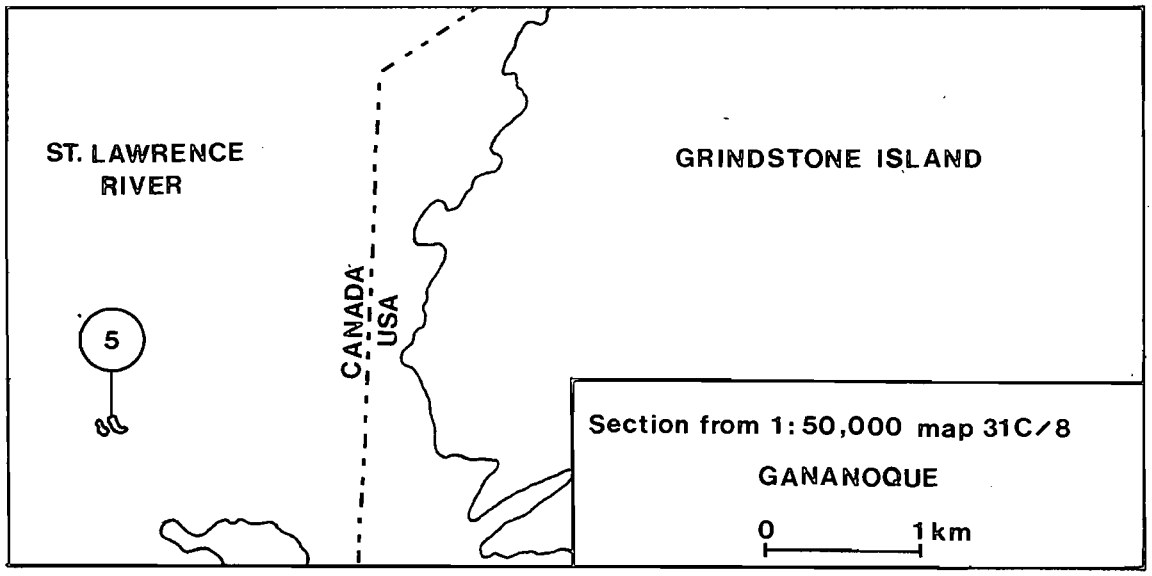
App. 11 (cont'd).

