

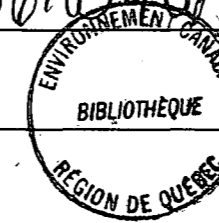


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**Gulls and terns nesting in northern Lake Ontario and the upper St. Lawrence River**by H. Blokpoel<sup>1</sup>**Abstract**

Results of a survey in 1976 of Herring Gulls (*Larus argentatus*), Ring-billed Gulls (*Larus delawarensis*), Common Terns (*Sterna hirundo*), and Caspian Terns (*Hydroprogne caspia*) that nested in the Canadian parts of Lake Ontario and the upper St. Lawrence River are presented. Where available, data for previous years are given as well. Some islands that used to have nesting gulls and terns but did not do so in 1976 are also briefly mentioned.

**Introduction**

Studies undertaken by the Toxic Chemicals Division of the Canadian Wildlife Service since 1971 have shown poor reproductive success in Lake Ontario Herring Gulls (Gilbertson 1974, Gilbertson and Hale 1974) and a high incidence of abnormal chicks in colonies of Ring-billed Gulls, Common Terns and Caspian Terns in the lower Great Lakes (Gilbertson *et al.* 1976). Both phenomena were associated with toxicant loads (Gilbertson 1974, Gilbertson *et al.* 1976). Experimental work is being carried out at present to elucidate those associations (D.B. Peakall, pers. comm.).

Reproduction of colonially nesting, fish-eating birds in the Great Lakes is also affected by human disturbance. Increases in pleasure boat traffic and visits to colonies may seriously affect the birds' breeding success.

In order to document possible changes in Lake Ontario gull and tern populations, the Ontario Region of CWS undertook an inventory in 1976. This paper reports the distribution and numbers of Herring Gulls, Ring-billed Gulls, Common Terns, and Caspian Terns nesting in the Canadian parts of Lake Ontario and the St. Lawrence River from Hamilton to the Ontario-Quebec border.

**Methods**

A census of most of the breeding colonies was taken by making ground counts of the nests. In a few cases aerial photography was used.

**Ground counts**

Islands were visited by boat and all nests counted. A structure was considered to be a nest if it was clearly completed, if it contained eggs or young, or if it clearly had contained young. Where necessary a colony was divided into strips and nests were counted in each strip. Strips were delimited using measuring tapes and temporary stakes (sticks and piled rocks).

It was impossible to survey the whole area (northern Lake Ontario and the upper St. Lawrence River) by boat. Decisions about what areas to cover by boat were largely determined

by information from published and unpublished reports, waterfowl survey flights, the weather conditions, and available craft.

Apart from Mugg's Island (Toronto), the area west of Presqu'île (see Fig. 1) was not visited by boat. In eastern Lake Ontario, boat surveys were made of the Presqu'île Bay area, Weller's Bay area, the islands east of Prince Edward Point, and the area south of Kingston (including the eastern tip of Amherst Island and the western side of Wolfe Island). To survey the St. Lawrence River, trips were made in the vicinity of Gananoque, Mallorytown, Brockville, Morrisburg, Long Sault, Cornwall and Fraser Point. The areas visited are only a small part of the total St. Lawrence River area, but all previously known nesting sites were visited.

**Air photography**

The LACS (Light Aircraft Camera System) equipment, developed by the Environmental Protection Service, Ottawa, was used to photograph four colonies. The system included: two vertically-mounted Vinten 492 cameras (negative format 70 x 70 mm) with 15-cm lenses; one video camera adjustable from vertical to a 15° forward-look angle; one video monitor; and one video cassette recorder. Further details can be found in the operation manual (Aird, in prep.). The equipment was installed in a Beaver aircraft on floats. Pictures were taken from a height of 800-1000 ft (240-300 m) above ground level. Kodak Aerocolor 2445 and Kodak Aerochrome Infrared 2443 films were used.

On 12 and 13 May 1976, air photographs were taken of Gull Island, Pigeon Island, Scotch Bonnet Island, and Little Galloo Island. The last island, in the U.S.A. south of Kingston, is not dealt with here. Ground observations confirmed that on the dates of aerial coverage the gull colonies were well established and the birds were incubating eggs.

Orange-coloured markers (60 x 60 cm plywood sheets) were laid out on Gull Island to delimit sample plots for which the actual number of nests on 13 May was known from ground observations. The markers showed up clearly on the photographs thus providing a means to arrive at the ratio between "nests counted on the ground" and "gulls counted on the picture" for the marked areas.

