H. Blokpoel
G.D. Tessier

The Ring-billed Gull in Ontario: a review of a new problem species

Occasional Paper
Number 57
Canadian Wildlife Service

H. Blokpoel
G.D. Tessier

The Ring-billed Gull in Ontario: a review of a new problem species

Occasional Paper
Number 57
Canadian Wildlife Service
Ottawa, 1986

Errata

In this paper, the authors quoted Ludwig (1974) incorrectly. As a result, the three following corrections are in order:

Page 11, third paragraph, last two sentences

Replace the last two sentences by:
"According to Ludwig (1974), that remnant population began to expand and by 1967 it had increased many times."

Page 16, Section 2.8, first paragraph

Replace this paragraph by:
"Between 1976 and 1984 the estimated population more than doubled, increasing at an average annual growth rate of 11.0 %."

Page 29, Summary, Point 2

Replace this sentence by:
"The estimated average annual growth of the Great Lakes nesting population was 11.0 % during 1976-84."

In adition, one reference in the Literature Cited was incomplete:

Page 32, right hand side, seventh reference

Replace "Southern, W.E." by:
"Southern, L.K.; Southern, W.E."

Environment Canada | Environnement Canada

Canadian Wildlife Service | Service canadien de la faune

H. Blokpoel*
G.D. Tessier*

The Ring-billed Gull in Ontario: a review of a new problem species

Occasional Paper
Number 57
Canadian Wildlife Service

Également disponible en français

*CWS, 1725 Woodward Drive,
Ottawa, Ont. K1A 0E7

Issued under the authority of the
Minister of Environment
Canadian Wildlife Service

Catalogue No. CW69-1/57-1986E
ISBN 0-662-14302-7
ISSN 0576-6370

Design: Rolf Harder & Assoc.

Contents

Acknowledgements

We thank the following people for providing unpublished information: B. Andress, T. Bahti, D. Boersma, J.W.A. Bonser, E. Broughton, D.E. Capen, D.S. Case, A.R. Clark, V. Cooper, G.A. Fox, P.M. Fetterolf, H.J. Kerwin, H. Lind, H. Lior, P. Madore, G. Matthews, R.D. McRae, R.I.G. Morrison, P. Mousseau, B. Pett, I.M. Price, J. Richards, C.J. Risley, D. Ross, W.C. Scharf, L.E. Schumann, G.A. Smith, W.E. Southern, A.D. Tomlin, J. van Riet, D.V. Weseloh and A. Wormington. S. Barleben helped in the office and S. Bradford typed the manuscript.

We are grateful to J.S. Wendt, CWS Banding Office, for providing band recovery data and for making useful suggestions.

S.G. Curtis and D.A. Welsh provided ideas and advice, and commented on earlier drafts. H. Boyd and P. Mousseau reviewed the final draft, which was edited by P. Loshak.

Photo: H. Blokpoel

Abstract

During the period 1976–84 the nesting population of the Ring-billed Gull (*Larus delawarensis*) in the Great Lakes and Upper St. Lawrence River increased at an average annual growth rate of 11%. In 1984 there were an estimated 700 000 pairs of Ring-bills in that area (about two-thirds in Canada and one-third in the USA). Because Ring-bills are highly adaptable it is likely that their numbers will continue to increase.

In Ontario, Ring-bills cause problems at airports and in parks, cause damage to agriculture, and may pose a threat to public health. Some measures to deal with local gull problems are reasonably effective but they are unpractical in many problem areas.

The large and growing Ring-billed Gull population is the underlying cause of the various gull problems. A program to reduce the total gull population in the Great Lakes area would be costly, complicated, and controversial. It is recommended that a study be carried out on the need for and the feasibility of an on-going, biologically sound, socially acceptable, internationally co-ordinated program to reduce the Ring-billed Gull population in the Great Lakes area to an acceptable level.

Introduction

Like man, the Ring-billed Gull is adaptable, opportunistic, omnivorous, gregarious, and prolific. During the last 35 years Ring-billed Gull numbers in Ontario have greatly increased and during the last few years the species has become a problem species in Ontario.

Like all other native gull species, the Ring-billed Gull is protected in Canada under the Migratory Birds Convention Act, which is administered by the Canadian Wildlife Service (CWS) of Environment Canada. CWS is receiving a large and increasing number of complaints of gull nuisance and gull damage. There is a growing demand, especially among farmers, boaters, and park operators, that something be done to reduce the various gull problems in Ontario.

Some gull problems can be dealt with on a site-by-site basis but several organizations would like to see a reduction of the total gull population in Ontario. All Ontario Ring-bills are part of the eastern population, which is concentrated in the Great Lakes and the St. Lawrence River down to Trois-Rivières. Gulls are mobile and readily colonize new areas. Efforts to reduce gull numbers in Ontario would have limited success unless complementary measures were taken in Quebec and the USA. A comprehensive population reduction program would be costly and complicated in terms of administration and logistics.

After publishing two Information Leaflets, "Gull Problems in Ontario" (Blokpoel 1983) and "Local Gull Control in Ontario" (Blokpoel 1984*a*), CWS is publishing this report to provide more background information and to discuss various options for gull control. Specifically, the goals of this paper are:

- to review what we know about the biology of the Ring-billed Gull in the Great Lakes in so far as it is relevant to the gull problems;
- to review what we know about the problems caused by Ring-bills in Ontario;
- to review what has been done to reduce local gull problems in Ontario;
- to discuss methods and a strategy for total population reduction; and
- to recommend further studies of gull problems and the development of methods to deal with them in a more effective way.

We wrote this report with the following audience in mind: the wildlife manager who has to deal with the various gull problems, the naturalist who is interested in gulls and their effects on other species, and the general public that is concerned about gull problems.

Breeding range of the eastern population

The approximate breeding range of the Ring-billed Gull is shown in Figure 1. There are two populations: the western population, which nests mainly on the prairies, and the eastern population, which nests mainly in the Great Lakes and St. Lawrence River area. Birds belonging to the western population normally winter along the Pacific coast of California and Mexico, and birds of the eastern population winter mainly along the coasts of the Gulf states, especially Florida.

Until recently the two breeding ranges in Canada were clearly separated, with the "migratory divide" running somewhere west of Lake Superior and east of Lake Manitoba. However, in 1981 and 1982 four new Ring-bill colonies were discovered in Lake of the Woods, well to the west of Lake Superior (Hirsch 1982, Ryder *et al.* 1983).

At present the heartland of the eastern population is the Great Lakes area and the St. Lawrence River down to Trois-Rivières. Smaller numbers are found further downstream along the St. Lawrence and the north shore of the Gulf of St. Lawrence, in southern James Bay, and in the Maritime Provinces (Fig. 1).

1. The Maritime Provinces

A summary of existing information for the Atlantic provinces (Lock, in press) shows six colonies on the Gulf coast of New Brunswick (sizes ranging from 3 to 406 nests) and three colonies on Prince Edward Island (5 to 159 nests). Although these numbers are relatively small, the breeding population of the Maritime Provinces has been growing in

Adult Ring-billed Gull in breeding plumage

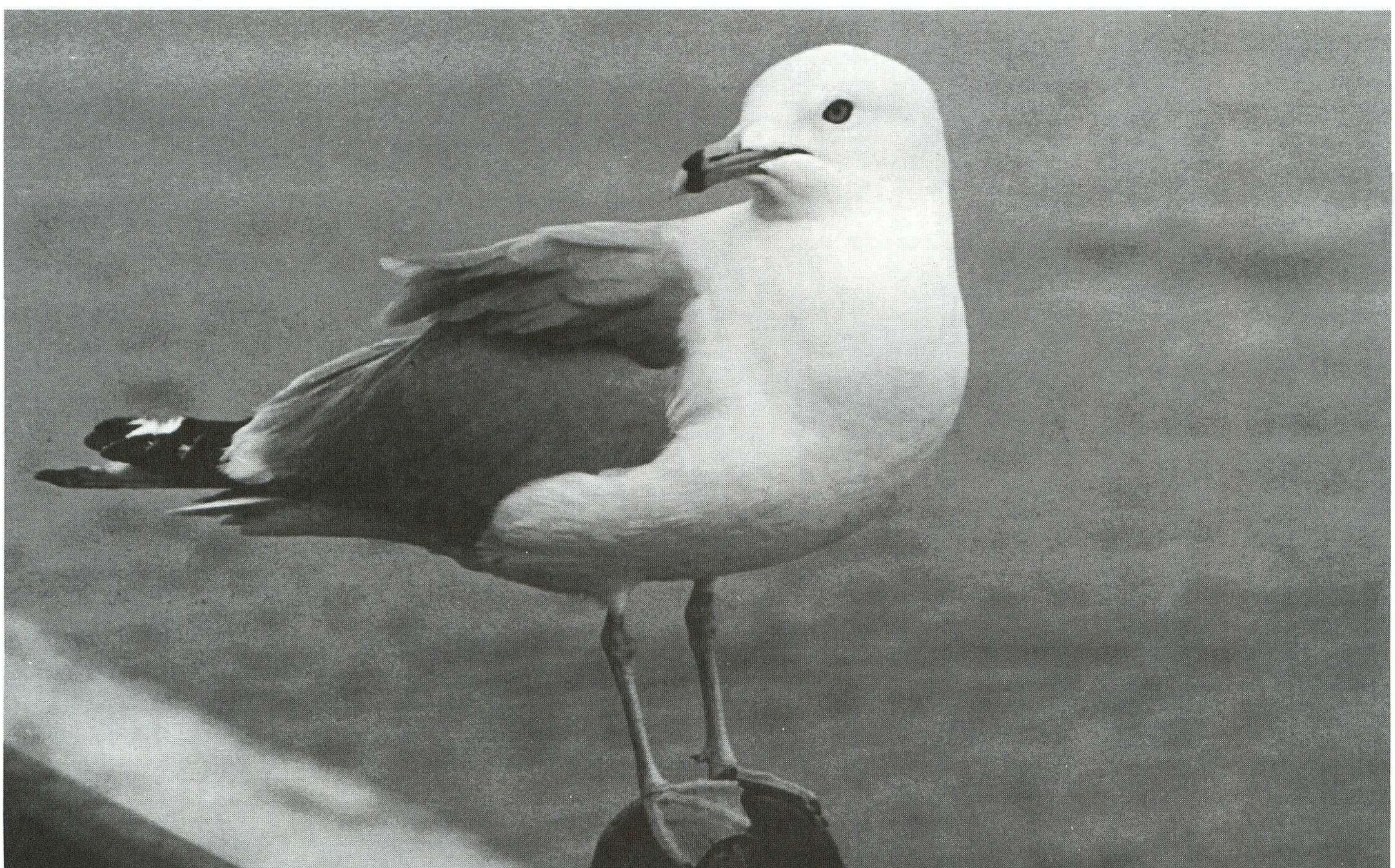


Photo: H. Blokpoel

recent years at a mean annual increase of close to 25% (Lock, in press).

2. Quebec

The breeding range in Quebec was recently described by Mousseau (1984*a*). In southern Quebec the Ring-bill first became established in 1953 on Moffat Island, off Montreal, and by 1981 a total of 28 471 nests was counted for six colonies in the Montreal area (Fig. 2). Smaller colonies have also sprung up in the Ottawa River and near Quebec City. In northern Quebec two small populations exist on the North Shore and in James Bay. Data for the North Shore area go back as far as 1833 when 400 nests were counted; numbers have since fluctuated with a peak of 3538 nests in 1940 and a low of 202 in 1976. In 1982 there were 391 nests at four nesting sites. Ring-bills have nested in southern James Bay since 1912 when two nests were found. The latest records, for 1972, report a colony of 36 nests. Since 1978 a few small colonies have become established in inland areas as well. Seventy percent of the 43 000 breeding pairs in Quebec are found in the Montreal area (Mousseau 1984*a*).

3. Ontario

The great majority of Ontario's Ring-bills nest on the Great Lakes and the St. Lawrence River, but recently the birds have begun nesting in inland areas as well. Confirmed breeding, i.e. nests with eggs and/or young, has been reported by observers for the Ontario Breeding Bird Atlas (OBBA) at Lake Muskoka, Lake Nippissing, Kukagami Lake, and the areas near Sudbury and Sioux Lookout (Fig. 2). The Ring-bill probably also nests near or on Lake Nipigon, and in the New Liskeard area (OBBA, pers. commun.). The vast area of northwestern Ontario has not been surveyed in detail and there may be several more as yet undiscovered colonies.

Further north, there are two colonies on James Bay (Peck and James 1983) and there is probably a colony on Hudson Bay (Fort Severn; OBBA, pers. commun.).

4. States bordering on the Great Lakes

The breeding range of the eastern population of the Ring-billed Gull extends into the USA, covering Vermont, New York, Ohio, Illinois, Michigan, Wisconsin, and Minnesota. In Vermont there were two colonies on Lake Champlain in 1984 (D.E. Capen, pers. commun.).

In New York State, Ring-bills nest on Lake Champlain, the St. Lawrence River, the lower Great Lakes, and Oneida Lake (Bull 1974, Scharf *et al.* 1978, Peterson 1985). In Ohio, there is only one colony, which recently became established on Lake Erie near Toledo (D.S. Case, pers. commun.). In Michigan, Ring-bills nest in the Detroit River and in the coastal areas of Lakes Huron, Michigan, and Superior (Scharf *et al.* 1978), but there is also one inland colony (L.E. Schumann, pers. commun.). Illinois has one colony; it became established in 1975 on Calumet Lake in Chicago (Kleen 1975). In Wisconsin most Ring-bills nest along the shore of Lake Michigan, but one small colony was found on Lake Superior in 1977 (Scharf *et al.* 1978; T. Bahti, pers. commun.). In Minnesota, Ring-bills have nested near Duluth at the western end of Lake Superior and on two large inland lakes (Green and Janssen 1975, Scharf *et al.* 1978).

Ring-billed Gull in juvenal plumage

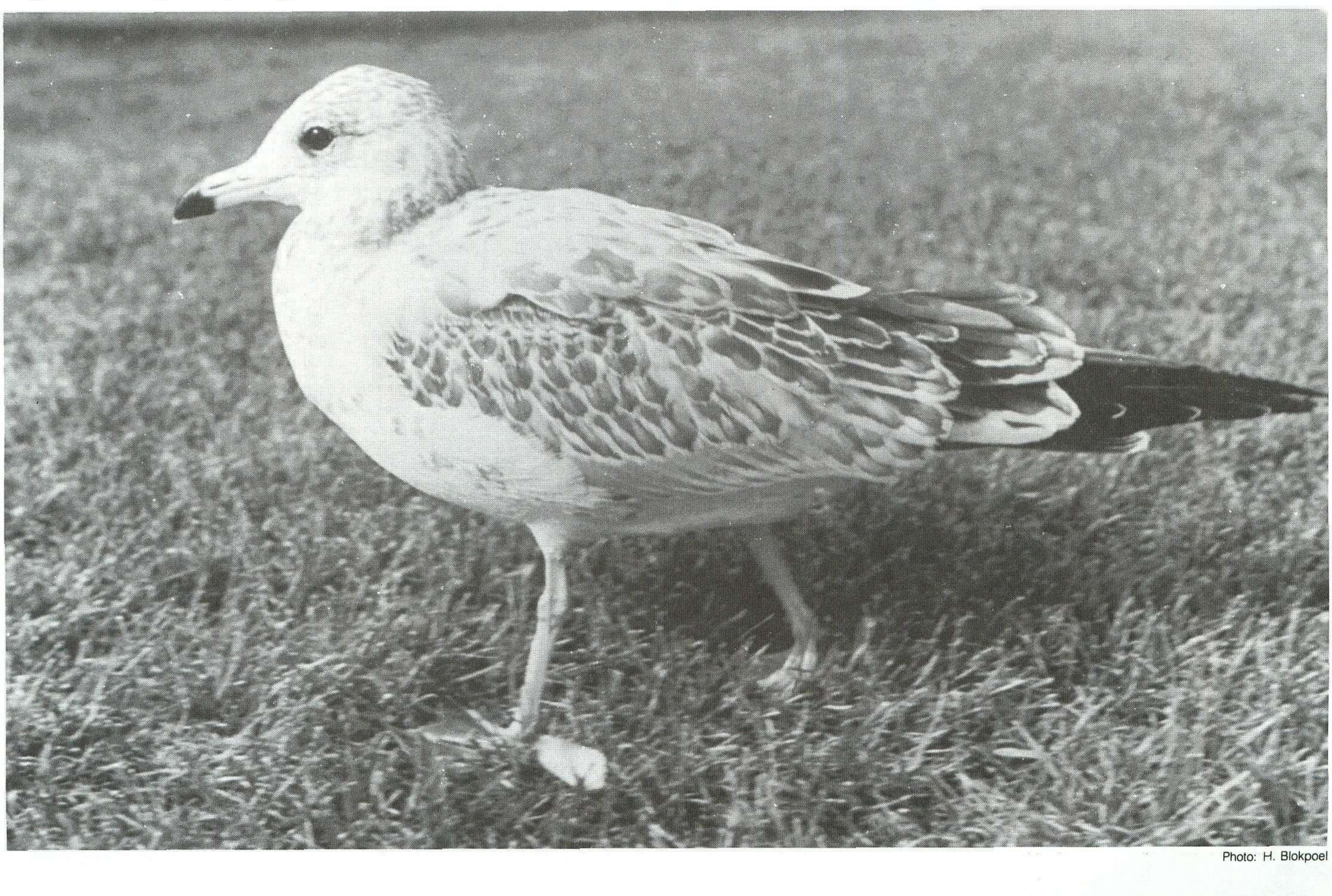


Photo: H. Blokpoel

Figure 1
Approximate ranges of the Ring-billed Gull. Western population after Vermeer (1970), eastern population after Southern (1974), Mousseau (1984*a*), Lock (in press), and this report