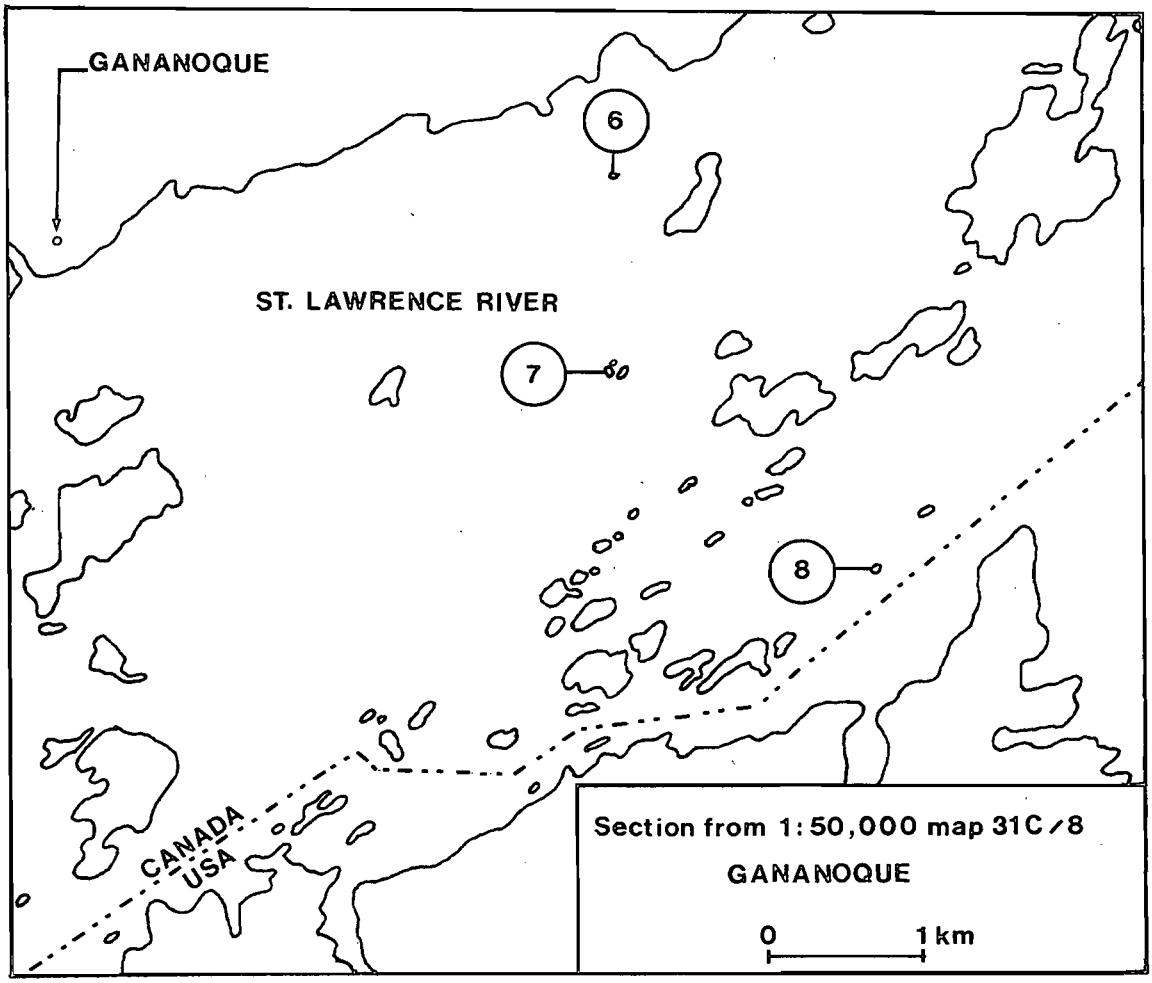

1
PIGEON ISLAND
LAKE ONTARIO
Section from 1:50,000 map 31C/2
BATH
0
1 km


2
3
LAKE ONTARIO
AMHERST ISLAND
Section from 1:50,000 map 31C/2