When analyzing the air photographs, the infrared film was used in most cases because the gull images were more distinct than on the colour film. Gull images on copies of the original film frames were counted using a Bausch and Lomb Stereozoom binocular microscope over a Richards MIM-0231100 light table. A grid, with squares of 2 x 2 mm, was laid under the film frame and taped to the light table. Each frame could thus be dealt with square by square. The position of the corners of the grid were marked on the film by scratching the emulsion with a pin in the margin of the frame, or in areas that had no birds.

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Figure 1  
Locations of colonies of gulls and terns in the Canadian part of Lake Ontario and the Ontario part of the St. Lawrence River in 1976. The numbers refer to locations listed in Table 1

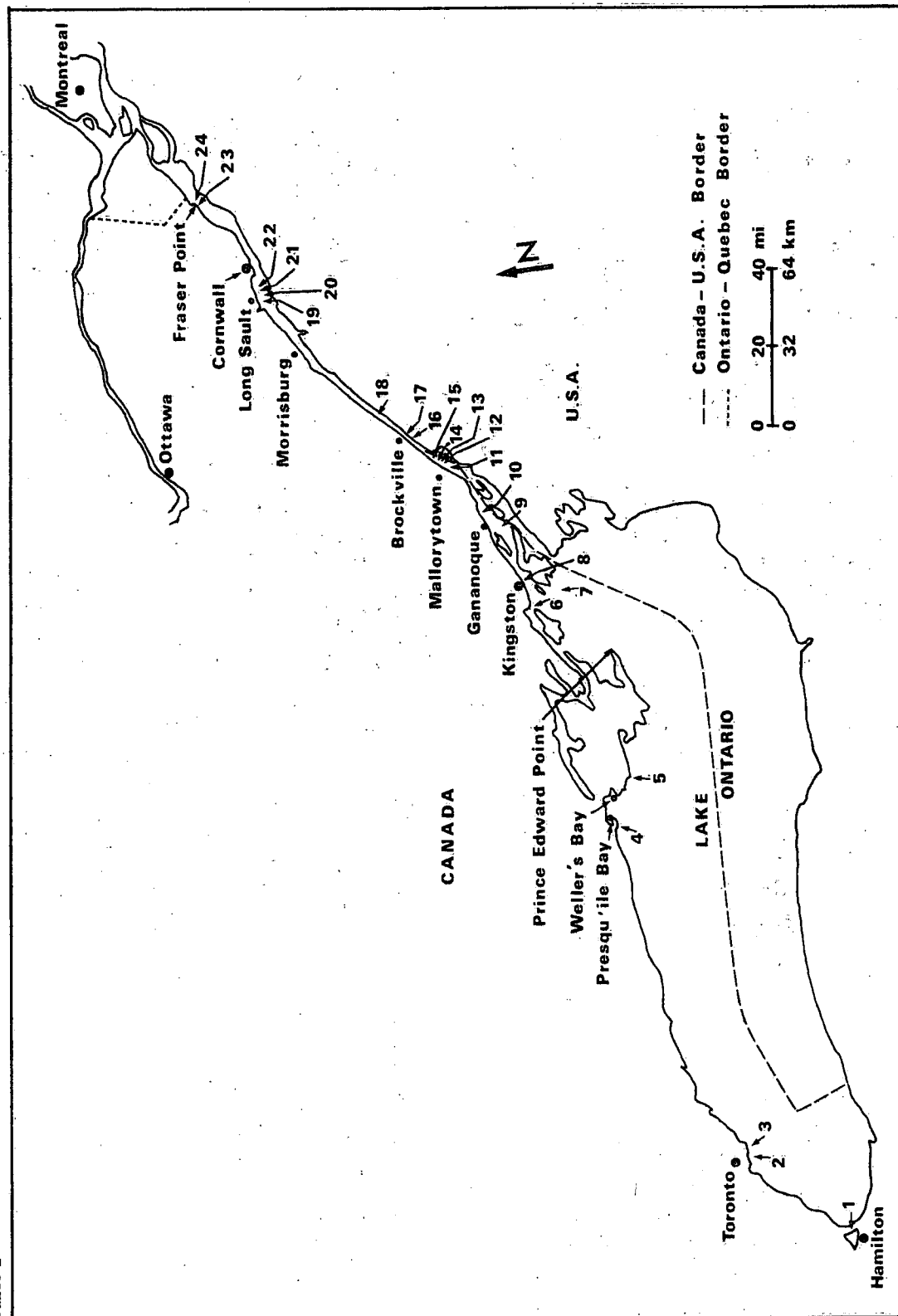


Table 1  
Numbers of gull and tern nests in Lake Ontario and the upper St. Lawrence River in 1976