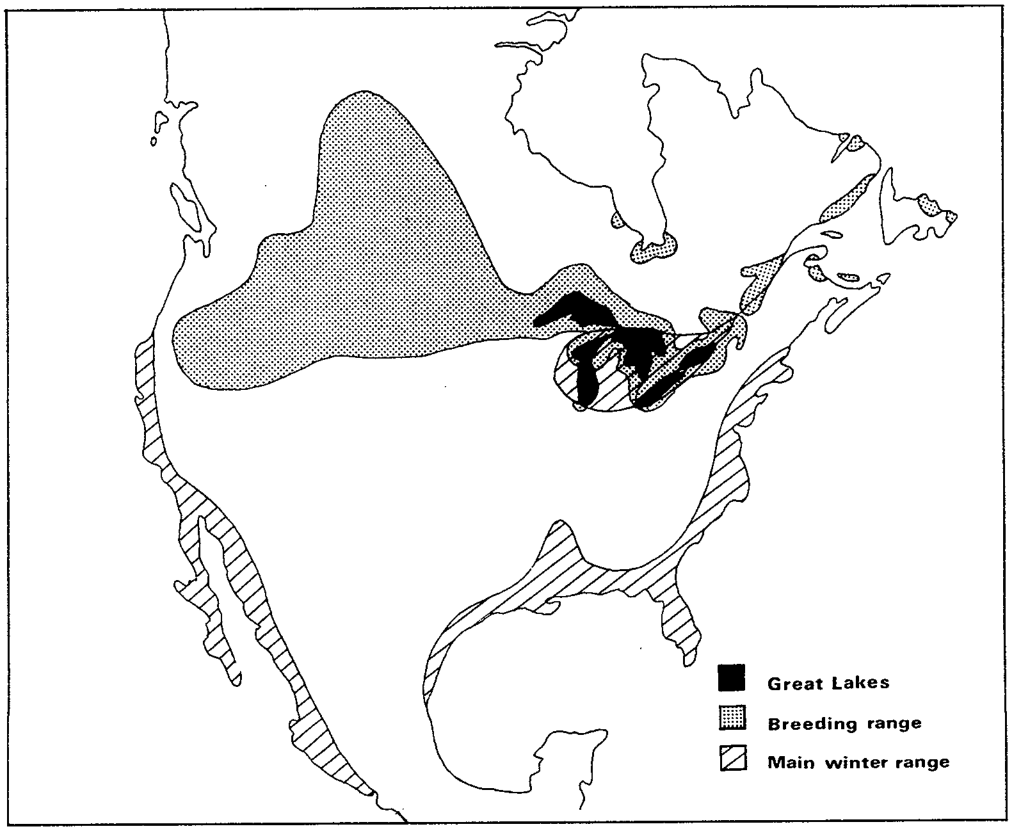
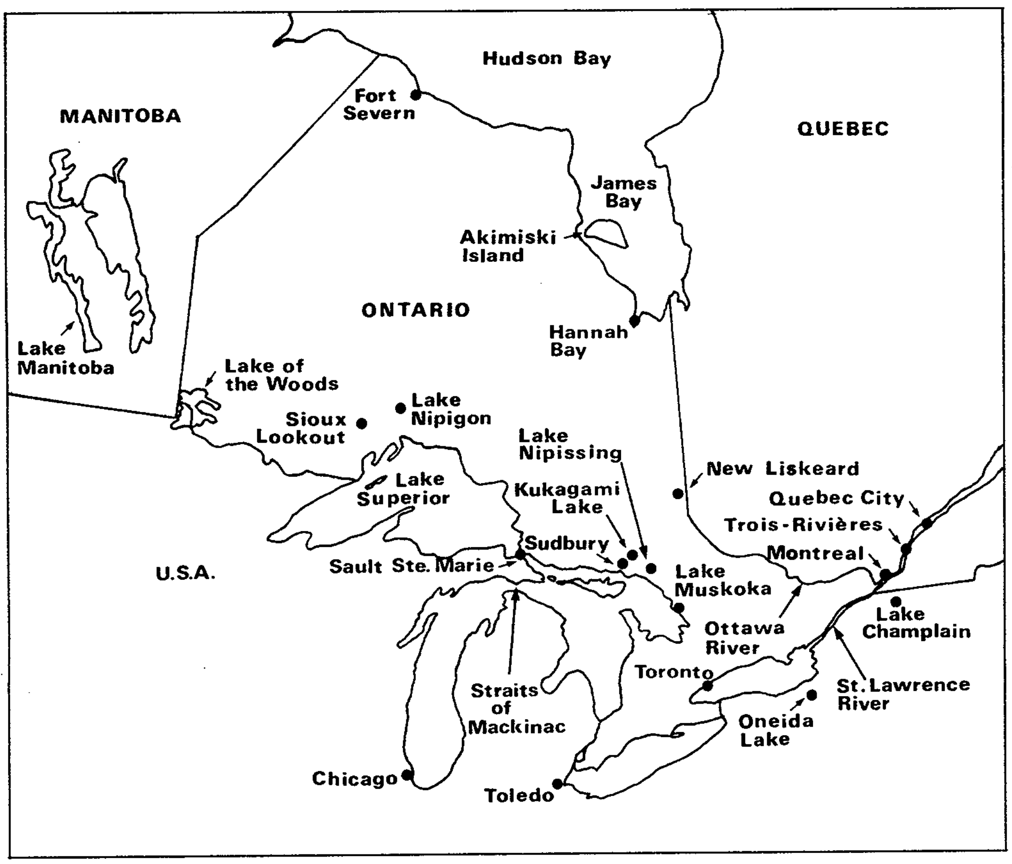


Figure 2
The main breeding range of the eastern population of the Ring-billed Gull encompasses the Great Lakes and St. Lawrence River down to Trois-Rivières. The map shows localities mentioned in the text



Post-breeding and pre-breeding distribution of Great Lakes gulls

The seasonal distribution of Great Lakes Ring-billed Gulls was studied in detail by Southern (1974), who analysed by month more than 18 000 encounters with banded birds. Southern refrains from using the term "winter distribution" because the term suggests a distinct area to which all birds migrate to spend the winter. The Great Lakes Ring-bills do not behave in this fashion.

"Although some Ring-billed Gulls make relatively fast trips to the southern extreme of their annual range, most proceed more casually, perhaps in response to climatic conditions or the availability of food. As a result some may spend up to five months (August through December) in transit between the nesting colony and southern areas having the highest winter

Figure 3
Locations (by degree-block) and numbers of direct recoveries in July of young-of-the-year Ring-billed Gulls banded at Gull Island, Ontario, 1964–83. Recovery numbers are not corrected for recovery effort

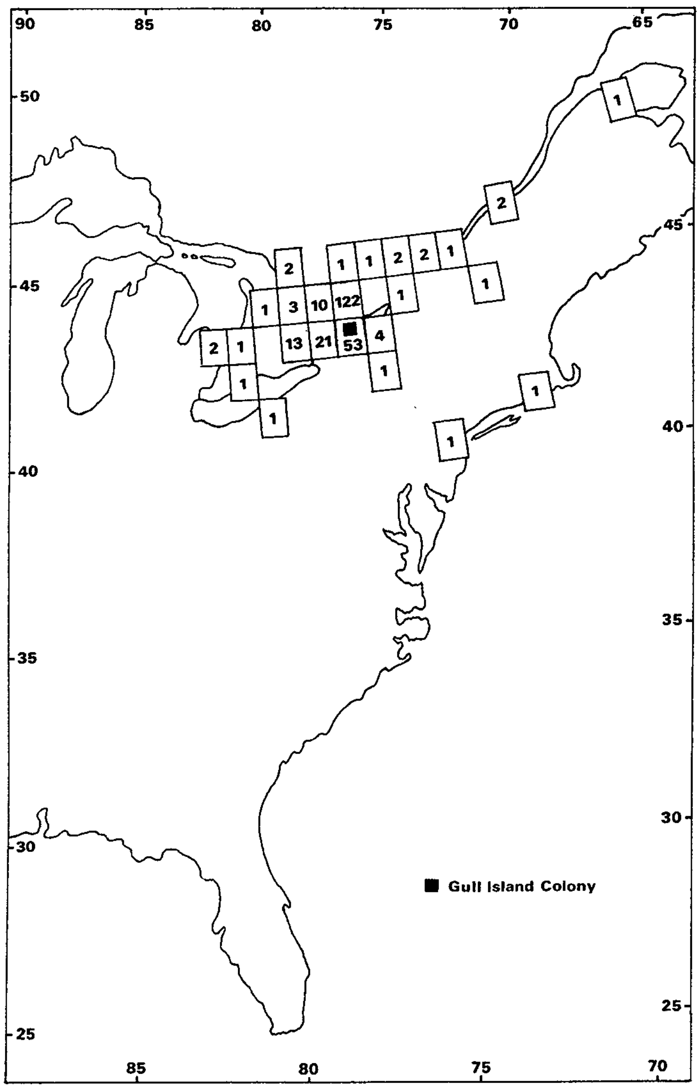
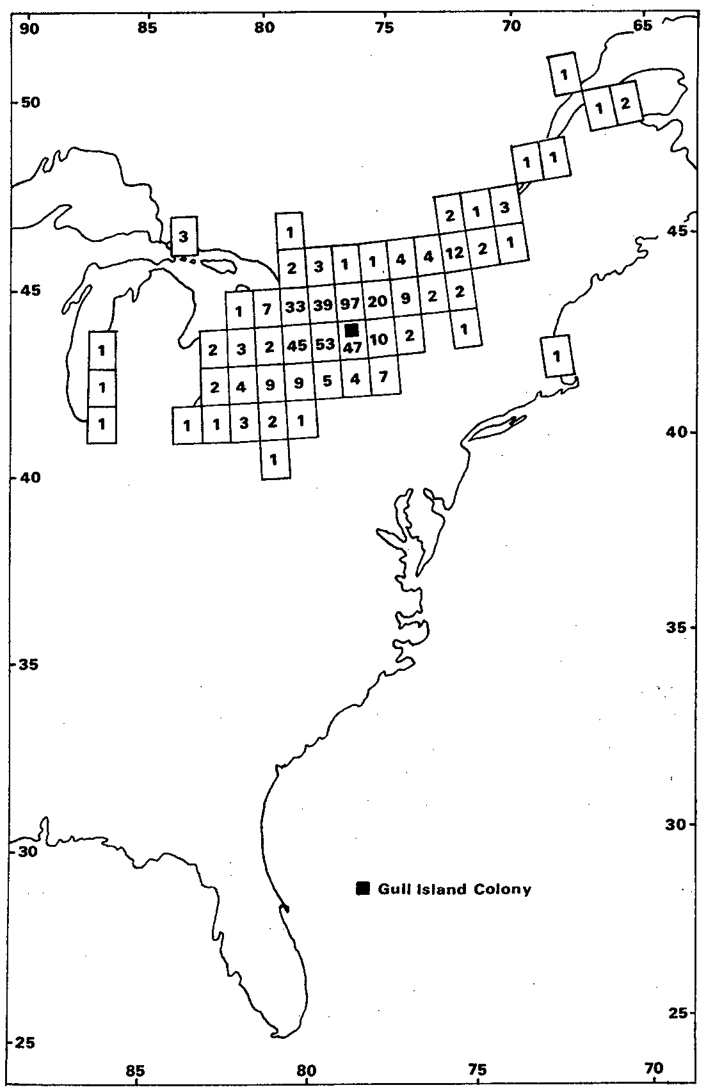


Figure 4
Locations (by degree-block) and numbers of direct recoveries in August of young-of-the-year Ring-billed Gulls banded at Gull Island, Ontario, 1964–83. Recovery numbers are not corrected for recovery effort



density. January and February (in part) are the only winter months during which the population appears to be static and even then the species is widely distributed" (Southern 1974, see Fig. 1).

In the northern part of the Great Lakes, fledglings and adults begin to leave their colonies by the end of July but in Lake Ontario this happens in early July. Southern summarizes as follows:

> "During August and September dispersal is widespread but there is an increasing tendency to accumulate in the lower Great Lakes Region. During October, southward migration is more apparent. Large concentrations develop on Lake Erie during November and December and this may represent a staging area for continued migration. Encounters increase in Florida and other southern areas during November and December, reaching a peak in January and February. During these months over 50% of the encounters are from Florida. Other areas having a significant number of encounters include the Carolina–Georgia coast, Chesapeake Bay, the Gulf coast, and the lower Great Lakes. Smaller quantities of recoveries were obtained from localities near inland waterways or from scattered regions apparently outside the primary post-breeding range (e.g. Cuba, Colombia).
>
> Northward migration begins in late February and during March and early April most Ring-billed Gulls leave the southern extreme of their range. May encounters for Florida have decreased to 3% whereas the Great Lakes proportion has increased to 74%. A migratory corridor exists between the Great Lakes Region and the Atlantic coast near Cheasapeake Bay. A significant number of encounters come from this area during spring and fall."

Perhaps as a result of the enormous population increase, stragglers have been reported in recent years from various European countries (Berndt and Rahne 1968, Hume 1973, Hogg 1979, Mullarney 1980), the Canary Islands (Bos and de Heer 1982), and Africa (Hoogendoorn 1982).

The gull problems during the breeding season are usually restricted to areas near gull colonies because most adults live on or near the gulleries during that time. After the breeding season the young disperse rapidly and may begin to cause problems relatively far from their colonies. As an example of the situation in Ontario, we plotted the distribution of direct band recoveries, i.e. birds recovered in the year of banding, for Ring-bills that were banded as chicks at Gull Island (near Brighton) in Lake Ontario. Recoveries were plotted by degree-block, i.e. a geographical area with a "width" of one degree longitude and a "height" of one degree latitude. Chicks begin to leave the Gull Island colony in early July and during that month some birds apparently move large distances (Fig. 3). In August their dispersal is even more widespread (Fig. 4). These results for a colony in southern Ontario are in good general agreement with those of Southern (1967) for a gullery in northern Michigan. Newly fledged Ring-bills are highly mobile and that has obvious implications for any effort to control local gull problems.

There are no similar data to determine the post-breeding dispersal of adults, but their dispersal pattern may well be similar to that of the young-of-the-year.

Summer distribution of Great Lakes sub-adult gulls

Little is known about the distribution of sub-adult Ring-bills during the breeding season. This group of non-nesting birds is comprised of all 1-year-olds and perhaps half of the 2-year-olds. During 10 years of fieldwork in Michigan Ring-bill colonies, Southern observed only two 1-year-old birds. Each was present for only a few hours. Many of the sub-adults appear to spend the summer months on the breeding range but stay away from high-density breeding areas (Southern 1974). This certainly applies to the situation in Lake Erie where 1-year-olds are rarely seen on the colonies and where up to 17 000 "oversummering" gulls have been reported at Long Point (Lambert and Nol 1978).

Favoured oversummering areas sometimes turn out to be the sites of new colonies, as was the case for the Eastern Headland (Blokpoel and Fetterolf 1978) and is so now at Long Point.

The population explosion in the Great Lakes area

1. Historical data up to 1967

In the days of John James Audubon the Ring-billed Gull must have been numerous because he referred to this species as "The Common American Gull" (Audubon 1840). Some 80 years later its numbers had dwindled and its breeding range had been reduced due to the gradual settlement of North America. In the words of Bent (1921),

> "The ring-billed gull yields readily to persecution, is easily driven away from its breeding grounds, and seems to prefer to breed in remote unsettled regions, far from the haunts of man. It could never survive the egging depredations which the herring gull has withstood successfully; hence its breeding range has been gradually curtailed as the country has become settled. Although its former breeding range was nearly as extensive as that of the herring gull it is now mainly restricted to the interior, in the lakes of the prairie and plains of the Northern States and Canada, where it far out numbers the herring gull and is still the common gull."

Barrows (1912) also mentioned that the Ring-billed Gull disappeared as a breeding species from the Great Lakes early in the 20th century. Ludwig (1974) states that it is not clear whether this disappearance was complete, but if there were Ring-bills nesting in the Great Lakes between 1906 and 1925 their numbers must have been small and restricted to remote parts of Georgian Bay. The Great Lakes population was fairly stable from 1940 to 1960 when it was estimated at 27 000 pairs (Ludwig 1974). By 1967, according to his estimates, the population had exploded to at least 141 000 pairs and had extended its breeding grounds westward from Lakes Ontario, Erie, and Huron to Lake Michigan.

2. The period 1976–84

There are no recent census data for the entire Great Lakes area. However, the US portions were surveyed in 1976 and 1977 (Scharf *et al.* 1978) and the Canadian (i.e. Ontario) portions of the Great Lakes were surveyed as follows: Lake Ontario in 1976 (Blokpoel 1977*a*), Lake Erie in 1977 (Blokpoel and McKeating 1978), Lake Superior in 1978 (Blokpoel *et al.* 1980), and Lake Huron in 1980 (D.V. Weseloh, pers. commun.). Since 1980, the growth of some Ring-bill colonies in the Canadian section of the lower Great Lakes has been monitored.

2.1. Lake Superior (west of Sault Ste. Marie)

The surveys of the US portion (Scharf *et al.* 1978) showed four colonies (with 99, 250, 308, and 1454 nests, total 2111) in 1976 and six colonies (with 67, 200, 234, 405, 550, and 1485 nests, total 2941) in 1977.

During the 1978 survey of Canadian Lake Superior, four colonies (with 17, 168, 2000, and 2750 nests, total 4935) were found (Blokpoel *et al.* 1980).

We were interested in determining population change in all the Great Lakes during the period 1976–84. Because the surveys were made in a few years only, we had to use an estimated annual growth rate to calculate the figures for 1976 and 1984. Scharf *et al.* (1978, their Table 31) give an annual growth rate for the US Great Lakes of 10.7%, which is in close agreement with the 9.4% growth rate calculated below for Lake Ontario, the lake for which we have the most comprehensive data set. For the purposes of this paper we used an annual growth rate of 10% for both the US and the Canadian portions of Lake Superior. Annual estimates (Table 1) show an estimated increase of 6189 pairs in 1976 to 14 474 pairs in 1984, or an increase of 234% in the 8-year period.

2.2. Lake Michigan (west of the bridge across the Straits of Mackinac)

The main result of the surveys by Scharf *et al.* (1978) are as follows: in 1976, 15 colonies were found, 1 of which was not surveyed. The colonies ranged in size from 50 to 4060 nests for a total of 27 371 nests. In 1977 they found 17 colonies ranging in size from 11 to 6905 nests for a total of 33 141 nests.

Although these figures indicate a growth rate of 21.1%, we used the more conservative estimate of 10% to calculate population estimates for 1984 (Table 1). During 1976–84 the population grew from about 27 000 to an estimated 65 000 pairs.

2.3. Lake Huron (from Sarnia to Sault Ste. Marie)

In 1976, in the US portion of Lake Huron, including the St. Mary's River, Scharf *et al.* (1978) found 15 colonies (sizes ranging from 5 to 5593 nests, for a total of 22 838 nests). In 1977, they found 15 colonies (sizes ranging from 1 to 7916 nests, for a total of 25 786 nests).

The survey of Canadian Lake Huron in 1980 showed 91 colonies ranging in size from 1 to 14 757 pairs. Total number of nests was 124 798 (D.V. Weseloh, pers. commun.).

Whole-lake estimates for the period 1976–84 were again calculated using an estimated annual growth rate of 10% (Table 1). During the 8-year period 1976–84, the population grew from an estimated 108 000 to an estimated 233 000 pairs.