BATH
0
1km


4
ST. LAWRENCE RIVER
SIMCOE
ISLAND
Section from 1:50,000 map 31C/2
BATH
0
1km

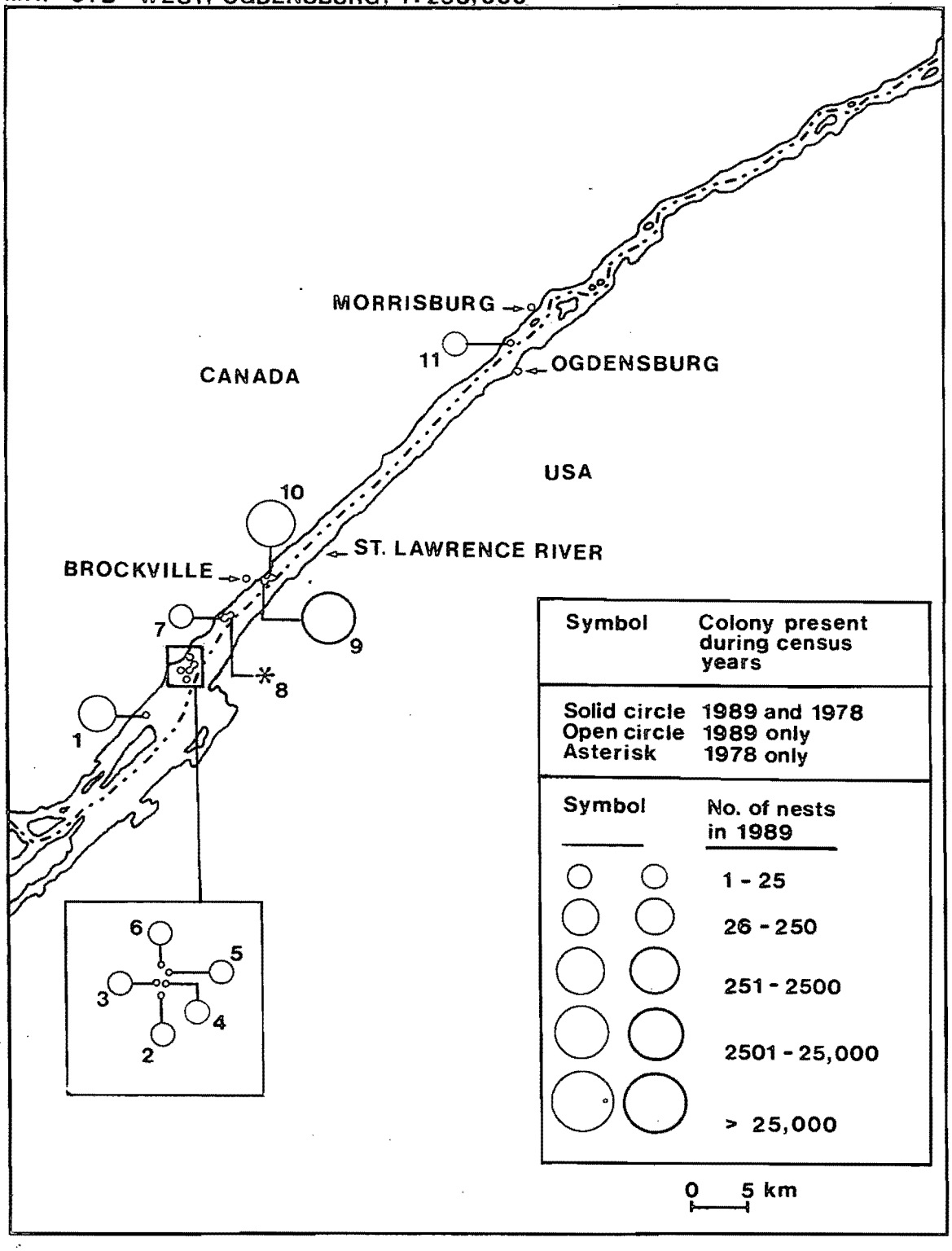
App. 11 (cont'd).