Table 1
Numbers of Ring-billed Gull nests at colonies in the Great Lakes and the St. Lawrence River, 1976–84

		1976	1977	1978	1979	1980	1981	1982	1983	1984
1. Lake Superior	(Canada)	4 078[a]	4 486[a]	4 935[b]	5 429[a]	5 972[a]	6 569[a]	7 226[a]	7 949[a]	8 743[a]
	(USA)	2 111[c]	2 941[c]	3 235[a]	3 558[a]	3 914[a]	4 305[a]	4 736[a]	5 210[a]	5 731[a]
	Total	6 189	7 427	8 170	8 987	9 886	10 874	11 962	13 159	14 474
2. Lake Michigan	(USA)	27 371[c]	33 141[c]	36 455[a]	40 101[a]	44 111[a]	48 522[a]	53 374[a]	58 711[a]	64 582[a]
	Total	27 371[c]	33 141[c]	36 455[a]	40 101[a]	44 111[a]	48 522[a]	53 374[a]	58 711[a]	64 582[a]
3. Lake Huron	(Canada)	85 239[a]	93 763[a]	103 139[a]	113 453[a]	124 798[d]	137 278[a]	151 006[a]	166 107[a]	182 718[a]
	(USA)	22 838[c]	25 786[c]	28 365[a]	31 201[a]	34 321[a]	37 753[a]	41 528[a]	45 681[a]	50 249[a]
	Total	108 077	119 549	131 504	144 654	159 119	175 031	192 534	211 788	232 967
4. Detroit River, Lake Erie, and Niagara River	(Canada)	13 791[e]	—	—	—	—	—	—	—	71 512[e]
	(USA)	10 132[e]	—	—	—	—	—	—	—	25 518[e]
	Total	23 923	—	—	—	—	—	—	—	97 030
5. Lake Ontario	(Canada)	40 787[f]	—	—	—	—	—	—	—	163 593[f]
	(USA)	75 000[f]	75 000	77 000	76 000	75 000	73 780	75 000	75 000	75 020[f]
	Total	115 787	—	—	—	—	—	—	—	238 613
Totals for Great Lakes	**(Canada)**	**143 895**	—	—	—	—	—	—	—	**426 566**
	(USA)	**137 452**	—	—	—	—	—	—	—	**221 100**
	Total	281 347	—	—	—	—	—	—	—	647 666
6. St. Lawrence River (Upper)	(Canada)	4 913[g]	—	—	—	—	—	—	—	16 000[g]
	(USA)	0[g]	—	—	—	—	—	—	—	675[g]
	Total	4 913	—	—	—	—	—	—	—	16 675
7. St. Lawrence River (Montreal area)	(Canada)	16 830[g]	—	—	—	—	—	—	—	35 575[g]
	Total	16 830[g]	—	—	—	—	—	—	—	35 575[g]
Totals for Great Lakes, & St. Lawrence River	**(Canada)**	**165 638**	—	—	—	—	—	—	—	**478 141**
	(USA)	**137 452**	—	—	—	—	—	—	—	**221 775**
	Total	303 090	—	—	—	—	—	—	—	699 916

[a] Estimated from data for other year(s) using 10% annual growth rate.
[b] Blokpoel *et al.* (1980).
[c] Scharf *et al.* (1978).
[d] D.V. Weseloh (pers. commun.).
[e] From Table 2.
[f] From Table 3.
[g] From Table 4.

Table 2
Numbers of Ring-billed Gull nests at colonies in the Detroit River, Lake Erie, and Niagara River, 1976–84. The numbers in the first column refer to Fig. 5

	1976	1977	1978	1979	1980	1981	1982	1983	1984
1. Grassy Island, Mich.	0[a]	1 644[a]	—	—	—	—	—	—	0[b]
2. Mud Island, Mich.	5 040[a]	5 290[a]	—	—	—	—	—	—	3 000[b]
3. Fighting Island, Ont.	0[c]	0[d]	—	—	0[e]	—	—	—	20 000[f]
4. Toledo Harbour, Ohio	68[c]	75[q]	—	2 000+[h]	—	—	—	—	4 000[h]
5. Point Pelee N.P., Ont.	0[c]	1[d]	—	—	—	—	—	1 000[i]	0[j]
6. Rondeau P.P., Ont.	0[j]	0[j]	0[j]	0[j]	0[j]	0[j]	0[j]	1 000[j]	0[j]
7. Long Point, Ont.	0[c]	0[d]	—	—	29[k]	—	—	642[i]&550[i]	1 286[l]&0[l]
8. Nanticoke, Ont.	0[e]	0[e]	0[e]	0[e]	—	—	550[m]	2 000[e]	5 400[n]
9. Mohawk Island, Ont.	473[c]	520[d]	—	—	792[e]	—	—	1 000+[p]	1 100+[c]
10. Port Colborne Breakwall, Ont.	214[c]	235[d]	224[e]	—	500[e]	—	—	—	1 130[e]
11. Port Colborne Mainland, Ont.	12 704[c]	13 974[d]	17 637[e]	—	25 575[e]	—	—	—	42 196[e]
12. Donnelly's Pier, NY	379[q]	524[a]	—	—	—	—	—	968[q]	1 065[c]
13. Stony Point, Buffalo, NY	0[q]	—	—	—	847[q]	—	—	6 655[q]	7 320[c]
14. Southeast Buckhorn Island, NY	3 640[a]	3 704[a]	—	—	3 975[q]	—	—	6 530[q]	7 183[c]
15. Tower Island, NY	1 005[c]	1 105[a]	1 330[e]	—	1 808[e]	—	—	—	2 950[e]
16. Table Rock Island, Ont.	400[r]	400[d]	400[r]	400[r]	400[r]	400[r]	400[r]	400[r]	400[r]
Total (Canada)	13 791	—	—	—	—	—	—	—	71 512
Total (USA)	10 132	—	—	—	—	—	—	—	25 518
Grand total (Canada and USA)	23 923	—	—	—	—	—	—	—	97 030

[a] Scharf *et al.* (1978).
[b] W.C. Scharf (pers. commun. to L. Schumann).
[c] Based on info for other year(s) and 10% annual growth rate.
[d] Blokpoel and McKeating (1979).
[e] H. Blokpoel (unpublished nest counts).
[f] D.V. Weseloh (pers. commun.).
[g] Tessen (1977).
[h] D.S. Case (pers. commun.).
[i] Weir (1983).
[j] A. Wormington (pers. commun.).
[k] McCracken *et al.* (1981).
[l] P. Madore (pers. commun.).
[m] C.J. Risley (pers. commun.).
[n] H.J. Kerwin (pers. commun.).
[p] A.R. Clark (pers. commun. to CWS London, Ont.).
[q] A.R. Clark (pers. commun.).
[r] Island was saturated in 1977.

2.4. Lake Erie area (from Sarnia to Niagara-on-the-Lake, see Fig. 5)

The available information for the Lake Erie area including the St. Clair River, Lake St. Clair, the Detroit River, and the Niagara River is presented in Table 2. To allow a comparison between 1976 and 1984, several "guesstimates" had to be made, as explained in the footnotes to Table 2.

As Table 2 shows, the population increased from almost 24 000 nests in 9 colonies in 1976 to about 97 000 nests in 13 colonies in 1984, an increase of more than 400% or an average annual growth rate of 19.1%.

Of the 13 colonies active in 1984, 11 were on man-made or man-altered habitat and 5 were on the mainland (as opposed to being on an island). During the period two small unsuccessful colonies were temporarily established at Long Point and Point Pelee. The colony at Nanticoke was disrupted by removal of eggs and nests early in the 1984 breeding season and nesting there will be discouraged in coming years. Tower Island and Table Rock Island are virtually saturated but most other colony sites still have room for further expansion, especially Fighting Island and Pt. Colborne Mainland.

2.5. Lake Ontario (east to Cape Vincent, N.Y., see Fig. 6)

In Lake Ontario, the population increased from 116 000 pairs in 5 colonies in 1976 to 239 000 pairs in 11 colonies in 1984 (Table 3). This represents an increase of 206% over the 8-year period, or an average annual growth rate of 9.4%.

Of the nine colonies with more than 100 nests existing in 1984, four were on man-made or man-altered sites and three were on the mainland. During the 1976–84 period one small colony became temporarily established on Carl Island. At the Eastern Headland and Mugg's Island the colonies are likely to decline because of (1) an increase in the vegetation due to natural succession, which makes the habitat less suitable for nesting, and (2) a program to deter the gulls from nesting in certain portions of the areas. Little Galloo Island, Gull Island, and to a lesser extent, Pigeon Island are saturated with gull nests and numbers there are likely to remain stable. At Hamilton Harbour, Bowmanville, and High Bluff Island there is still ample room for expansion and we predict rapid growth of those colonies.

Some Ring-billed Gull colonies in Ontario have grown spectacularly. At the Eastern Headland of the Toronto Outer Harbour the gulleries increased from 21 nests in 1973 to 74 500 in 1984

Photo: H. Blokpoel

Figure 5
Locations of Ring-billed Gull colonies in the Lake Erie area from Sarnia to Niagara-on-the-Lake

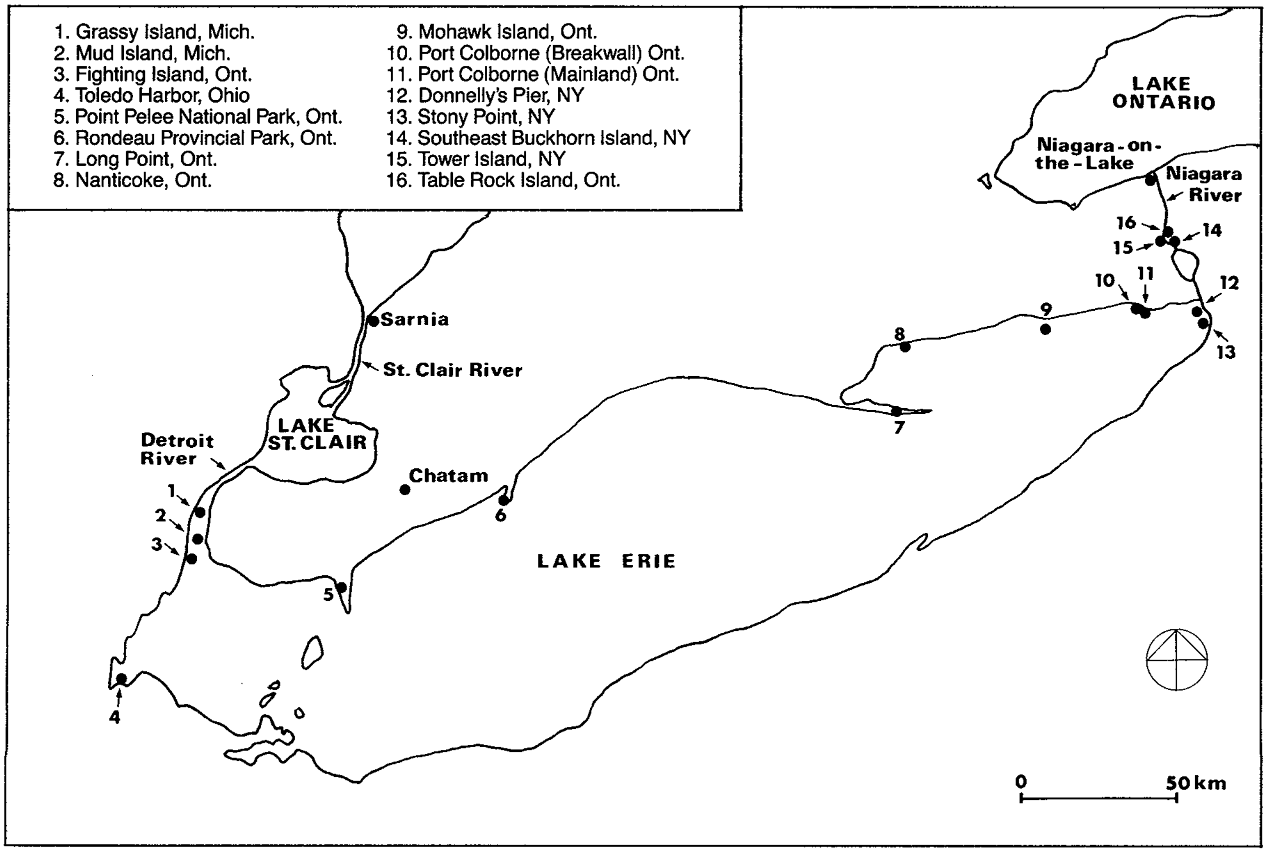


Figure 6
Locations of Ring-billed Gull colonies on Lake Ontario and the St. Lawrence River

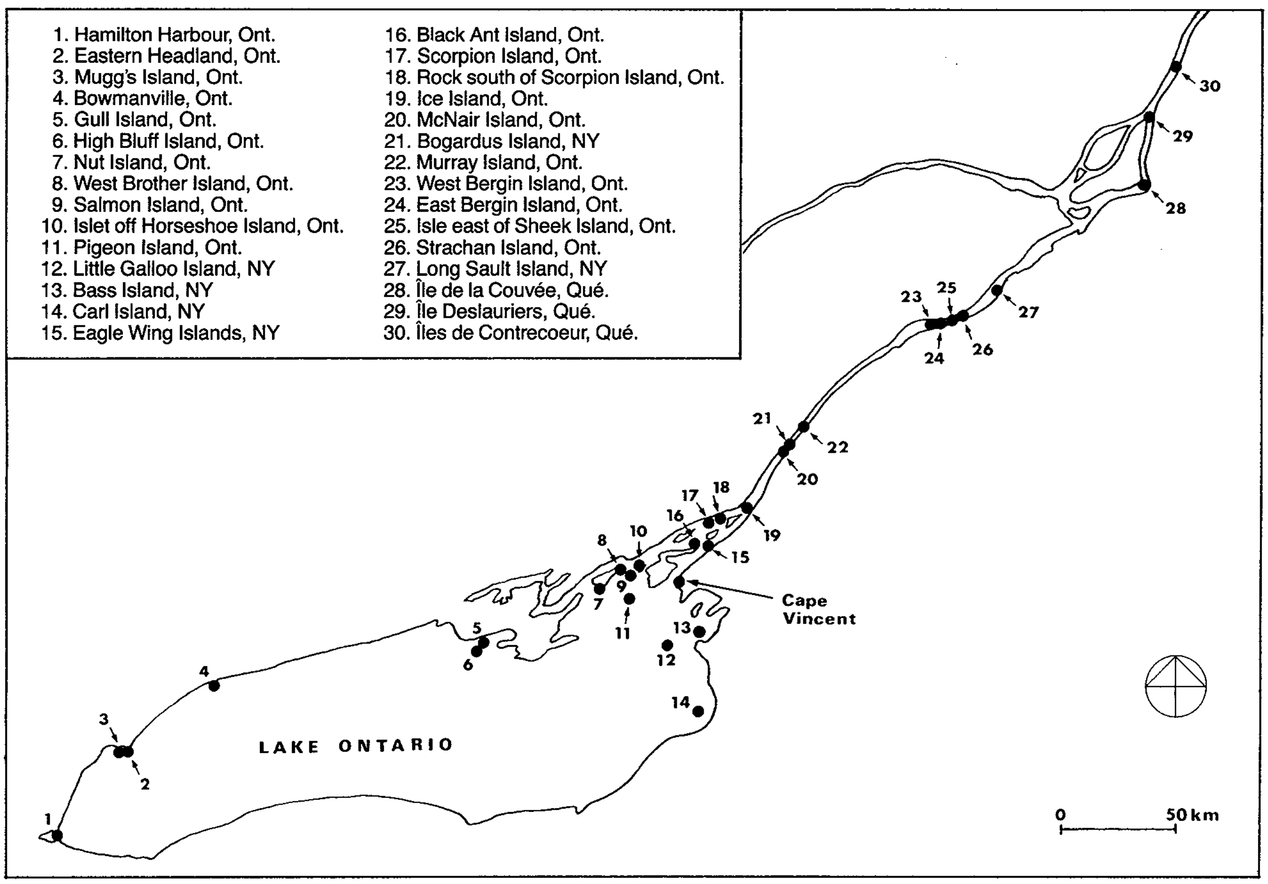


Table 3
Numbers of Ring-billed Gull nests at colonies in Lake Ontario, 1976–84. The numbers in the first column refer to Figure 6

	1976	1977	1978	1979	1980	1981	1982	1983	1984
1. Hamilton Harbour, Ont.	0[a]	—	—	—	329[b]	1 800– 2 400[b]	—	—	11 224[b]
2. Eastern Headland, Ont.	10 382[a]	20 564[c]	22 735[c]	31 000[c]	66 528[d]	70 000–75 000[e]	75 000–80 000[f]	70 000–80 000[g]	74 564[b]
3. Mugg's Island, Ont.	3 885[a]	—	—	—	6 045[b]	—	—	—	7 715[b]
4. Bowmanville, Ont.	0[a]	—	—	—	—	"several hundreds"[h]	"thousands"[h]	5 000[b]	10 731[b]
5. Gull Island, Ont.	23 707[a]	—	26 504[b]	27 000[i]	27 000[i]	27 000[i]	27 000[i]	27 000[i]	27 000[i]
6. High Bluff Island, Ont.	0[a]	—	—	679[j]	—	10 000–15 000[k]	—	20 000[k]	27 135[b]
7. Nut Island, Ont.	0[a]	0[m]	0[m]	—	—	300[l]	—	0[m]	0[m]
8. West Brother Island, Ont.	0[a]	0[l]	0[l]	0[l]	0[l]	18[l]	—	0[n]	0[p]
9. Salmon Island, Ont.	0[a]	—	—	—	—	200[l]	—	200[n]	220[p]
10. Islet off Horseshoe Island, Ont.	0[a]	0	0	0	0	3[l]	—	—	4[p]
11. Pigeon Island, Ont.	2 813[a]	2 500[q]	5 010[r]	—	5 000[s]	4 000[l]	5 000[i]	5 000[i]	5 000[i]
12. Little Galloo Island, NY	75 000[i]	75 000[i]	77 000[t]	—	—	73 780[e]	75 000[i]	75 000[i]	75 000[i]
13. Bass Island, NY	0[u]	37[u]	—	—	—	—	0[v]	—	20[v]
14. Carl Island, NY	0[u]	—	—	—	—	—	170[v]	—	0[v]
Total (Canada)	40 787	—	—	—	—	—	—	—	163 593
Total (USA)	75 000	—	—	—	—	—	—	—	75 020
Grand total	115 787	—	—	—	—	—	—	—	238 613

[a] Blokpoel (1977*a*).
[b] H. Blokpoel (unpubl. data).
[c] Courtney and Blokpoel (1980).
[d] Fetterolf *et al.* (1984).
[e] Blokpoel and Weseloh (1982).
[f] Blokpoel and Tessier (1984).
[g] Blokpoel and Tessier (1983).
[h] J. Richards (pers. commun.).
[i] Estimated maximum occupancy.
[j] R.D. McRae (pers. commun.).
[k] G.A. Fox (pers. commun.).
[l] Weir (1981).
[m] G. Matthews (pers. commun.).
[n] D.V. Weseloh (pers. commun.).
[p] Estimated from data for other year(s) using 10% annual growth rate.
[q] Goodwin (1977).
[r] I.M. Price (pers. commun.).
[s] Goodwin (1980).
[t] Chamberlaine (1978).
[u] Scharf *et al.* (1978).
[v] G.A. Smith (pers. commun.).

Table 4
Numbers of Ring-billed Gull nests at colonies in (*a*) the upper St. Lawrence River (Cape Vincent, N.Y. to Cornwall, Ont.) and (*b*) the Montreal Area, 1976–84. The numbers in the first column refer to Figure 6

	1976	1977	1978	1979	1980	1981	1982	1983	1984
(*a*)									
15. Eagle Wing Islands, NY	0[a]	—	—	10[b]	—	—	28[a]	—	125[a]
16. Black Ant Island, Ont.	0[c]	—	131[d]	—	8[e]	7[e]	14[a]	—	0[a]
17. Scorpion Island, Ont.	0[c]	—	1[d]	1[e]	21[f]	132[e]	272[a]	—	550[a]
18. Rock s. of Scorpion Island, Ont.	0[c]	—	2[d]	—	—	0[e]	—	—	0[a]
19. Ice Island, Ont.	0[c]	19[d]	131[d]	7[a]	0[f]	0[e]	0[a]	—	0[a]
20. Murray Island, Ont.	13[c]	0[d]	1[d]	38[e]	175[f]	—	700[a]	—	900[a]
21. McNair Island, Ont.	0[c]	—	0[d]	—	—	—	450[a]	—	550[a]
22. Bogardus Island, NY	0[g]	0[g]	0[d]	—	—	—	463[a]	—	550[a]
23. West Bergin Island, Ont.	6[c]	0[d]	40[d]	—	—	—	0[a]	—	0[g]
24. East Bergin Island, Ont.	0[c]	0[d]	2[d]	—	—	—	0[a]	—	0[g]
25. Long Sault Island, NY	0[d]	0[d]	5[d]	—	—	—	0[a]	—	0[a]
26. Islet e. of Sheek Island, Ont.	1[c]	—	7[h]	—	1[i]	1[i]	13[i]	—	0[a]
27. Strachan Islands, Ont.	4 893[c]	5 000[d]	7 803[h]	8 583[g]	9 829[h]	10 812[g]	11 893[g]	—	14 000[j]
Total (Canada)	4 913	—	—	—	—	—	—	—	16 000
Total (USA)	0	—	—	—	—	—	—	—	675
(*b*)									
28. Île de la Couvée, Que.	9 017[g]	9 918[g]	10 910[k]	15 228[k]	14 732[k]	14 331[k]	16 093[k]	17 702[k]	19 473[g]
29. Île Deslauriers, Que.	1 662[g]	1 829[g]	2 012[k]	4 413[k]	4 961[k]	5 340[k]	5 874[g]	6 461[g]	7 108[g]
30. Îles de Contrecoeur, Que.	6 151[k]	—	8 954[k]	8 595[k]	9 626[k]	8 800[k]	8 994[l]	8 994[l]	8 994[l]
Total (Canada)	16 830	—	—	—	—	—	—	—	35 575
Grand total (Canada)	21 743	—	—	—	—	—	—	—	51 575
Grand total (USA)	0	—	—	—	—	—	—	—	675
Grand total (Canada & USA)	21 743	—	—	—	—	—	—	—	52 250

[a] G.A. Smith (pers. commun.).
[b] J.W.A. Bonser (pers. commun.).
[c] Blokpoel (1977*a*).
[d] Maxwell and Smith (1983*a*).
[e] B. Andress (pers. commun.).
[f] D. Ross (pers. commun.).
[g] Estimated from data for other year(s) using 10% annual growth rate.
[h] H. Blokpoel (unpubl. nest counts).
[i] J. van Riet (pers. commun.).
[j] Estimated maximum occupancy.
[k] Mousseau (1984*a*).
[l] Average for 1978–81.

2.6. Upper St. Lawrence River (Cape Vincent, N.Y. to Cornwall, Ont., see Fig. 6)

The available information, presented in Table 4(*a*), shows that the estimated population more than tripled from 5000 pairs in 1976 to 17 000 pairs in 1984. This corresponds to an average annual growth rate of 16.5%. All colonies active in 1984 were on islands.

In this area there is heavy commercial and pleasure boat traffic and many of the islands receive intense summer use. The dominant colony is the one on the Strachan Islands near Cornwall, Ontario, which grew from 4893 nests in 1976 to an estimated 14 000 nests in 1984. This site is now presumably fully occupied by nesting gulls. The island complex was created when the river level increased after completion of the dam in Cornwall. Five new colonies became established on Eagle Wing, Scorpion, Murray, McNair, and Bogardus Islands. All these natural islands are much smaller and less suitable for nesting than the Strachan Islands complex.

2.7. Montreal area (St. Lawrence River from Montreal down to Trois-Rivières, see Fig. 6)

Neither Blokpoel (1977*a*) nor Mousseau (1984*a*) reports Ring-bills breeding on the St. Lawrence River between Cornwall and the Montreal area. In the Montreal area nest numbers more than doubled, increasing from about 17 000 (on four colonies) in 1976 to some 36 000 (on six colonies) in 1984 (Table 4(*b*)). This represents an average annual growth rate of 9.8%.

There is still room for expansion on most islands and a further population increase is expected (P. Mousseau, pers. commun.). One of the six colonies active in 1984 is on a man-made site.

2.8. The entire Great Lakes area

According to Ludwig (1974) the Great Lakes population in 1967 was at least 141 000 pairs. Our estimates indicate that the nesting population had almost doubled by 1976 (281 000 pairs, Table 1). This increase represents an average annual population growth of 7.9% during 1967–76. By 1984 the estimated population had again more than doubled (648 000 pairs), increasing at an average annual growth rate of 11.0% during 1976–84. Thus both the population and the growth rate are increasing.

Of the total 1984 nesting population of 648 000 pairs on the Great Lakes, 34% was in the USA and 66% in Canada. When we include the figures for the Upper St. Lawrence River and the Montreal area, the total becomes 700 000 pairs (32% in the USA and 68% in Canada). These 700 000 pairs were distributed over an estimated minimum of 169 colonies. A conservative estimate of average fledging success in the Great Lakes area is 1.5 chicks per nest (see Table 5) or 1 050 000 fledglings produced by the 1 400 000 adults nesting in 1984. Including the large but unknown numbers of non-nesting 1-year-olds and 2-year-olds, as well as any non-nesting adults, the total population in the Great Lakes area at the end of the 1984 breeding season was probably in excess of 3 000 000 individuals.

Our calculated growth rate of the nesting population in the Great Lakes area is, of course, only as good as our population estimates, which in turn depend on assumed growth rates for three lakes and several colonies on the remaining two lakes. We believe that we made reasonable assumptions and consider the above figures adequate for the purpose of this report.

Ecology during the breeding season

1. Breeding chronology

Although some Ring-bills spend the winter on the lower Great Lakes, most gulls migrate to warmer areas along the Atlantic coast of the southern USA (Fig. 1). Many gulls return to the colonies in early spring. For example, at the Eastern Headland colony in Toronto most gulls return in March. Often there is still snow on the ground and ice in the embayments of the Toronto Harbour when the gulls begin to arrive in good numbers. Soon after their return they start establishing and defending territories.

At the Headland the first eggs are usually laid around 22 April, with the peak of laying during the first week of May. The normal clutch is three eggs (Table 5). About 24 days after clutch completion, the eggs begin to hatch. Thus peak hatching is usually during the last week of May. Most chicks fledge about 7 weeks after hatching and many young gulls begin to leave the Headland during the second week of July. At Granite Island on the north shore of Lake Superior the breeding schedule is basically the same, but 2 to 3 weeks later (D. Boersma, pers. commun.).

2. Nesting habitats and substrates

In general, Ring-bills prefer to nest on islands with sparse, low vegetation. In the Great Lakes such islands are also preferred sites of Herring Gulls (*Larus argentatus*), Caspian Terns (*Sterna caspia*), and Common Terns (*Sterna hirundo*).

As many natural islands are either fully occupied (e.g. Little Galloo Island, Table 3) or taken over by people, many Ring-bills now nest on several man-made sites that are insular (e.g. Strachan Islands and Donnelly's Pier) or peninsular (e.g. the Eastern Headland and Port Colborne Mainland).

The Ring-bill benefits greatly from its ability to nest on various artificial sites such as construction sites, harbour dykes, dredge spoil areas, piles of rubble, and slag dumps. Scharf (1981) pointed out the importance of man-made habitat for Ring-bills nesting in the US Great Lakes. Ring-bills even nested on a garbage dump near Ottawa (Weir 1983).

Nesting substrates vary greatly, including sand, earth, driftwood, concrete, slag, rocks, and boulders.

At the Eastern Headland we noted that the Ring-billed Gulls did not colonize completely bare, sandy areas. As soon as some vegetation, e.g. young cottonwoods, had colonized the bare areas, some Ring-bills would begin to nest close to that vegetation. These nesting gulls apparently attracted other gulls, many of which had to nest in the bare areas. When the young cottonwoods increased in height in following years, the Ring-bills kept coming back to their nest sites and at present many gulls nest in dense stands of cottonwoods 5–8 m tall. At some other colonies, e.g. Mugg's Island, Ring-bills are found nesting under tall trees as well.

3. Nest densities

Ring-bills are very gregarious and they nest in tightly packed colonies. The nest density varies somewhat with the nesting habitat. At the Eastern Headland in 1982 we counted nests in plots of 5 × 5 m^2 and obtained the following nest densities:

	Number of nests/m^2		Number of
	Mean	Range	plots
Beach completely covered with driftwood	1.3	1.24–1.32	3
Sandy soil with willows (90–120 cm high)	0.9	0.80–1.16	3
Piles of rocks and broken concrete	0.9	0.68–1.00	5
Wet meadow	0.8	0.64–0.88	3
Bare sand with small pepples	0.6	0.56–0.72	3
Pebble beach	0.6	0.44–0.72	4
Sandy soil with cottonwoods (360–500 cm high)	0.5	0.40–0.60	3

Table 6
Food of Ring-billed Gulls during the breeding season at colonies in the Great Lakes and St. Lawrence River

Area, location, year	Food (A = adult, C = chick)
Lake Michigan	
Île aux Galets, 1971[a]	Mainly fish, insects, and earthworms (A, C)
Lake Huron	
Rogers City, 1964[a]	Insects and fish (A, C)
Rogers City and Bird Island 1971[a]	Mainly fish, insects, and earthworms (A, C)
Chantry Island, 1978[b]	Mainly earthworms, voles, fish, corn, insects; some small birds, and garbage (A, C)
Lake Ontario	
Eastern Headland, 1977[c]	Mainly fish, insects, and earthworms (C)
Gull Island, 1977[d]	Mainly fish and insects. Occasionally earthworms (C)
Montreal area	
Île de la Couvée, 1978[e]	Mainly insects, garbage, earthworms and fish. Some molluscs and one vole (C)

[a] Jarvis and Southern 1976.
[b] Allan 1978.
[c] Haymes and Blokpoel 1978*b*.
[d] Kirkham and Morris 1979.
[e] Lagrenade and Mousseau 1981*a*.

Table 5
Main results of published studies of reproductive success of Ring-billed Gulls at colonies in the Great Lakes and St. Lawrence River

Lake and location	Years	Method (no. visits)	Mean clutch size	Nests (*N*)	Chicks hatched per egg laid (%)	Fledglings per egg hatched (%)	Age when fledged (days)	Fledglings per nest
1) *Lake Superior*								
Granite Island, centre[a]	1977	daily	3.19	325	59.5	54.3	21	1.03
Granite Island, edge[a]	1977	daily	3.08	80	58.5	59.0	21	1.06
Granite Island, early[b]	1979	every second or third day	2.90	67	73.2	69.6	21	1.47
2) *Lakes Huron and Michigan*								
26 colonies[c]	1960–65	—	2.96	6700	91	74	—	1.74
3) *Lake Huron*								
Rogers City[d]	1972	every second day	2.83	80	62.8	86.6	21	1.54
Bird Island[d]	1972	every second day	2.73	107	59.6	69.5	21	1.13
4) *Lake Ontario*								
Toronto Outer Harb., early[e]	1977	daily	2.97	82	83	61	23	1.50
Mugg's Island[f]	1977	least disturbance	2.88	85	93	95	35	2.53
Mugg's Island[f]	1977	medium disturbance	2.99	75	90	77	35	2.05
Mugg's Island[f]	1977	most disturbance	2.96	53	79	57	35	1.34
5) *Upper St. Lawrence River*								
Ice Island[g]	1978	daily	2.42	123	74.4	—	—	—
6) *Montreal area*								
Île de la Couvée[h]	1978	every third day	2.90	386	74	49	21	1.04
Île de la Couvée[h]	1978	every third day	2.90	386	74	36	65	0.77
Lefebvre Island[i]	1979	3 planned visits	2.82	193	75.2	89.8	23	1.91
Petite Colonie Island[i]	1979	every second day	2.88	120	74.9	80.3	23	1.73
Petite Colonie Island[i]	1979	3 planned visits, "simulated"	2.89	109	79.7	56.2	23	1.29

[a] Ryder and Ryder (1983).
[b] Boersma and Ryder (1983).
[c] Ludwig (1966).
[d] Dexheimer and Southern (1974).
[e] Haymes and Blokpoel (1978*c*), early plots for which fledging success was known.
[f] Fetterolf (1983*a*).
[g] Maxwell and Smith (1983*b*).
[h] Lagrenade and Mousseau (1981*b*).
[i] Mousseau (1984*b*).

4. Food

Studies of the food of Ring-billed Gulls during the breeding season indicate opportunistic feeding habits, as is evident from the enormously varied diet, including fish, earthworms, insects, voles, small songbirds, corn, and garbage (Table 6).

After the breeding season the gulls disperse and often become a pest by feeding on cash crops and by begging for food. One Ontario farmer is convinced that the gulls are learning to feed on his tomatoes: during 1982–84 the number of gulls in his fields and the amount of damage greatly increased. Although no study was done, it may well be that the opportunistic Ring-bill has only just begun to eat tomatoes. In New York State some Ring-bills have learned to snatch unpicked cherries from the trees (Kibbe 1979).

The diverse diet is the result of the gull's agility and adaptability: it can plunge dive for fish, hawk for insects in the air (Pettingill 1958, Lauro 1977), follow the plow looking for earthworms and grubs (Hailman 1960), scrounge french fries at fast food outlets, hunt for voles in fields, and forage at garbage dumps among dump trucks and bulldozers.

Although some of the feeding by Ring-bills results in conflicts with man, they also play a useful role by eating undesirable insects, grubs, and voles, and by removing food remains from public areas.

5. Factors affecting reproductive success

5.1. Predation

In the Great Lakes area, predators in Ring-billed Gull colonies include foxes, raccoons, skunks, and Great Horned Owls (*Bubo virginianus*) (Emlen *et al.* 1966, Shugart 1977, Patton and Southern 1978, Southern *et al.* 1982).

The nocturnal presence of predators at a colony may result in destruction of some eggs, young, and adults, as well as in temporary desertion of the colony by the adults. These panic flights may cause additional mortality when eggs and young chicks are left unattended for several hours during cold nights (Emlen *et al.* 1966, see also Hunter *et al.* 1976).

There is also a report of a garter snake eating two Ring-bill chicks (Fetterolf 1979). So far, there are no reports of rat predation at Great Lake gulleries, even though many colonies are near cities and/or on the mainland. In conclusion, predation does not appear to be significant in the Great Lakes area.

5.2. Disturbance by people and their pets

As many colonies are located near towns, human visits are almost inevitable. Some specific examples include a group of photographers dropped off for the day at the Port Colborne Breakwall colony, boys on trail bikes driving through the Port Colborne Mainland colony, and people occasionally allowing their dogs to run loose through the Eastern Headland colonies. Impacts are difficult to measure and vary with the phase of breeding.

5.3. Food shortage

Perhaps because the Ring-bill has such a varied diet, there have been no published reports of large-scale starvation of either adults or chicks on the breeding colonies. The only exception occurred in 1983 during a week-long heat wave, which warmed the surface water of Lake Ontario near the Eastern Headland. This probably forced smelt and alewives down to cooler water layers, where they were unavailable to Ring-bills. During that week considerable mortality occurred, especially among larger chicks (P.M. Fetterolf, pers. commun.).

Ecology after the breeding season

After the breeding season, the inexperienced young-of-the-year have to learn to forage, to defend themselves, to find safe places to rest and to roost, and to stay out of the way of approaching dangers such as vehicles and aircraft. Many young birds are unable to cope with their hazardous surroundings and die of injuries, diseases and/or starvation.

The post-breeding activities of gulls near Kingston in southeastern Ontario consisted of (1) flying from the night-time roost to the day-time feeding area (a garbage dump), (2) feeding at the dump, (3) loafing at loafing areas near the dump, (4) occasional swarm circling, i.e. soaring in a compact flock up to some 1000 m, and (5) flying back from the feeding area to the roost. The gulls left the Kingston area in early December just after the local freezing of Lake Ontario and it was postulated that the lack of drinking water near the dump triggered the departure (Cooke and Ross 1972).

Population dynamics

The size of any population is determined by natality, mortality, immigration, and emigration.

1. Natality

For the purpose of this report we consider natality to be the number of chicks fledged per nest. This variable is usually referred to as the reproductive success. There have been several published studies of reproductive success of Ring-bills on the Great Lakes and St. Lawrence River (Table 6).

A comparison of the results of the different studies is confounded by two variables: (1) the age at which the different investigators considered the chicks to be fledged, and (2) the amount of disturbance caused by the investigators during their studies.

Ring-bill chicks normally fledge, i.e. are capable of sustained free flight, at the age of about 35 days (Fetterolf 1983*a*), but many authors consider the chicks to have fledged at an earlier date (Table 6). Although most pre-fledge chick mortality occurs during the first 21 days of life there can be a certain amount of mortality between day 21 and day 35 (see Île de la Couvée, 1978, Table 6).

In field studies, the investigator often has an effect on the subject under study. This so-called "investigator effect" has affected the outcome of many studies of Ring-billed Gull reproductive success. Studies where human disturbance is kept to a minimum show a higher reproductive success than those where disturbance was relatively intense and/or frequent (Fetterolf 1983*a*, Mousseau 1984*b*). Thus, the real reproductive success reported in some of the studies listed in Table 6 may have been somewhat higher than indicated.

2. Mortality

There have been few studies of mortality of Great Lakes Ring-billed Gulls. Working in colonies in Lake Huron and Lake Michigan in 1965, Ludwig (1966) netted 120 banded adults. In that sample there were 19 2-year-old, 34 3-year-old, and 27 4-year-old gulls. From this age distribution he concluded that in that population nearly half of the 2-year-olds and all of the 3-year-olds bred. This conclusion may be incorrect because he apparently did not consider banding effort in each of the preceding years: The more chicks that are banded in year X the greater the chance of trapping 2-year-olds in year X + 2, 3-year-olds in year X + 3, etc. From these data and unpublished banding recoveries, pre-adult mortality appeared to be near 60% of the fledged birds and adult mortality was about 12% (Ludwig 1966).