ST. LAWRENCE RIVER
GRINDSTONE ISLAND
CANADA
USA
5
Section from 1:50,000 map 31C/8
GANANOQUE
0
1 km

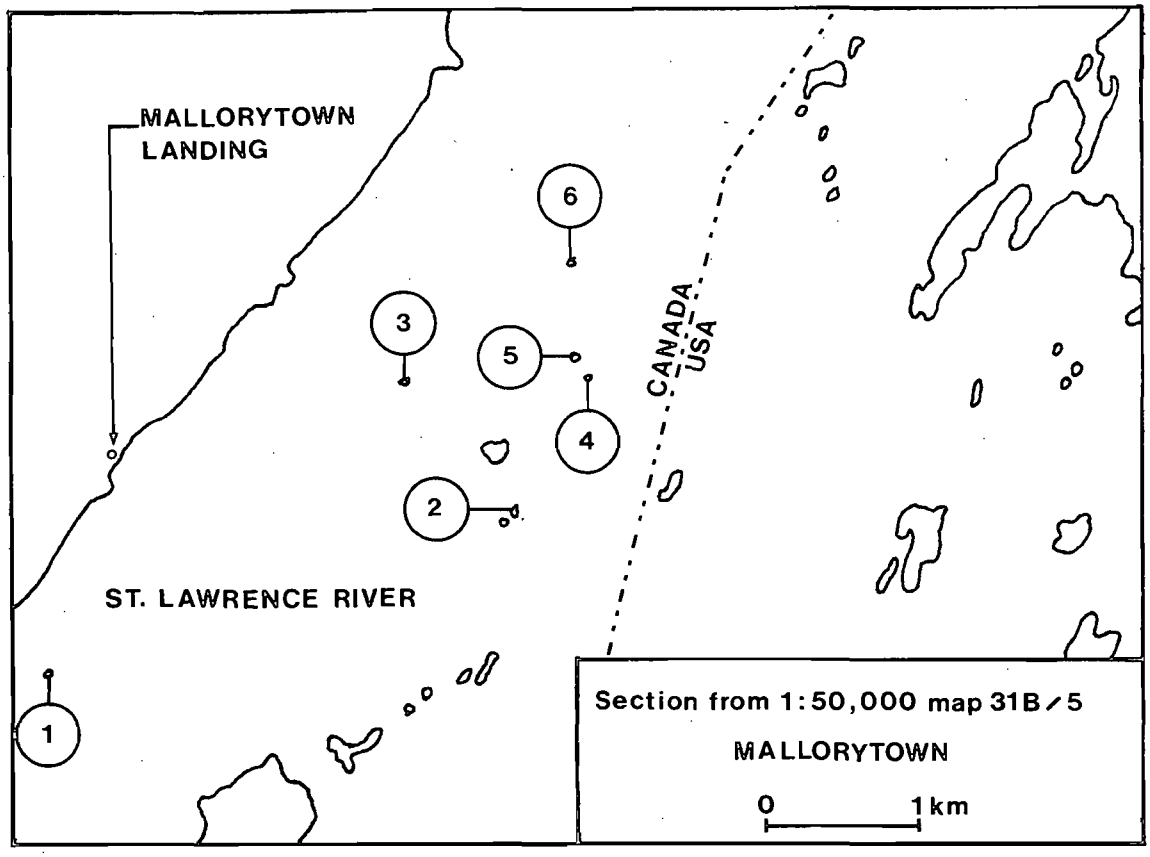

GANANOQUE
6
ST. LAWRENCE RIVER
7
8
CANADA
USA
Section from 1:50,000 map 31C/8
GANANOQUE
0
1 km

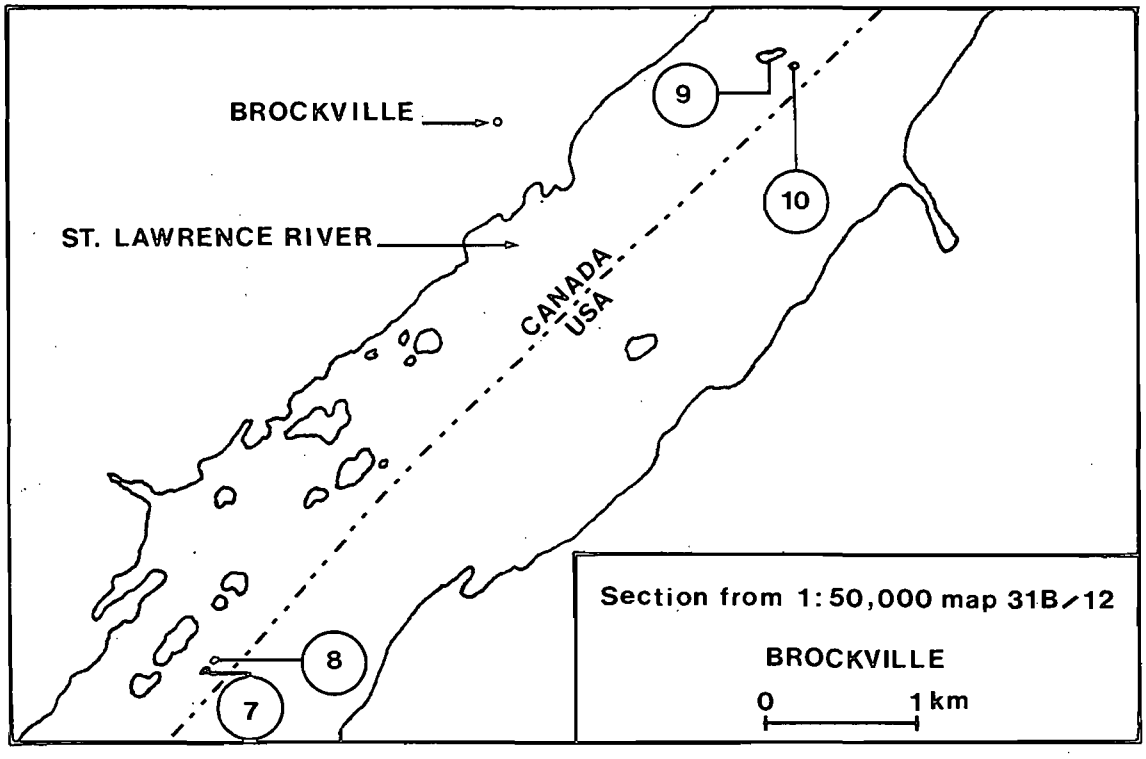
Appendix 12.

MAP 31B - WEST, OGDENSBURG, 1:250,000

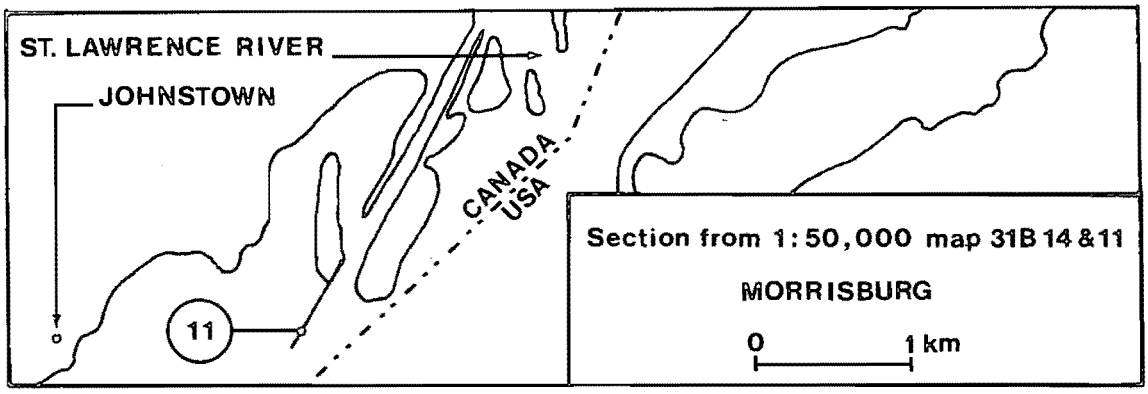


App. 12 (cont'd).


MALLORYTOWN
LANDING
6
3
5
4
2
CANADA
USA
ST. LAWRENCE RIVER
1
Section from 1:50,000 map 31B/5
MALLORYTOWN
0
1 km