In a later paper, Ludwig (1967) studied the effect of band loss (caused by band wear) on calculations of survival in Great Lakes Ring-bills. He found that band loss began to depress band recovery rates between the fourth and fifth year, and that after the sixth year band loss assumed a constant rate of 38% per year of the surviving bands. Ludwig compiled correction factors from his band-loss study and applied them to raw banding data. This produced corrected estimates of survivorship: 49.7% of Ring-bill fledglings survived to the mean age of first breeding (about 2.5 years) and 13% of the adults died annually.

The only other information on mortality in Ring-bills can be gleaned from a paper by Southern and Southern (1985), who discussed the effects of wing-tags. In 1982 they trapped and colour-banded 53 adult Ring-bills and 48 (90.6%) of these gulls were observed on their colony in 1983. Thus for that particular group of adult birds the annual mortality during that particular year was at most 9.4%. This mortality figure would be significantly lower even if only a few more colour-banded birds had returned to the colony (but were missed by the observers) or if a few colour-banded birds had nested in a different colony in 1983.

3. Emigration and immigration

Emigration (i.e. birds of a certain population leave that group to nest elsewhere) and immigration (i.e. birds that do not belong to a certain population enter its breeding area to nest) are both affected by site tenacity.

From his Lake Huron study, Southern (1967*b*) concluded that Ring-bills do not necessarily return to their natal colony to breed for the first time. Instead, the apparent tendency is for the first-time breeders to select a colony in the general area of their natal colony. Depending on the prevailing environmental conditions they may establish new colonies, enlarge old colonies, or compete with established adults in fully occupied colonies.

Ring-bills that have nested in a stable colony show a strong tendency to return to the same colony and same nest site in following years (Southern 1977, Southern and Southern 1980). Even in a new, rapidly changing colony this site tenacity was evident and increased significantly with age of the birds (Blokpoel and Courtney 1980).

The spectacular growth of the Ring-bill colony complex at the Eastern Headland, from some 21 pairs in 1973 to 22 735 pairs in 1978, provided an unique opportunity to study the pattern of immigration at that site. Blokpoel and Haymes (1979) studied the origins of the immigrants that had colonized the area by 1977. In that year the colony had already grown to some 20 000 pairs, including 214 banded birds that had been banded at other colonies. At that time no Ring-bills had yet been banded at the Headland. Of the

214 banded birds, 200 (93%) had been banded as chicks and 14 (7%) as adults. The 200 birds banded as chicks had been banded at 16 colonies on the Great Lakes (northern Lake Michigan, Lake Huron, the Detroit River, eastern Lake Erie, and Lake Ontario) and one colony in Lake Champlain, N.Y. During a follow-up study in 1978, Blokpoel and Courtney (1982) encountered 276 3- to 6-year-old banded Ring-bills at the Headland that had been banded on 19 colonies of origin (Fig. 7). There was great variability in the number of banded birds contributed by the different "donor" colonies (here referred to as colonies of origin). This was to be expected because there was great variability in banding effort at the colonies of origin in preceding years. From the banding reports submitted by the banders to the Banding Office, Blokpoel and Courtney (1982) calculated for each colony of origin the "contribution index", i.e. the actual number of banded birds encountered at the Headland in 1978, expressed as a proportion of the number of birds banded at the colonies of origin and expected to be still alive in 1978. They calculated contribution indices for 3-to 6-year-old Ring-bills only, because many do not begin to breed until they are 3 years old, and the great majority of the encountered banded birds were in that group.

The natural logarithm of the contribution index for each colony of origin was then plotted against the distance from the Headland. In addition, the regression equation was calculated. There was a significant relationship between the

Figure 8
Regression line and regression equation describing the relation between contribution index and distance between the colonies of origin and the Eastern Headland. See text for explanation

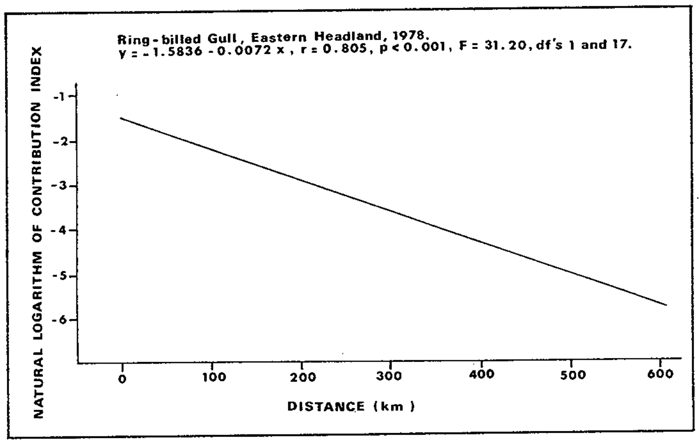
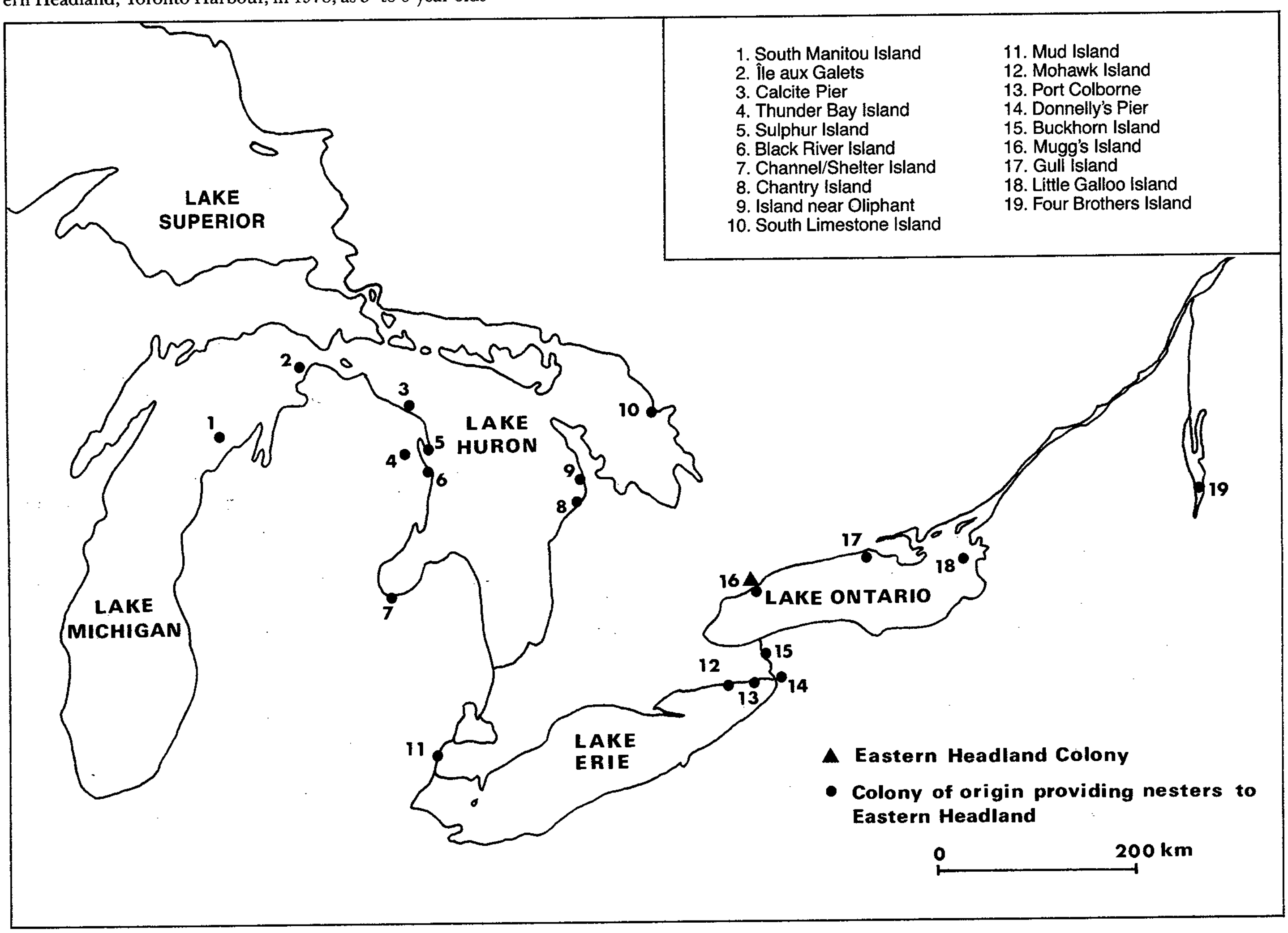


Figure 7
Colonies of origin of banded Ring-billed Gulls that were nesting at the Eastern Headland, Toronto Harbour, in 1978, as 3- to 6-year olds



natural logarithm of the contribution index and the distance from colony of origin (Fig. 8).

The regression equation was then used to estimate how many 3- to 6-year-old unbanded birds from the known colonies of origin and from any other known Ring-bill colony (of more than 400 pairs and within a 550-km radius) had emigrated to the Headland by 1978. This figure was 28 032 birds or 62% of the 45 470 gulls that nested at the Headland in 1978. More than 60% of the colonizers was thus "accounted for" by immigration of 3- to 6-year-olds from 44 colonies of origin and recruitment from the Headland itself. The remainder of the gulls nesting in 1978 presumably consisted of birds younger than 3 years, older than 7 years, and of any age from colonies that were either unknown or for which population information was lacking.

4. Future population size

There appears to be very little interchange between the eastern and western populations (Ryder *et al.* 1983). The great bulk of the eastern population nests at present in the Great Lakes and the St. Lawrence River down to Trois-Rivières. We do not know how many gulls emigrate out of this "heartland" to the fringe areas on the North Shore and in the Maritimes. We assume here that immigration into and emigration out of the "heartland" area are negligible. This means that the population size of the Great Lakes/St. Lawrence River area is determined solely by natality and mortality.

Ludwig (1967) stated that a fledgling rate of 0.523 per pair suffices to maintain a stable population. Even if no gulls breed until their third year and none contribute young after their 25th year, only 0.63 fledglings per pair annually will keep the population stable (Ludwig 1967). As Ludwig (1974) pointed out, that value is in good agreement with Emlen's (1956) field estimate of 0.67 fledglings produced per pair, made in 1952 and 1953 at a colony in Lake Michigan when that population was stable.

In recent years the reproductive success has been much higher than that reported by Emlen (1956). Assuming that annual mortality will not significantly increase, we predict further substantial increases in the numbers of Ring-bills nesting in the Great Lakes/St. Lawrence River region.

5. Limiting factors

The rapid growth of the Great Lakes Ring-bill population over the last 35 years cannot continue indefinitely, and the question is: what are the factors that will eventually limit the population if no human efforts are made to reduce the population?

It is unlikely that food will soon become the limiting factor because the gulls feed on almost anything and when feeding conditions deteriorate in early winter they migrate to better areas.

Natural nesting habitat, at least on the lower Great Lakes, is getting scarce. However, the Ring-bills adapt by nesting on marginal natural habitat and by switching to man-made habitat. The recently discovered colonies in inland Ontario suggest that the gulls may have begun to invade the lakes of central and northern Ontario. A similar trend was noted in Quebec (Mousseau 1984).

Diseases, pollution, and predation, even if serious for one or more years in a part of the breeding range, would certainly affect the population size but would not, in the long term, limit gull numbers on the entire breeding range.

In sum, we do not yet know the limiting factors of the Great Lakes Ring-bill population.

Conflicts with man's interests

The growing numbers of Ring-billed Gulls have resulted in an increasing number of problems, especially in southern Ontario. These problems are reviewed below.

1. Damage in farm areas

Ontario farmers complain about the increasing damage to their crops and the reduction of earthworm populations in their fields because many worms are eaten by Ring-billed Gulls during ground-tilling operations.

The nature, extent, and dollar value of damage caused by gulls to agriculture in Ontario is not well documented. CWS mailed a questionnaire to 84 farmers in southern Ontario who had received a permit in 1984 to scare and/or kill gulls that were damaging their crops. The main topics of this questionnaire survey were the issuing of permits, the effectiveness of shotgun patrols, and the damage caused by gulls. An analysis of the 60 questionnaires that had been returned by the middle of January 1985 (Blokpoel 1985) showed the nature and frequency of crop damage. The following table shows the numbers of farmers who reported a particular kind of damage.

	Pecking/ eating	Pulling shoots or seeds	Trampling	Defecating
Tomatoes	40	5	4	8
Corn	7	6	2	2
Beans	6	3	2	3
Wheat	4	2	5	2
Strawberries	4	1	2	2
Cucumbers	4	0	0	0
Asparagus	2	0	0	0
Onions	1	2	1	0
Cherries	1	0	0	0
Peas	1	0	0	1

Of the 60 farmers who returned the questionnaire, 36 were able to put a dollar figure on the damage caused by the gulls. These estimated a total of $43 780 in damage. In addition, four farmers reported that damage was "substantial" and seven reported that damage was "light" or "minor". It is likely that the total damage suffered by the 60 farmers was about $50 000. This amount does not include costs associated with preventing damage (e.g. the extra man hours and shotgun shells needed to scare the gulls). After the returned questionnaires had been analysed, only one more questionnaire was received. That grower reported a loss to his tomatoes of $14 000 – $16 000.

Gulls are frequently involved in bird strikes because they often loaf in groups at or near airports and they are not very adept at avoiding approaching aircraft

Photo: H. Blokpoel

It is not known how much damage was suffered by other farmers in southern Ontario and a scientific survey of gull-related damage to agriculture in all of Ontario should be undertaken.

Regarding the often-expressed concern that gulls eat too many earthworms, there has been no investigation to determine the impact of Ring-bills on the soil fauna of Ontario's farmlands. In Switzerland, farmers worried about a possible reduction of soil fertility due to earthworm depletion by increasing numbers of wintering Black-headed Gulls (*Larus ridibundus*). A detailed study during 1975–78 by Cuendet (1979) arrived at the following conclusions:

> "During ploughing and harrowing, the Black-headed Gulls are able to eat 5 to 13% of the earthworm biomass present in a given field. However, at least 25% of the ingested worms have been previously wounded by the machines, and they would die in any case. The most frequently recorded biomasses of earthworms vary between 1000 and 2000 kg/ha. One Black-headed Gull can ingest daily 150 to 200 g of earthworms (wet weight).
>
> Earthworms are an essential food for the Black-headed Gulls, but they cannot decrease significantly the earthworm biomass in the cultivated fields. Earthworm populations are controlled by organic matter present in the soil (i.e. food), not by predation. If food is not limiting, yearly production of earthworms seems equal to the biomass. Consequently, 100% of the biomass can be yearly destroyed without depleting earthworm populations."

Although it is unlikely that Ring-billed Gulls have a significant impact on earthworm numbers on Ontario farms (A.D. Tomlin, pers. commun.), a study should be undertaken to determine the effect of gulls on the soil fauna in Ontario farm areas.

2. Hazards to aircraft

Collisions between birds and airplanes can result in serious damage to the aircraft. Gulls are world-wide hazards at airports because of their relatively large size, slow flight, gregarious nature, and tendency to rest on runways (Blokpoel 1976).

In Ontario, the Ring-billed Gull has become a serious problem at several airports, especially at Toronto International Airport, Toronto Island Airport, Canadian Forces Base Trenton, and North Bay Airport. The gulls visit the airports to feed on insects and earthworms, or to loaf on the tarmac. The open environment of the airfields provides ideal resting areas that have good visibility in all directions.

3. Hazards to human health

With the increase in numbers of gulls frequenting public places, there has been growing concern about their effect on public health in Ontario.

In recent years the Toronto beaches had to be closed in the course of the summer due to high *Escherichia coli* counts in the near-shore water. Some people speculated that the Ring-billed Gulls nesting at the nearby Eastern Headland and Mugg's Island colonies were the main culprits. Although no scientific data are available, circumstantial evidence suggests that the Ring-bills contributed very little to the *E. coli* levels (Fetterolf 1983*b*).

Elsewhere in Ontario, residents living on a small lake have become concerned about possible pollution of the lake water due to the increasing numbers of roosting Ring-billed Gulls. In the UK, bacterial contamination of water supplies by roosting gulls has been reported (e.g. Benton *et al.* 1983). Because of those concerns, we briefly review public health aspects of the growing Ring-bill population.

Aspergillosis, caused by the fungus *Aspergillus fumigatus*, is common in domestic and wild waterfowl but rarely infects man (Austwick 1969, O'Meara and Witter 1971). It has been reported in Herring Gulls in Boston Harbour (Davis and McClung 1940) and in Ring-billed Gulls at the Toronto Waterfront (Broughton 1979).

Histoplasmosis, caused by the fungus *Histoplasmosis capsulatum*, flourishes in concentrated fecal deposits of birds and bats (Gordon and Ziment 1967, Smith 1971). People become infected by inhaling spores, and outbreaks of the disease among humans occur most frequently when soil that contains large quantities of excrement is disturbed (Sarosi *et al.* 1971). There have been two serious outbreaks in the Great Lakes area, both of which were associated with the Ring-billed Gull colony at Rogers City, Michigan. In one incident, a piece of machinery covered with gull excrement was taken indoors for cleaning. After cleaning operations several individuals became ill with a disease later diagnosed as histoplasmosis. Apparently, excrement had accumulated on the machinery during many years in the gullery and provided an ideal substrate for the growth of *H. capsulatum* (W.E. Southern, pers. commun.). The other incident involved university students who had observed gulls from blinds located in the Rogers City gullery. The entire class came down with histoplasmosis and two students were seriously ill. The blinds had apparently served as good incubators for the fungus (W.E. Southern, pers. commun.).

Botulism is caused by a toxin produced by the bacterium *Clostridium botulinum*. The disease is seasonal, occurring in late summer and early autumn, apparently coinciding with maximum build-up of decaying aquatic vegetation, low water levels, and warm temperatures. The disease occurs with great regularity along the Toronto waterfront, affecting waterfowl and gulls (E. Broughton, pers. commun.). During a large-scale outbreak of the disease in Lake Michigan, more than 12 000 gulls and loons died between 1959 and 1964. Five percent of the victims were Ring-billed Gulls (Rosen 1971). The disease in gulls can spread to man through fecal material being ingested or being brought in contact with open wounds. Normal sanitary precautions should prevent people from becoming infected.

Salmonellosis is caused by bacteria in the genus *Salmonella*. In Europe several gull species have been affected by this disease (Steele and Galton 1971) and gulls have caused *Salmonella* pollution in water reservoirs (Benton *et al.* 1983). In Ontario the disease was recently found in young emaciated Ring-billed Gulls (Ontario Ministry of Health 1985). Outbreaks of this disease among gulls have been attributed to the birds' habit of feeding on garbage dumps and sewage disposal sites (Muller 1965). A number of outbreaks in domestic poultry in North America have been the result of contact with free-flying birds. There have been cases of salmonellosis in humans, as a result of handling infected poultry (E. Broughton, pers. commun.), but there are no reports of gull researchers who contracted the disease through the handling of gulls.