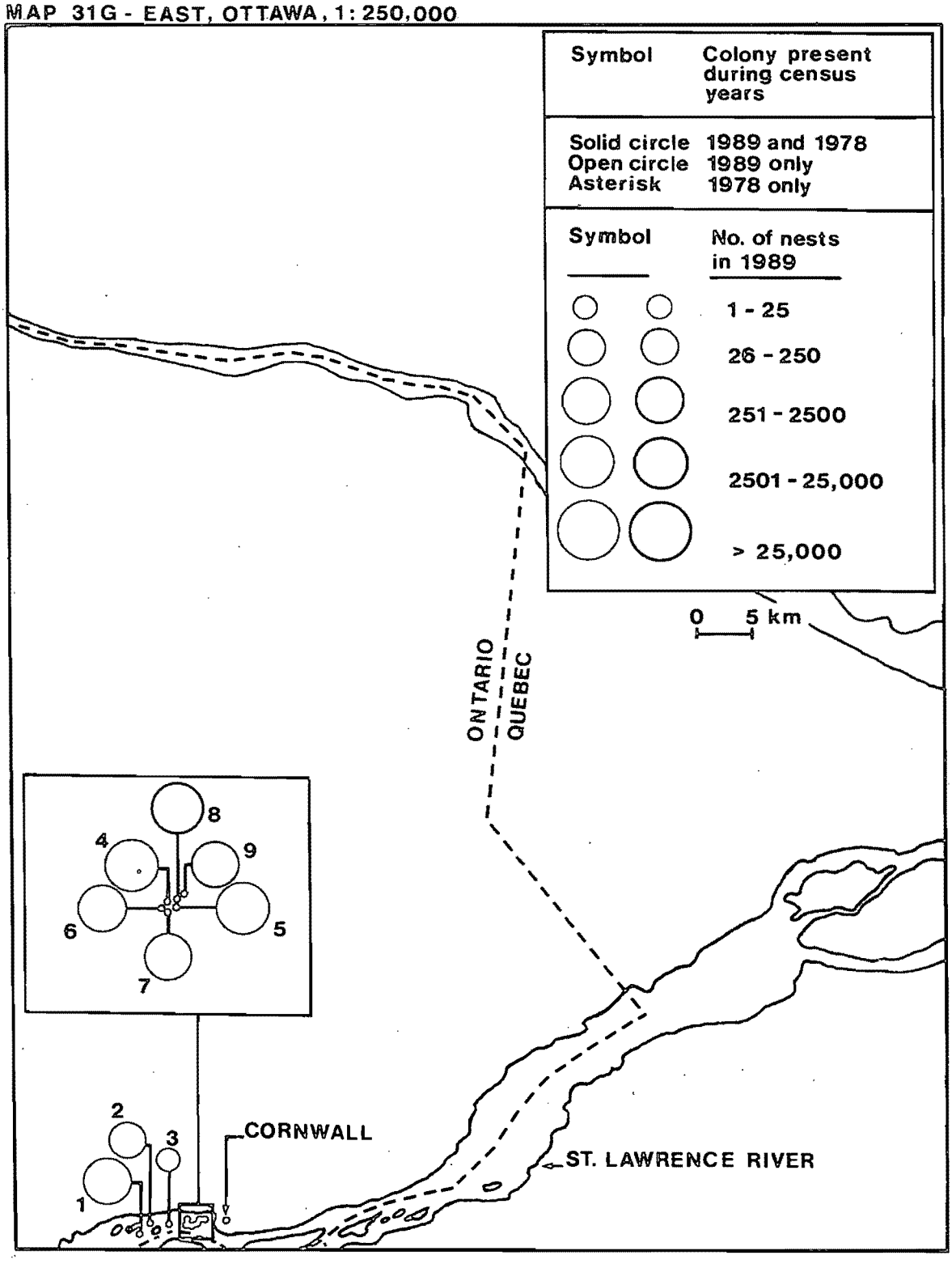

BROCKVILLE
9
10
ST. LAWRENCE RIVER
CANADA
USA
8
7
Section from 1:50,000 map 31B/12
BROCKVILLE
0
1 km

App. 12 (cont'd).

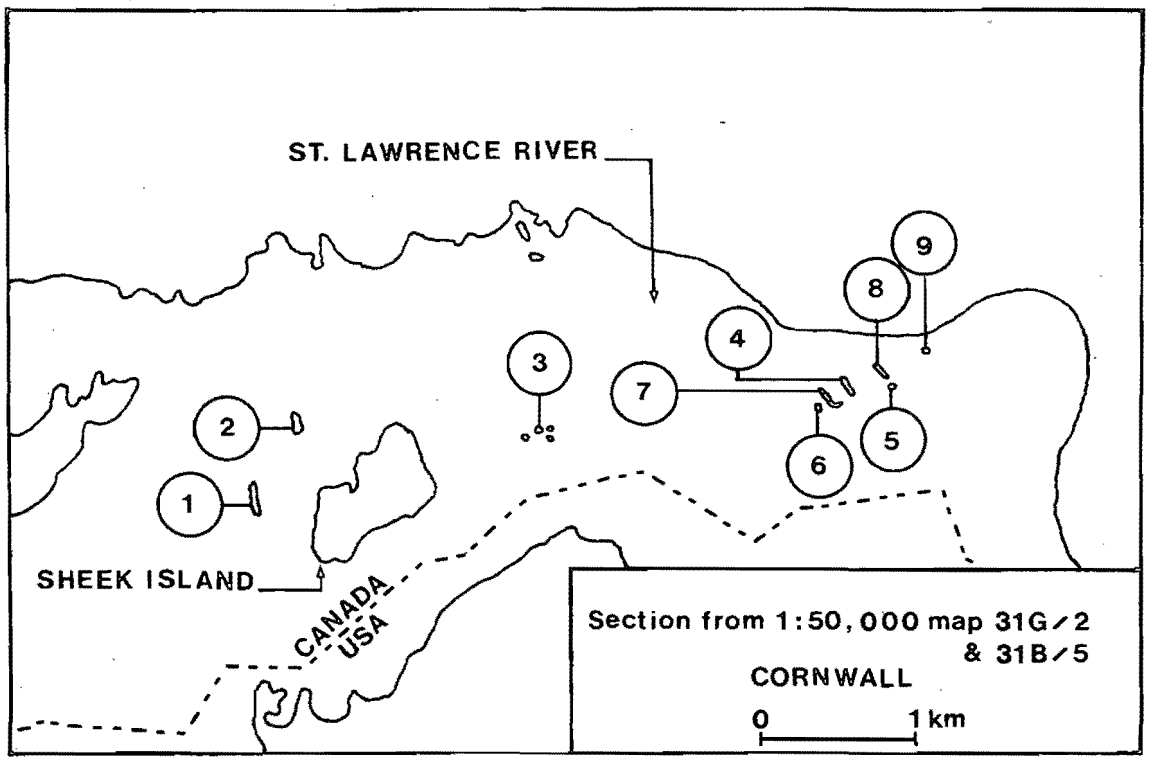

ST. LAWRENCE RIVER
JOHNSTOWN
CANADA
USA
11
Section from 1:50,000 map 31B 14 &11
MORRISBURG
0
1 km

Appendix 13 .

MAP 31G - EAST, OTTAWA, 1:250,000



App. 13 (cont'd).


ST. LAWRENCE RIVER
1
2
3
4
5
6
7
8
9
SHEEK ISLAND
CANADA
USA
Section from 1:50,000 map 31G/2
& 31B/5
CORNWALL
0
1 km