Chlamydiosis (also known as ornithosis or psittacosis), caused by the bacterium *Chlamydia psittaci*, is a world-wide disease that is common in caged birds, pigeons, and poultry (Blackmore 1968, LaForce 1977, Iannini 1980). It also occurs in free-flying birds. It has been reported in Herring Gulls in Europe (Miles and Shrivastav 1951) and in Laughing Gulls (*L. atricilla*) and several tern species in North America (Burkhart and Page 1971). Because so many larids have been implicated as carriers of ornithosis and because the pathogen has a wide distribution, some Ring-billed Gulls in the Great Lakes are probably infected. However, we know of no reports of the presence of the disease in Ontario gulls. People can become infected by handling sick or diseased birds. We know of no gull workers who contracted the disease, so passage of the disease from wild bird to man is probably rare.

Campylobacter enteritis is a human illness characterized by acute diarrhoea (Skirrow 1977). At present the disease occurs in Canada more frequently than Salmonellosis (H. Lior, pers. commun.). The illness can be caused by the bacteria *Campylobacter jejuni*, *C. coli*, and *C. laridis* (Skirrow 1977, Tauxe *et al.* 1985). Gulls, pigeons, waterfowl, poultry, cattle, and many other animals may act as a reservoir for these pathogenic species (Skirrow 1977, Benjamin *et al.* 1983).

The time has come for a comprehensive study of the threat to public health posed by the large numbers of Ring-billed Gulls frequenting public places in Ontario. In addition, the possibility of cattle contracting Salmonellosis by grazing on pastures that are used by large numbers of resting Ring-billed Gulls should be investigated. A study in the UK showed that Herring Gulls can transmit salmonellae via their faeces to cattle (Williams *et al.* 1977).

After they leave their colony many young-of-the-year beg for food in public parks such as Ontario Place on Toronto's Waterfront

Photo: H. Blokpoel

4. Nuisance in parks

Complaints about gull nuisance in Ontario parks are numerous. Gulls befoul parking lots, picnick areas, play areas, benches, golf courses, beaches, marinas, docks, and boats. In many cases gulls are initially attracted to parks because some visitors feed them. Gulls then soon learn to beg for food. Their aggressive begging and food stealing is annoying to many people. A survey carried out at Ontario Place, Toronto, showed that 49% of the visitors did not like the large numbers of gulls at the site (V. Cooper, pers. commun.).

Many Ontario parks are on a waterbody and have a beach area. These beach areas are often good resting habitat. It is not surprising that during the summer season several parks have gull problems, because they meet all the ecological requirements of the gulls — a dependable food supply, and safe places for day-time resting and night-time roosting.

Although the nuisance created by gulls is real enough for many park operators and park visitors, it should be kept in mind that some other visitors may enjoy the presence of the gulls despite their dirty habits.

5. Miscellaneous problems

At Ontario Hydro's Generating Station near Nanticoke on Lake Erie, Ring-billed Gulls polluted the water supply for the plant. A growing colony at that site was located adjacent to the main building. The air-intake of the building's ventilation system was located very close to the colony. On hot days the odour circulating through the plant caused nausea among employees.

At Thessalon on the North Channel of Lake Huron a Ring-bill colony became established on a small island just offshore from the town's centre. Hungry gulls stole groceries from pick-up trucks and entered shops. On hot days with light onshore winds, the smell of the gullery pervaded the town.

Some large Ring-bill colonies are located near a city or town. Many newly fledged young-of-the-year die shortly after leaving their colony due to starvation, injuries, or disease. These dying and dead birds are unsightly and unsanitary, and their presence on public beaches is unpleasant to many residents.

In Toronto and elsewhere, Ring-bills have caused problems on flat roofs of large buildings by pulling out insulation material and by plugging drainage pipes with shedded feathers. There is also a report of gulls eating turkey feed at an Ontario turkey farm.

Conflicts with other bird species

1. Common Tern

The Common Terns that nest in the Great Lakes area form a fairly distinct population (Austin 1953, Haymes and Blokpoel 1978*a*) and this population has declined in recent years (Morris and Hunter 1976, Shugart and Scharf 1983, Courtney and Blokpoel 1983). One of the more serious problems that the Common Tern faces in the Great Lakes area is the gradual take-over by Ring-billed Gulls of many preferred colony sites (Morris and Hunter 1976, Courtney and Blokpoel 1983, Maxwell and Smith 1983*a*).

2. Caspian Tern

Ring-bills are nesting in increasing numbers on all Caspian Tern colonies in the Great Lakes. It is not well known whether or not the Ring-bills are taking over traditional Caspian Tern nesting areas. As far as we know, at most colonies numbers of tern nests are either stable or increasing. There are, however, indications that many Caspian Terns are forced to nest on low-lying fringe areas that are prone to inundation.

Another problem is better documented: when people visit Caspian Tern colonies, the terns take readily to the air, giving nearby Ring-billed Gulls a chance to damage their eggs (Quinn 1980, Blokpoel 1981). Because many Caspian Tern colonies are visited by people, the presence of large numbers of Ring-bills may have a negative impact on some colonies.

3. Piping Plover

The Piping Plover (*Charadrius melodus*) has disappeared over most of its range in Ontario and is now officially listed as an endangered species in Ontario. The species was formerly common at Long Point but has not nested there since 1978. Reviewing the decline of the Piping Plover at Long Point, McCracken *et al.* (1981) mention that predation and disturbance of nests by Ring-billed Gulls has possibly been a major factor. Long Point is an important summering area that attracts many thousands of non-nesting Ring-bills.

Gull control

The Ring-billed Gull has become an irritating nuisance in many parts of Ontario and a serious pest in several urban and rural areas. In addition, the burgeoning Ring-bill population is having a negative impact on other bird species. CWS has received many complaints about gull problems and many organizations want to see the gulls controlled in order to reduce those problems as soon as possible.

Until now, gull problems have been dealt with on a case-by-case basis, by attempting to find specific solutions for local problems. In the following section we review how local problems have been dealt with in Ontario.

1. Local solutions to local problems

As mentioned earlier, gulls are protected under the Migratory Birds Convention Act. Although the MBC Act was established to protect birds, it also recognizes the fact that birds can, and do, cause problems. When gulls are causing damage to crops or other property, any person may, *without a permit*, scare them away as long as he does not use firearms or aircraft and does not injure or kill the birds. Where warranted, CWS will issue to the landowner a permit to use a firearm to scare and/or kill gulls. Killing or molesting gulls at their colonies, or taking their nests or eggs is prohibited. Thus scaring gulls from a breeding colony is in general not permitted. CWS may issue a permit to control gulls at a colony if the situation warrants it.

Farm areas — In cases where there is crop damage, CWS issues permits to farmers on an individual basis to use a firearm to scare and/or kill the problem birds on their property. In 1984, 89 permits were issued to farmers in Ontario for gull control. Often a few gulls had to be killed to scare the birds effectively. Leaving the carcasses conspicuously in the field provided an added deterrent in some cases (Blokpoel 1985).

CWS has received reports that some farmers plow at night to minimize the impact of gulls on their earthworm populations. We do not know how widespread or effective this method is.

Airports — Special permits are issued to airports to scare and/or kill birds that present a flight safety hazard. At some Ontario airports Ring-bills and other nuisance birds are scared away by bird control contractors, who use a variety of methods including shell crackers, live shells, gas bangers, and birds of prey. They are allowed to kill birds under the Airport Permit issued to the airport manager. Their techniques have been described (Blokpoel 1977*b*, 1980, 1984*b*) and evaluated (Risley and Blokpoel 1984).

Parks and built-up areas — Gull problems in public parks can sometimes be remedied or reduced by installing wires over the areas that are the key attractants to the gulls (Blokpoel and Tessier 1984).

The technique of overwiring was used successfully to discourage Ring-bills at Toronto's City Hall Square and at outdoor restaurants at Ontario Place (a waterfront park near Toronto). At City Hall Square, four tall flagpoles were installed to suspend an almost invisible "ceiling" of metal wires over a pool and restaurant area. The stainless steel wires ran parallel at a spacing of 2.5 m and at a height of 8–10 m above the ground. At Ontario Place, monofilament fishing lines were attached to existing structures resulting in an irregularly shaped dense network of criss-crossing lines 3–5 m above the ground. The wires and lines almost completely eliminated the gull problems and no signs of habituation were noticed (Blokpoel and Tessier 1984). Wires were also effective in keeping Ring-bills out of an embayment area at Ontario Hydro's Nanticoke Generating Station on Lake Erie (B. Pett, pers. commun.) and in excluding them from traditional nesting areas (Blokpoel and Tessier 1983).

Most bird-scaring methods (shell crackers, live shells, gas bangers, distress calls, birds of prey) are not suitable for use in public parks and built-up areas. Constant harassment of the gulls by people (possibly using trained dogs) and strict enforcement of park rules not to feed gulls and not to litter, in combination with the use of wires in selected areas, appear at present the best way to cope with the nuisance.

Problems near a gull colony — When local problems that exist during the breeding season are clearly the result of a nearby nesting colony of Ring-bills, the only practical solution is to break up that colony and force the gulls to move elsewhere. Such problems existed at Thessalon Harbour and Nanticoke; at both colonies all gull eggs were removed and all nests destroyed. Eggs of gulls that re-nested were also removed. Re-occupation of the colonies was effectively prevented, thus significantly reducing the problems that the colonies had created. It is, however, necessary to repeat the procedure in following years because the gulls have a strong tendency to return to established nesting sites.

In the Toronto area there are two large colonies (the Eastern Headland and Mugg's Island) that cause several problems both during and after the nesting season. In 1984 a contractor was hired to prevent the Eastern Headland gullery from further expanding to a newly built endikement area. The contractor used tethered birds of prey that were frequently moved around the area where no gulls were to nest. He also used some additional methods and his operations were 100% effective. For many days the gulls kept circling

Ring-billed Gulls nest on many man-made environments, such as the Ontario Hydro Generating Station at Douglas Point on Lake Huron

Photo: H. Blokpoel

over the endikement area (where a few thousand pairs had nested in 1983), but eventually they all left.

A permanent but expensive way to prevent gulls from nesting is to change the habitat so that it becomes unsuitable for nesting by gulls. This can be done by installing wires (Blokpoel and Tessier 1984), or by planting thick, thorny vegetation. In many situations this method is not practical, e.g. when the gulls nest at a construction site or a docking area.

Shortcomings of local gull control — Local gull control is often unpractical and frequently costly. In cases where local gull control is feasible and effective, it solves that particular problem but in many cases the problem is shifted to another area rather than eliminated altogether. When the displaced gulls begin to cause problems in new areas, those problems are usually not as severe as the original ones. In spite of its shortcomings, local gull control is likely to continue to be the main solution to specific problems in the immediate future.

2. Overall population reduction

The core of many gull problems in Ontario is the large and growing nesting population of opportunistic gulls that have adapted to man-made environments. Any program to reduce that population would presumably result in a reduction of the various gull problems. However, a reduction of the gull population by a specified amount will not necessarily result in a similar reduction of all gull problems. Say, for example, that all adult gulls that feed on dump A nest at nearby colony B. Reducing the size of colony B by 50% would not guarantee a 50% reduction in gulls feeding at dump A. Most dumps are very attractive to gulls and gull numbers present at a dump are probably determined more by the "carrying capacity" of the dump than by the abundance of gulls nesting nearby.

In the same way, if gulls have learned to prefer tomatoes over other foods, a reduction of X% in the overall gull population may not lead to a reduction of X% in gull damage to tomatoes. This is an important consideration when trying to determine what would constitute an acceptable population level.

There would be many other difficulties in a gull population control program. Any such program would have to be thoroughly justified, biologically sound, and socially acceptable.

Justification for gull population reduction — A program to reduce the gull population to an acceptable level and to keep it at that level would have to be an on-going program. Any on-going, and thus costly, program should only be begun when there are solid and properly documented reasons to do so. Unfortunately, there are very few reports that adequately document the hazards to flight safety and to public health, or the damage to agriculture, industry, and tourism. Such information is sorely needed and documentation is difficult to obtain.

In general, a gull population reduction program (like any program to control a pest that causes economic damage) should be cost effective, i.e. the total costs of the program should not exceed the total damage caused by the gulls. However, if the problems also affect public health and flight safety, cost effectiveness is often not the only consideration. In cases where human life is threatened, a pest control program may provide benefits to society that cannot be measured in dollars. It is, nevertheless, important to obtain information on the costs (in terms of dollars) associated with the various gull problems. Although such costs are usually difficult to determine or estimate, proper documentation of the economic damage by gulls will help in determining whether or not a gull population reduction program is feasible.

Methods of gull population reduction — A gull population can be brought down only by (1) increasing mortality, i.e. killing of adults, sub-adults, and young, and/or (2) reducing natality, i.e. preventing eggs from hatching. Some methods may be useful in small accessible areas but are not suitable for a large region with difficult access. It is possible that a population reduction program would use different methods in different portions of the area concerned, and we therefore briefly review the known methods of gull population reduction.

(A) Increasing mortality — Mortality in a bird population can be increased by cannon-netting, trapping, poisoning, narcotizing, and shooting adults and sub-adults (Thomas 1972) and by collecting young on their breeding colonies.

Although the Ring-billed Gull has lost much of its fear of man, it is still a wild and highly adaptable bird. For that reason, techniques such as shooting and cannon-netting would have very little success in large-scale operations. The Ring-bills rapidly learn to recognize the threats posed by the equipment and the operators and stay out of their way. Trapping individual birds by placing traps over their nests is useful to eliminate a few Herring or Great Black-backed Gulls from a tern colony but is useless in large-scale operations.

Poisoning and narcotizing are the quickest ways to bring about a reduction of the population. Adults can be most effectively killed by poisoning them on their colonies. In all poisoning operations the goal is to get the right amount of poison into the right bird at the right time. Operations to poison gulls on their colonies usually have major shortcomings: (1) some birds regurgitate poisoned bait and develop bait shyness; (2) it is difficult to kill both members of a pair; (3) non-target species may eat the bait and die. In addition, there are numerous logistical problems: (1) preparing and laying out of poisoned bait; (2) removing regurgitated and unused bait; (3) finding, collecting, and disposing of affected birds at and near the colonies; (4) ensuring safety to personnel; (5) adequate posting of the colonies; and (6) keeping track of the effectiveness of the operations (Thomas 1972).

Compared to poisons, narcotics (i.e. sleep-inducing chemicals) have the advantage that non-target birds that have eaten the poisoned bait have a chance to recover, but a disadvantage is that narcotized gulls may recover before they can be dispatched.

(B) Reducing natality — Reproductive failure can be brought about by (1) removal of eggs or (2) sterilization of eggs. Methods for egg removal include: organized egg collection, biological control, i.e. the release of a predator on a colony, and the use of substitute eggs (Thomas 1972).

For an organized egg collection to be effective, all eggs must be removed regularly, e.g. every 2 weeks, to make sure that clutches of re-nesters and late nesters are included in the program. A drawback of this method is that some of the nesting gulls may disperse and nest at other sites or in more inaccessible places. This may result in the collection of re-laid eggs being made more difficult and time-consuming than of those laid originally (Thomas 1972).

Biological control by introducing a fox or raccoon to island colonies requires at least two visits (one to bring the animal and one to retrieve it after the breeding season to prevent it from starving). This method is not species-specific: introduced foxes would affect all other ground-nesting birds as well. Another drawback is that many gulls would probably desert the colony to nest elsewhere. In the three northern Great Lakes there are still unoccupied suitable islands for nesting and predator introductions would have limited overall effect. In the USA, foxes and raccoons were introduced annually on Herring Gull colonies off the coast of Massachusetts, resulting in a major reduction in colony size and occasionally in total colony abandonment (Kadlec 1971).

The use of substitute eggs to replace the collected natural eggs has the advantage that it could prevent the gulls from re-nesting. Ideally, the gulls continue to incubate the artificial eggs until well after the normal time of hatching. When the birds finally desert their clutches they have lost the physiological urge to reproduce for that year. However, Thomas (1972) reported that in Europe only a few Black-headed Gulls accepted dummy eggs, resulting in substantial re-laying throughout the colony. This method might be suitable for some small Ring-bill colonies, but for large, remote colonies it would involve the problem of bringing tens of thousands of dummy eggs to islands that often have poor access by boat. After the breeding season the dummy eggs would have to be collected and either stored on the island or brought back.

Methods of sterilizing eggs involve certain treatments of the eggs to prevent them from hatching. The ideal method would be cheap and easy to apply under a variety of weather conditions, would not cause undue harm to the incubating birds or cause them to desert and re-nest, and would have no negative impact on the environment. Addled eggs may putrefy and burst. This may result in weight loss of the eggs and their rejection by the nesting birds, which may then re-nest (Thomas 1972). Pricking of eggs results in considerable nest desertion and re-laying. Hypodermic injection with formalin and egg shaking by hand causes little re-laying but would be extremely time-consuming in large-scale operations (Thomas 1972).

The only reported large-scale egg-treatment programs involved the spraying of eggs with an oil emulsion solution. In the USA, Herring Gull colonies in Maine were visited annually and all eggs were sprayed with a mixture of oil emulsion and formaldehyde. The oil seals the pores in the egg shell thus suffocating the embryo, and the formaldehyde prevents the egg from rotting and bursting. This spraying mixture resulted in 95% hatching failure (Gross 1952).

In Denmark, a large Herring Gull colony on Saltholm Island near Copenhagen has been reduced by annual spraying of eggs from 42 800 pairs in 1970 to 10 800 pairs in 1981 (Jensen and Lind 1981), and to 10 400 in 1983 (H. Lind, pers. commun.). Since 1975, when the population appeared to level off at about 25 000 pairs, narcotics have been used in addition to egg spraying. The addition of formaldehyde was found to be of no use in preventing the eggs from rotting, so its use was stopped, much to the relief of the spraying crew. Since 1975, the mixture used has consisted of 62.5% oil and 37.5% water. The oil is a non-poisonous, commercially available, dormant oil (normally used for fighting plant pests), and is easily emulsifiable in water. To ensure that eggs do not hatch they have to be sprayed so that the liquid covers at least three-quarters of the surface of each egg. Each year the entire island is covered twice. The second visit is necessary to treat those clutches that were laid after the first visit. There is a problem in that, at most, only 90% of the nests are found during the first visit. A good proportion of the missed nests will be found and sprayed on the second visit if the eggs have not yet hatched (Jensen and Lind 1981).

As far as we know, none of the methods reviewed above have been properly evaluated for Ring-billed Gulls and tests are needed before these methods could be applied in any large-scale Ring-billed Gull control operations.

Management strategies for gull population reduction — Reduction of a gull population would require an integrated approach that takes into account the ecology, behaviour, and adaptability of that particular gull species. Breeding biology, post-breeding dispersal and migration, food and foraging habits, and availability and utilization of habitat should all be considered when developing a plan to reduce a gull population.

A proposed management strategy for Herring Gulls in New England demonstrates the necessity for an integrated plan. Although this strategy was never put into effect, the reasoning behind the proposal was biologically sound. The goal was to reduce the 135 000 pairs of Herring Gulls on 270 islands in the eastern USA (Drury and Nisbet 1969). Of the control methods considered, the most promising appeared to be the spraying of eggs for several years. However, if this method were applied alone, it would tend to redistribute gulls over previously unused breeding areas, because birds that fail to hatch eggs for several years in succession may shift to new areas. Hence the spraying program would have to be combined with selective elimination of those birds that shift to new colonies.

In addition, a few known attractive colony sites were to be selected for elimination of breeding adults. By keeping these attractive sites under-occupied, they would attract a continuous flow of immigrants, so that they would act as population "sinks". Elimination of adults could be done by placing poisoned bait in the gulls' nests. The authors had obtained good results with DRC-1339 baited with bread and laid out in gull nests. The eggs were first broken to overcome the gulls' inhibition against feeding near the nests.

Even if the program had been carried out carefully in New England, the growing Herring Gull population in Atlantic Canada would eventually have begun to provide recruits that would re-colonize the US colonies. Thus, a similar program would have had to be carried out at breeding colonies along the east coast of Canada in order to deal with the whole Atlantic population of North America (Drury and Nisbet 1969).

This management program was proposed in 1969 and the estimated annual cost of the full program, including experimental and research studies, was in the order of US $100 000. Assuming that they would be able to reduce natality by 80%, the authors predicted "a decrease in the breeding population after 5 years, but it might be very slow". However, the program would immediately relieve the airport problems, because young birds attracted by city dumps are disproportionately represented at airports (Drury and Nisbet 1969).

When considering a program to reduce the Ring-billed Gull population, the first difficulty is in determining the boundaries of "the" population. The gulls in Ontario belong to the eastern population, and as mentioned earlier, the heartland of the eastern population at present covers the Great Lakes area, i.e. the Great Lakes and the St. Lawrence River down to Trois-Rivières. Sizeable colonies also exist in Lake Champlain on the Vermont/New York border and in Oneida Lake in northern New York State. An on-going population reduction campaign in the Great Lakes area using the egg spraying technique would probably result in the emigration of many gulls out of the Great Lakes area and their settlement elsewhere, mainly in inland Ontario, Quebec, New York, Michigan, Wisconsin, and Minnesota. That would be an unacceptable development because the displaced gulls would soon begin to cause problems in their new breeding areas during the nesting season and would still be a problem in the Great Lakes area during late summer and fall, because all the man-made attractions of the Great Lakes area would remain unchanged.

Assuming that the displaced gulls would reproduce successfully outside the Great Lakes area, their numbers would build up over the years and some of their offspring would try to nest inside the Great Lakes area. This would mean that the campaign in the Great Lakes area would have to be intensified or "the Great Lakes area" would have to be expanded to cover most or all of the new colonies, some of which would be located in remote areas with difficult access. It would be sensible to regulate the success of the egg spraying program on the present breeding range so that no adults, or only a few, would shift to inaccessible areas. As was recommended for New England Herring Gulls, certain attractive colonies could be used as population sinks. At such colonies, good numbers of adults would be eliminated to make or maintain room for immigrants, and the spraying program would be done selectively to prevent massive emigration.

Public acceptance of gull population reduction — Because many Canadians highly value their wildlife, many wildlife control programs tend to create controversy. An on-going, large-scale program should be socially acceptable, i.e. it should be acceptable to the majority of the people living in the affected area. This would be particularly so if, as is likely, the program were to be publicly funded and carried out, in many instances, on public property.

It would probably be impossible to run a gull control program without criticism from some animal rights movements but many wildlife organizations would probably agree with a control program if it were properly justified, biologically sound, reasonably humane, and efficiently run. Before a control program could begin, there would be a need for discussions with naturalist clubs and other organizations concerned about the welfare of animals.

Summary

1. In 1984 there were an estimated 700 000 pairs of Ring-billed Gulls nesting in about 170 colonies in the Great Lakes and the St. Lawrence River down to Trois-Rivières, Quebec. At the end of the 1984 breeding season the population in that area was probably in excess of 3 000 000 individuals. About two-thirds of that population was located in Canada, with the remainder in the USA.

2. The estimated average annual growth rate of the Great Lakes nesting population was 7.9% during the period 1967–76 and 11.0% during 1976–84.

3. The Ring-billed Gull is a highly adaptable bird that thrives in man-altered environments. It has a varied diet (including garbage, fish offal, and handouts), nests on many kinds of man-made sites, and has lost most of its fear of man. It is likely that unless man interferes the gull population will continue to increase for several more years.

4. In Ontario, the number of problems caused by the Ring-billed Gull is rapidly increasing. The gulls pose a threat to flight safety; cause serious damage to crops; are a potential health hazard to people, cattle, and fowl; and are an unacceptable nuisance in many parks, marinas, beaches, playgrounds, and other public areas.

5. Gulls can be frightened away from areas where they are not wanted by persistent harassment, using a variety of methods (shellcrackers, live shells, blank shells, distress calls, gas bangers, and birds of prey). Gulls can be physically excluded from areas where they are not wanted by installing monofilament lines or stainless steel wires. Some sites can be made less attractive to gulls by preventing people from feeding them and from littering.

6. In many problem situations, local gull control is unpractical and, where it is practical, it often shifts the problem but does not eliminate it. Local gull control does not normally result in a reduction of the total gull population, which is the underlying cause of the various gull problems. Despite these shortcomings, local gull control will continue to be the major answer to gull problems in the immediate future.

7. Reduction of the total population of Ring-billed Gulls would require strong justification, because it would involve an on-going, costly, and complicated program. Such a program would have to be biologically sound and socially acceptable. To be successful the program would have to cover the heartland of the eastern population, i.e. the Great Lakes and the St. Lawrence River down to Trois-Rivières. Thus such a program would require co-operation between Canada and the USA.

Recommendations

We recommend that an effort be made to determine the need for and feasibility of an on-going, biologically sound, socially acceptable, internationally co-ordinated program to reduce the Ring-billed Gull population in the Great Lakes area (i.e. the Great Lakes and the St. Lawrence River down to Trois-Rivières) to an acceptable level. More specifically we make the following recommendations:

1. Obtain better documentation about the nature, extent, and costs of gull problems in aviation, public health, agriculture, industry, recreation, and other spheres of human activity.

2. Obtain better documentation on the effects of Ring-billed Gulls on other bird species.

3. Obtain information about the biology of Ring-billed Gulls that is relevant to the gull problems and develop a predictive population model for the Great Lakes area.

4. Develop reasonably humane techniques (*a*) to physically exclude or to scare Ring-billed Gulls away from areas where they are not wanted, and (*b*) to reduce their reproductive success.

5. Propose to the USA a joint committee to deal with gull problems on both sides of the border.

6. Carry out a public information exchange program regarding the gull problems.

Literature cited

Allan, L.J. 1978. Food of the Ring-billed and Herring Gulls nesting on Chantry Island, Lake Huron, 1978. Can. Wildl. Serv., Wildl. Toxicol. Div., Manuscr. Rep. 39. 14 pp.

Audubon, J.J. 1840. *In* Bent 1921.

Austin, O.L. 1953. The Migration of the Common Tern (*Sterna hirundo*) in the Western Hemisphere. Bird Banding 24:39–55.

Austwick, P.K.C. 1969. Mycotic infections. Pages 249–271 *in* McDiarmid, A., ed. Diseases in free-living wild animals. Symp. Zool. Soc. London, No. 24. Academic Press.

Barrows, W.B. 1912. Michigan Bird Life. Spec. Bull., Dep. Zool. and Physiol., Mich. Agri. Coll.

Benjamin, J.; Leaper, S.; Owen, R.J.; Skirrow, M.B. 1983. Description of *Campylobacter laridis*, a new species comprising the nalidixic acid resistant thermophilic *Campylobacter* (NARTC) group. Current Microbiol. 8:231–238.

Bent, A.C. 1921. Life histories of North American gulls and terns. US Natl. Mus. Bull. 113:1–345.

Benton, C.; Khan, F.; Monaghan, P.; Richards, W.N.; Shedden, C.B. 1983. The contamination of a major water supply by gulls (*Larus* sp.). A study of the problem and remedial action taken. Water Res. 17:789–798.

Berndt, R.; Rahne, U. 1968. Erstnachweiss der Ringschnabelmöwe (*Larus delawarensis*) in Europa. J. Ornithol. 109:438–440.

Blackmore, D.K. 1968. Some observations on ornithosis. Part II. The disease in cage and aviary birds. Pages 151–155 *in* Graham-Jones, O., ed. Some diseases of animals communicable to man in Britain. Pergamon Press, Oxford, UK.

Blokpoel, H. 1976. Bird hazards to aircraft. Clarke, Irwin and Company Ltd., Toronto. 236 pp.

Blokpoel, H. 1977*a*. Gulls and terns nesting in northern Lake Ontario and the upper St. Lawrence River. Can. Wildl. Serv. Prog. Notes No. 75. 12 pp.

Blokpoel, H. 1977*b*. The use of falcons to disperse nuisance birds at Canadian airports: an update. Paper presented at the Third World Conf. on Bird Hazards to Aircraft. Paris, France. Oct. 1977. 9 pp.

Blokpoel, H. 1980. Gull problems at Ontario airports: no magic solutions. Proc. First Meet. Bird Strike Prev. Workshop, Ottawa. 17 and 18 Sept. 1980. 30 pp.

Blokpoel, H. 1981. An attempt to evaluate the impact of cannon-netting in Caspian Tern colonies. Colon. Waterbirds 4:61–67.

Blokpoel, H. 1983. Gull problems in Ontario. Can. Wildl. Serv., Ottawa. Inf. leafl. 9 pp.

Blokpoel, H. 1984*a*. Local gull control in Ontario. Can. Wildl. Serv. Ottawa. Inf. leafl. 7 pp.

Blokpoel, H. 1984*b*. The Ring-billed Gull versus flight safety: a continuing conflict in Ontario, Canada. Proc. 17th Meet. of the Bird Strike Comm. Europe, Rome, Italy, 15–19 Oct. 1984. 5 pp.

Blokpoel, H. 1985. Report on damage to crops by gulls in southwestern Ontario in 1984. Unpubl. rep. for Can. Wildl. Serv., Ottawa. 3 pp.

Blokpoel, H.; Courtney, P.A. 1980. Site tenacity in a new Ring-billed Gull colony. J. Field Ornithol. 51:1–5.

Blokpoel, H.; Courtney, P.A. 1982. Immigration and recruitment of Ring-billed Gulls and Common Terns on the lower Great Lakes. Can. Wildl. Serv. Prog. Notes No. 133. 12 pp.

Blokpoel, H.; Fetterolf, P.M. 1978. Colonization by gulls and terns of the Eastern Headland, Toronto Outer Harbour. Bird-Banding 49:59–65.

Blokpoel, H.; Haymes, G.T. 1979. Origins of Ring-billed Gulls at a new colony. Bird-Banding 50:210–215.

Blokpoel, H.; McKeating, G.B. 1978. Fish-eating birds nesting in Canadian Lake Erie and adjacent waters. Can. Wildl. Serv. Prog. Notes No. 87. 12 pp.

Blokpoel, H.; Ryder, J.P.; Seddon, I.; Carswell, W.R. 1980. Colonial Waterbirds nesting in Canadian Lake Superior in 1978. Can. Wildl. Serv. Prog. Notes No. 118. 13 pp.

Blokpoel, H.; Tessier, G.D. 1983. Monofilament lines exclude Ring-billed Gulls from traditional nesting areas. Proc. Ninth Bird Control Semin., Bowling Green, Ohio, 4–6 Oct. 1983.

Blokpoel, H.; Tessier, G.D. 1984. Overhead wires and monofilament lines exclude Ring-billed Gulls from public places. Wildl. Soc. Bull. 12:55–58.

Blokpoel, H.; Weseloh, D.V. 1982. Status of colonial waterbirds nesting on Little Galloo Island, Lake Ontario. Kingbird 32:149–157.

Boersma, D.; Ryder, J.P. 1983. Reproductive performance and body conditions of earlier and later nesting Ring-billed Gulls. J. Field Ornithol. 54:374–380.

Bos, E.; de Heer, P. 1982. Ring-billed Gulls on Canary Islands in March 1982. Dutch Birding 4:90–91.

Broughton, E. 1979. Field investigation and laboratory examination of specimens collected from the Toronto waterfront, Aug. 28 and 29, 1979. Unpubl. rep. for Can. Wildl. Serv., Ottawa. 3 pp.

Bull, J. 1974. The Birds of New York State. Doubleday/Natural History Press, Garden City, NY. 392 pp.

Burkhart, R.L.; Page, L.A. 1971. Chlamydiosis (ornithosis–psittacosis). Pages 118–140 *in* Davis, J.W.; Anderson, R.C.; Karstad, H.L.; Trainer, D.O., eds. Infectious and parasitic diseases of wild birds. Iowa State Press, Ames, Iowa.

Chamberlaine, L.B. 1978. Region 6 — St. Lawrence. Kingbird 28:250–253.

Cooke, F.; Ross, R.K. 1972. Diurnal and seasonal activities of a post-breeding population of gulls in southeastern Ontario. Wilson Bull. 84: 164–172.

Courtney, P.A.; Blokpoel, H. 1980. Behaviour of Common Terns nesting near Ring-billed Gulls. Can. Field-Nat. 94:336–338.

Courtney, P.A.; Blokpoel, H. 1983. Distribution and numbers of Common Terns on the lower Great Lakes during 1900–1980: a review. Colon. Waterbirds 6:107–120.

Cuendet, G. 1979. Etude du comportement alimentaire de la mouette rieuse (*Larus ridibundus* L.) et son influence sur les peuplements lombriciens. Doctoral thesis, Univ. of Lausanne, Lausanne, Switzerland. 111 pp.

Davis, W.A.; McClung, L.S. 1940. Aspergillosis in wild Herring Gulls. J. Bact. 40:321–323.

Dexheimer, M.; Southern, W.E. 1974. Breeding success relative to nest location and density in Ring-billed Gull colonies. Wilson Bull. 86:288–290.

Drury, W.H.; Nisbet, I.C.T. 1969. Strategy of management of a natural population: the Herring Gull in New England. Pages 443–453 *in* Proc. World Conf. Bird Hazards to Aircraft, Kingston, Ont. 2–5 Sept. 1969. Natl. Res. Council of Canada, Ottawa.

Emlen, J.T. 1956. Juvenile mortality in a Ring-billed Gull colony. Wilson Bull. 68:232–238.

Emlen, J.T.; Miller, D.E.; Evans, R.M.; Thompson, D.H. 1966. Predator-induced parental neglect in a Ring-billed Gull colony. Auk 83:677–679.

Fetterolf, P.M. 1979. Common garter snake predation on Ring-billed Gull chicks. Can. Field-Nat. 93:317–318.

Fetterolf, P.M. 1983*a*. Effects of investigator activity on Ring-billed Gull behaviour and reproductive performance. Wilson Bull. 95:23–41.

Fetterolf, P.M. 1983*b*. Canada Goose/gull management plan for the Toronto Waterfront. Unpubl. rep. for the Metropolitan Toronto and Region Conservation Authority, Toronto. 85 pp.

Fetterolf, P.M.; Blokpoel, H.; Mineau, P.; Tessier, G. 1984. Incidence, clustering, and egg fertility of larger than normal clutches in Great Lakes Ring-billed Gulls. J. Field Ornithol. 55:81–88.

Goodwin, C.E. 1977. Ontario Region. Am. Birds 31:1131–1135.

Goodwin, C.E. 1980. Ontario Region. Am. Birds 34:890–892.

Gordon, M.A.; Ziment, I. 1967. Epidemic of acute histoplasmosis in western New York State. New York State J. Med. 67:235–243.

Green, J.C.; Janssen, R.B. 1975. Minnesota Birds. Where, when and how many? Univ. of Minnesota Press, Minneapolis, Minnesota. 217 pp.

Gross, A.O. 1952. The Herring Gull – Cormorant control project. Unpubl. rep. to the US Fish and Wildl. Serv., Boston, Mass. 14 pp.

Hailman, J.P. 1960. Ring-billed Gulls following the plow. Raven 31:109.

Haymes, G.T.; Blokpoel, H. 1978*a*. Seasonal distribution and site tenacity of the Great Lakes Common Tern. Bird-Banding 49:142–151.

Haymes, G.T.; Blokpoel, H. 1978*b*. Food of Ring-billed Gull chicks at the Eastern Headland of the Toronto Outer Harbour in 1977. Can. Field-Nat. 92:392–395.

Haymes, G.T.; Blokpoel, H. 1978*c*. Reproductive success of larids nesting on the Eastern Headland of the Toronto Outer Harbour in 1977. Ont. Field Biol. 32:1–17.

Hirsch, K. 1982. New colonies in Lake of the Woods. Loon 54:37–39.

Hogg, R.H. 1979. Ring-billed Gull in Aberdeenshire. Scott. Birds 10:275–276.

Hoogendoorn, W. 1982. Ring-billed Gull in Morocco in August 1982. Dutch Birding 4:91–92.

Hume, P.A. 1973. Ring-billed Gull in Glamorgan: a species new to Britain and Ireland. Brit. Birds 66:509–512.

Hunter, R.A; Ross, H.A.; Ball, A.J.S. 1976. A laboratory simulation of predator-induced incubation interruption using Ring-billed Gull eggs. Can. J. Zool. 54:628–633.

Iannini, P.B. 1980. Psittacosis. Current Therapy 1980:53–54.

Jarvis, W.L.; Southern, W.E. 1976. Food habits of Ring-billed Gulls breeding in the Great Lakes region. Wilson Bull. 88:621–631.

Jensen, A.; Lind, H. 1981. Population control of Herring Gulls at Saltholm through egg spraying 1969–1981. Part III. Control through egg spraying. Unpubl. rep. for Copenhagen Airport, Copenhagen, Denmark. In Danish.

Kadlec, J.A. 1971. Effects of introducing foxes and raccoons on Herring Gull colonies. J. Wildl. Manage. 35:625–636.

Kibbe, D.P. 1979. Niagara–Champlain Region. Am. Birds 33:860–862.

Kirkham, I.R.; Morris, R.D. 1979. Feeding ecology of Ring-billed Gull (*Larus delawarensis*) chicks. Can. J. Zool. 57:1086–1090.

Kleen, V.M. 1975. The changing seasons; the nesting season: June 1 – July 31, 1975. Middlewestern Prairie Region. Am. Birds 29:978–982.

LaForce, F.M. 1977. Psittacosis. Current Therapy 1977:59–60.

Lagrenade, M.-C.; Mousseau, P. 1981*a*. Alimentation des poussins de Goélands à bec cerclé de l'Ile de la Couvée, Québec. Le Naturaliste canadien 108:131–138.

Lagrenade, M.-C.; Mousseau, P. 1981*b*. Reproduction des Goélands à bec cerclé à l'Ile de la Couvée, Québec. Le Naturaliste canadien 108:119–130.

Lambert, A.; Nol, E. 1978. Status of the Piping Plover at Long Point, 1978. Unpubl. rep. for Long Point Bird Observatory, Port Rowan, Ont. 40 pp.

Lauro, A.J. 1977. Gull predation on an ant swarm. Kingbird 27:87–88.

Lock, A.R. In press. Recent increases in the breeding population of Kittiwakes and Ring-billed Gulls in the Maritime Provinces of Canada. Can. Field-Nat.

Ludwig, J.P. 1966. Herring and Ring-billed Gull populations of the Great Lakes 1960–65. Great Lakes Res. Div., Univ. Mich. Publ. 15:80–89.

Ludwig, J.P. 1967. Band-loss — its effects on banding data and apparent survivorship in the Ring-billed Gull population. Bird-Banding 38:309–323.

Ludwig, J.P. 1974. Recent changes in the Ring-billed Gull population and biology in the Laurentian Great Lakes. Auk 91:575–594.

Maxwell, G.R.; Smith, G.A. 1983*a*. Nest site competition and population estimates of island nesting Common Terns, Ring-billed Gulls, and Herring Gulls in the St. Lawrence River. Kingbird 33:19–25.

Maxwell, G.R.; Smith, G.A. 1983*b*. Reproductive success of island nesting Ring-billed Gulls and Common Terns in the St. Lawrence River. Kingbird 33:26–33.

McCracken, J.D.; Bradstreet, M.S.W.; Holroyd, G.L. 1981. Breeding birds of Long Point, Lake Erie: a study in community succession. Can. Wildl. Serv. Rep. Ser. No. 44. 74 pp.

Miles, J.A.R.; Shrivastav, J.B. 1951. Ornithosis in certain sea birds. J. Anim. Ecol. 20:195–200.

Morris, R.D.; Hunter, R.A. 1976. Factors influencing desertion of colony sites by Common Terns (*Sterna hirundo*). Can. Field-Nat. 90:137–143.

Mousseau, P. 1984*a*. Etablissement du Goéland à bec cerclé, *Larus delawarensis*, au Québec. Can. Field-Nat. 98:29–37.

Mousseau, P. 1984*b*. A comparison of two methods to assess the breeding success of Ring-billed Gulls. J. Field Ornithol. 55:151–159.

Mullarney, K. 1980. Ring-billed Gulls in Co. Mayo. A species new to Ireland. Irish Birds 1:517–525.

Müller, G. 1965. *Salmonella* in bird faeces. Nature (London) 207:1315.

O'Meara, D.C.; Witter, J.F. 1971. Aspergillosis. Pages 153–162 *in* Davis, J.W.; Anderson, R.C.; Karstad, H.L.; Trainer, D.O., eds. Infectious and parasitic diseases of wild birds. Iowa State Press, Ames, Iowa.

Ontario Ministry of Health. 1985. Ontario Disease Surveillance Report, Vol. 6, No. 17, Disease Control and Epidemiol. Serv., Public Health Br., Min. of Health, 15 Overlea Boulevard, Toronto.

Patton, S.R.; Southern, W.E. 1978. The effect of nocturnal red fox predation on the nesting success of colonial gulls. Proc. Colon. Waterbird Group 1:91–101.

Peck, G.K.; James, R.D. 1983. Breeding birds of Ontario, nidiology and distribution. Vol. I: Nonpasserines. Life Sciences Misc. Publ., R. Ont. Mus., Toronto. 321 pp.

Peterson, J.M.C. 1985. 1984 colonial bird census. High Peaks Audubon News. 13:10.

Pettingill, O.S. 1958. Ring-billed Gulls hawking may-flies. Jack-Pine Warbler 36:154.

Quinn, J.S. 1980. Parental investment and brood reduction in Caspian Terns (*Sterna caspia*). Unpubl. M.Sc. Thesis, Brock Univ., St. Catharines, Ont.

Risley, C.J.; Blokpoel, H. 1984. Evaluation of effectiveness of bird-scaring operations at a sanitary landfill site near CFB Trenton, Ontario, Canada. Pages 265–274 *in* Proc. Wildl. Hazards to Aircraft Conf. and Train. Workshop. Charleston, South Carolina. 22–25 May 1984.

Rosen, M.N. 1971. Botulism. Pages 100–117 *in* Infectious and parasitic diseases of wild birds. Davis, J.W.; Anderson, R.C.; Karstad, H.L.; Trainer, D.O., eds. Iowa State Press, Ames, Iowa. pp. 100–117.

Ryder, J.P.; Ryder, P.L.; Termaat, B. 1983. Newly discovered Ring-billed Gull colonies in Lake of the Woods. Loon 55:156–157.

Ryder, P.L.; Ryder, J.P. 1983. Reproductive performance of Ring-billed Gulls in relation to nest location. Condor 83:57–60.

Sarosi, G.A.; Parker, J.D.; Tosh, F.E. 1971. Histoplasmosis outbreaks: their patterns. Pages 123–129 *in* Ajella, L.; Chick, E.W.; Furculaw, M.L., eds. Histoplasmosis; Proc. of the Second Natl. Conf. Charles C. Thomas, Publ., Springfield, Illinois.

Scharf, W.C. 1981. The significance of deteriorating man-made island habitats to Common Terns and Ring-billed Gulls in the St. Mary's River, Michigan. Colon. Waterbirds 4:155–159.

Scharf, W.C.; Shugart, G.W.; Chamberlain, M.L. 1978. Colonial birds nesting on man-made and natural sites in the US Great Lakes. Report WES-TR-D-78-FWS/OBS-17, US Army Engineer Waterways Exp. St., Vicksburg, Mississippi. 140 pp.

Shugart, G.W. 1977. Resident red fox predation upon an island gull colony. Jack-Pine Warbler 55:199–205.

Shugart, G.W.; Scharf, W.C. 1983. Common Terns in the northern Great Lakes: current status and population trends. J. Field Ornithol. 54:160–169.

Skirrow, M.B. 1982. Campylobacter enteritis — the first five years. J. Hyg. (Cambridge) 89:175–184.

Smith, C.D. 1971. The role of birds in the ecology of *Histoplasmosis capsulatum*. Pages 14–148 *in* Ajello, L.; Chick, E.W.; Furculaw, M.L., eds. Histoplasmosis; Proc. of the Second Natl. Conf. Charles C. Thomas, Publ., Springfield, Illinois.

Southern, W.E. 1967*a*. Dispersal and migration of Ring-billed Gulls from a Michigan population. Jack-Pine Warbler 45:102–111.

Southern, W.E. 1967*b*. Colony selection, longevity, and Ring-billed Gull populations: preliminary discussion. Bird-Banding 38:52–60.

Southern W.E. 1974. Seasonal distribution of Great Lakes region Ring-billed Gulls. Jack-Pine Warbler 52:155–179.

Southern, W.E. 1977. Colony selection and colony site tenacity in Ring-billed Gulls at a stable colony. Auk 94:469–478.

Southern L.K.; Southern, W.E. 1980. Philopatry in Ring-billed Gulls. Proc. Colon. Waterbird Group 3:27–32.

Southern, W.E. 1985. Some effects of wing tags on breeding Ring-billed Gulls. Auk 102:38–42.

Southern, L.K.; Patton, S.R.; Southern, W.E. 1982. Nocturnal predation on *Larus* gulls. Colon. Waterbirds 5:169–172.

Steele, J.H.; Galton, M.M. 1971. Salmonellosis. Pages 51–58 *in* Davis, J.W.; Anderson, R.C.; Karstad, H.L.; Trainer, D.O., eds. Infectious and parasitic diseases of wild birds. Iowa State Press, Ames, Iowa.

Tauxe, R.V.; Patton, C.M.; Edmonds, P.; Barrett, T.J.; Brenner, D.J.; Blake, P.A. 1985. Illness associated with *Campylobacter laridis*, a newly recognized *Campylobacter* species. J. Clin. Microbiol. 21:222–225.

Tessen, D.D. 1977. Western Great Lakes Region. Am. Birds 31:1142–1150.

Thomas, G.J. 1972. A review of gull damage and management methods at nature reserves. Biol. Conserv. 4:117–127.

Vermeer, K. 1970. Breeding biology of California and Ring-billed Gulls: a study of ecological adaptation to the inland habitat. Can. Wildl. Serv. Rep. Ser. No. 12. 52 pp.

Weir, R. 1981. Colonial waterbird survey — offshore Kingston Islands. Blue Bill 28:85–86.

Weir, R. 1983. Ontario Region. Am. Birds 37:982–985.

Williams, B.M.; Richards, D.W.; Stephens, D.P.; Griffiths, T. 1977. The transmission of *S. livingstone* to cattle by the herring gull (*Larus argentatus*). Vet. Rec. 100:450–451.

Other publications in the Occasional Papers Series

No. 1
Birds protected in Canada under the Migratory Birds Convention Act, 4th ed. Publication bilingue.
Cat. No. CW69-1/1. Publ. 1957, rev. 1980.
No. 2
Canadian bird names, French, English and scientific.
Publication bilingue.
Cat. No. CW69-1/2. Publ. 1957, rev. 1972.
No. 3
Use of aerial surveys by the Canadian Wildlife Service by D.A. Benson.
Out of print.
Cat. No. CW69-1/3. Publ. 1963, repr. 1966.
No. 4
Queen Elizabeth Islands game survey, 1961 by J.S. Tener.
Cat. No. CW69-1/4. Publ. 1963, repr. 1972.
No. 5
Age determination in the polar bears by T.H. Manning.
Cat. No. CW69-1/5. Publ. 1964, repr. 1973.
No. 6
A wildlife biologist looks at sampling, data processing and computers by D.A. Benson.
Out of print.
Cat. No. R69-1/6. Publ. 1964.
No. 7
Preliminary report on the effects of phosphamidon on bird populations in New Brunswick by C.D. Fowle. Out of print.
Cat. No. R69-1/7. Publ. 1965.
No. 8
Birds of Nova Scotia — New Brunswick border region by G.F. Boyer.
Cat. No. CW69-1/8. Publ. 1966, repr. 1981.
No. 9
Effects of dietary methylmercury on Ring-necked Pheasants, with special reference to reproduction by N. Fimreite.
Cat. No. R69-1/9. Publ. 1971.
No. 10
Trends in populations of barren-ground caribou over the last two decades: a re-evaluation of the evidence by G.R. Parker.
Cat. No. CW69-1/10. Publ. 1971, repr. 1972.
No. 11
The Canada migratory game bird hunting permit and related surveys by D.A. Benson.
Cat. No. R69-1/11. Publ. 1971.
No. 12
Observations on duck hunting in eastern Canada in 1968 and 1969 by H.J. Boyd.
Cat. No. R69-1/12. Publ. 1971.
No. 13
Evaluation of ecological effects of recent low water levels in the Peace–Athabasca Delta by H.J. Dirschl.
Cat. No. CW69-1/13. Publ. 1972.
No. 14
The Great Cormorants of eastern Canada by A.J. Erskine.
Cat. No. CW69-1/14. Publ. 1972.
No. 15
Distribution of barren-ground caribou harvest in north-central Canada by G.R. Parker.
Cat. No. CW69-1/15. Publ. 1972.
No. 16
Bird migration forecasts for military air operations by H. Blokpoel.
Cat. No. CW69-1/16. Publ. 1973.
No. 17
Waterfowl populations on the Peace–Athabasca Delta. 1969 and 1970 by D.J. Nieman and H.J. Dirschl.
Cat. No. CW69-1/17. Publ. 1973.
No. 18
Gammarus predation and the possible effects of *Gammarus* and *Chaoborus* feeding on the zooplankton composition in some small lakes and ponds in western Canada by R.S. Anderson and L.G. Raasveldt.
Cat. No. CW69-1/18. Publ. 1974.
No. 19
A summary of DDE and PCB determinations in Canadian birds, 1969 to 1972 by M. Gilbertson and L. Reynolds.
Cat. No. CW69-1/19. Publ. 1974.
No. 20
Development of a simulation model of Mallard Duck populations by C.J. Walters, R. Hilborn, E. Oguss, R.M. Peterman and J.M. Stander.
Cat. No. CW69-1/20. Publ. 1974.
No. 21
Use of museum specimens in toxic chemical research by A.M. Rick.
Cat. No. CW69-1/21. Publ. 1975.
No. 22
Impoundments for waterfowl by W.R. Whitman.
Cat. No. CW69-1/22. Publ. 1976.
No. 23
Minimizing the dangers of nesting studies to raptors and other sensitive species by R.W. Fyfe and R.R. Olendorff.
Cat. No. CW69-1/23. Publ. 1976.
No. 24
Waterfowl damage to Canadian grain: current problems and research needs by L.G. Sugden.
Cat. No. CW69-1/24. Publ. 1976.
No. 25
Census techniques for seabirds of arctic and eastern Canada by D.N. Nettleship.
Cat. No. CW69-1/25. Publ. 1976.
No. 26
Notes on the present status of the polar bear in James Bay and Belcher Islands area by Charles Jonkel, Pauline Smith, Ian Stirling and George B. Kolenosky.
Cat. No. CW69-1/26. Publ. 1976.
No. 27
Limnological and planktonic studies in the Waterton Lakes, Alberta by R. Stewart Anderson and Roderick B. Green.
Cat. No. CW69-1/27. Publ. 1976.
No. 28
Birds and mammals of the Belcher, Sleeper, Ottawa, and King George Islands, Northwest Territories by T.H. Manning.
Cat. No. CW69-1/28. Publ. 1976.
No. 29
Developments in PPS sampling – Impact on current research by A.R. Sen.
Cat. No. CW69-1/29. Publ. 1976.
No. 30
Dynamics of snowshoe hare populations in the Maritime Provinces by Thomas J. Wood and Stanley A. Munroe.
Cat. No. CW69-1/30. Publ. 1977.
No. 31
Migration and population dynamics of the Peace–Athabasca Delta goldeye population by D.B. Donald and A.H. Kooyman.
Cat. No. CW69-1/31. Publ. 1977.
No. 32
The effects of fire on the ecology of the Boreal Forest, with particular reference to the Canadian north; a review and selected bibliography by John P. Kelsall, E.S. Telfer and Thomas D. Wright.
Cat. No. CW69-1/32. Publ. 1977.
No. 33
The ecology of the polar bear (*Ursus maritimus*) along the western coast of Hudson Bay by Ian Stirling, Charles Jonkel, Pauline Smith, Richard Robertson and Dale Cross.
Cat. No. CW69-1/33. Publ. 1977.
No. 34
Canvasback habitat use and production in Saskatchewan parklands by Lawson G. Sugden.
Cat. No. CW69-1/34. Publ. 1978.
No. 35
The diets of muskoxen and Peary caribou on some islands of the Canadian High Arctic by Gerald R. Parker.
Cat. No. CW69-1/35. Publ. 1978.

No. 36
Observations of Mallards in the parkland of Alberta by Michael F. Sorensen.
Cat. No. CW69-1/36. Publ. 1978.
No. 37
The wildlife valuation problem: A critical review of economic approaches by William A. Langford and Donald J. Cocheba.
Cat. No. CW69-1/37. Publ. 1978.
No. 38
Spatial changes in waterfowl habitat, 1964-74, on two land types in the Manitoba Newdale Plain by G.D. Adams and G.G. Gentle.
Cat. No. CW69-1/38. Publ. 1978.
No. 39
Patterns of pelagic distribution of seabirds in western Lancaster Sound and Barrow Strait, Northwest Territories, in August and September 1976 by D.N. Nettleship and A.J. Gaston.
Cat. No. CW69-1/39. Publ. 1978.
No. 40
Responses of Peary caribou and muskoxen to helicopter harassment by Frank L. Miller and Anne Gunn.
Cat. No. CW69-1/40. Publ. 1979.
No. 41
Avian Community structure of six forest stands in La Mauricie National Park, Quebec by J.-L. DesGranges. Disponible également en français.
Cat. No. CW69-1/41E. Publ. 1979.
No. 42
Population ecology studies of the polar bear in northern Labrador by Ian Stirling and H.P.L. Kiliaan. Disponible également en français.
Cat. No. CW69-1/42E. Publ. 1980.
No. 43
Census methods for murres, *Uria* species; a unified approach by T.R. Birkhead and D.N. Nettleship. Disponible également en français.
Cat. No. CW69-1/43E. Publ. 1980.
No. 44
Population ecology studies of the polar bear in the area of southeastern Baffin Island by Ian Stirling. Wendy Calvert, and Dennis Andriashek. Disponible également en français.
Cat. No. CW69-1/44E. Publ. 1980.
No. 45
Polynyas in the Canadian Arctic by Ian Stirling and Holly Cleator, eds. Disponible également en français.
Cat. No. CW69-1/45E. Publ. 1981.
No. 46
The Lesser Snow Geese of the eastern Canadian Arctic by H. Boyd, G.E.J. Smith, and F.G. Cooch. Disponible également en français.
Cat. No. CW69-1/46E. Publ. 1982.
No. 47
The distribution and abundance of seals in the eastern Beaufort Sea, 1974-79 by Ian Stirling, Michael Kingsley, and Wendy Calvert. Disponible également en français.
Cat. No. CW69-1/47E. Publ. 1982.
No. 48
Foraging behaviour of Peary caribou in response to springtime snow and ice conditions by F.L. Miller, E.J. Edmonds, and A. Gunn. Disponible également en français.
Cat. No. CW69-1/48E. Publ. 1982.
No. 49
A review of some important techniques in sampling wildlife by A.R. Sen. Disponible également en français.
Cat. No. CW69-1/49E. Publ. 1982.
No. 50
Intensive regulation of duck hunting in North America: its purpose and achievements by Hugh Boyd. Disponible également en français.
Cat. No. CW69-1/50E. Publ. 1983.
No. 51
Human dimensions of migratory game-bird hunting in Canada by Shane A.D. Parker and Fern L. Filion. Disponible également en français.
Cat. No. CW69-1/51E. Publ. 1984.
No. 52
Components of hunting mortality in ducks by G.S. Hochbaum and C.J. Walters. Disponible également en français.
Cat. No. CW69-1/52E. Publ. 1984.
No. 53
The interpretation of aerial surveys for seabirds: some effects of behaviour by A.J. Gaston and G.E.J. Smith. Disponible également en français.
Cat. No. CW69-1/53E. Publ. 1984.
No. 54
Waterfowl studies in Ontario, 1973–81 by S.G. Curtis, D.G. Dennis, and H. Boyd, eds. Disponible également en français.
Cat. No. CW69-1/55E. Publ. 1985.
No. 55
The reported kill of ducks and geese in Canada and the USA, 1974–82 by Hugh Boyd. Disponible également en français.
Cat. No. CW69-1/55E. Publ. 1985.
No. 56
Population dynamics of the Common Loon (*Gavia immer*) associated with mercury-contaminated waters in northwestern Ontario by J.F. Barr. Disponible également en français.
Cat. No. CW69-1/56E. Publ. 1986.

Canada