No. on Fig. 1	Area	Date	Method (air photo, ground count, rough estimate)	Herring Gull	Ring-billed Gull	Common Tern	Caspian Tern	Main observer(s) <sup>±</sup>
1	Hamilton Harbour	6 June	GC	7?	0	0	0	TCD
2	Mugg's Island	spring	RE	45	3 391-4379	0	0	PMF
3	Leslie Spit	10, 11 June	GC	12	10 382	1246	4	HB, PMF
	Leslie Spit	6 July	GC	—	—	—	7	PMF
4	Gull Island	10 May	GC	41	—	—	—	GAF, APG
	Gull Island	12, 13 May	AP	—	23 707 ± 4652	—	—	HB
	Gull Island	spring	GC	—	—	53	—	IK
5	Scotch Bonnet Island	14 April	GC	63	0	0	0	GAF, APG
	Scotch Bonnet Island	29 April	GC	85	0	0	0	GAF, APG
	Scotch Bonnet Island	10 May	GC	79	0	0	0	GAF, APG
	Scotch Bonnet Island	13 May	AP/RE	≥78	—	—	—	HB
6	West Brother Island	21 April	GC	21	0	0	0	GAF, APG
	West Brother Island	20 May	GC	16	0	0	0	HB, SMT
7	Pigeon Island	13 May	AP	—	≥2 813	—	—	HB
	Pigeon Island	spring	GC	24	—	0	40	IMP
8	Snake Island	28 April	GC	56	0	0	0	GAF, APG
	Snake Island	20 May	GC	74	0	0	0	HB, SMT
9	Black Ant Island	8 May	GC	12	0	0	0	ECW
	Black Ant Island	20 May	GC	22	0	0	0	HB, SMT
	Black Ant Island	30 May	GC	12(+5)	0	0	0	ECW
10	Rock W of Scorpion Island	20 May	GC	0	0	5	0	HB, SMT
	Rock W of Scorpion Island	30 May	GC	0	0	6	0	ECW
11	Channel Island	3 June	GC	0	0	16	0	HB, JRJC
12	Ice Island	3 June	GC	—	5	113	0	HB, JRJC
	Ice Island	15 June	GC	1	0	121	0	GMH
13	Little Corn Island	15 June	GC	1	0	0	0	GMH
14	Griswold Island	3 June	GC	12	0	1	0	HB, JRJC
15	Gull Island shoal	3 June	GC	7	0	0	0	HB, JRJC
16	Shoal 1, SE of Stovin Island	17 June	GC	1	0	0	0	HB, JRJC
17	Shoal 2, SE of Stovin Island	17 June	GC	0	0	1	0	HB, JRJC
18	Murray Island	17 June	GC	0	13	13	0	HB, JRJC
19	Small Island W of Sheek Island	18 June	GC	1	0	0	0	HB, JRJC
20	West Bergin Island	29 June	RE	0	6	0	0	HB, AC
21	Small Island E of Sheek Island	27 May	GC	0	1	30	0	HB, RKR
22	Strachan Island	27 May	GC	0	4 893	0	0	HB, RKR

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Table 1 (continued)

No. on Fig. 1	Area	Date	Method (air photo, ground count, rough estimate)	Herring Gull	Ring-billed Gull	Common Tern	Caspian Tern	Main observer(s)*
23	Small Island S of St. Francis Island	18 June	GC	0	0	1	0	HB, JRJC
24	Grape Island	18 June	GC	0	0	7	0	HB, JRJC
Totals†				354	45 700 (approx.)	1495	47	

\*HB - H. Blokpoel; JRJC - J.R.J. Charron; AC - A. Code; TCD - T.C. Dauphiné; PMF - P.M. Fetterolf; GAF - G.A. Fox; APG - A.P. Gilman; GMH - G.M. Hamre; IK - Ian Kirkham; IMP - I.M. Price; SMT - S.M. Teeple; ECW - E.C. Waltz.  
 †Using the season's maximum, where possible.

Table 2  
 Numbers of gull and tern nests, Mugg's Island, 1962-75

Year	Herring Gull	Ring-billed Gull	Common Tern	Caspian Tern	Reference or source
1962	-*	-	100	-	ONRS†
1963	-	nesting but no estimates	100's of young	-	ONRS
1966	-	750	150-250	-	ONRS
1969	-	-	-	1	ONRS
1972	11	2250-2500	300-350	-	Morris & Hunter (1976)
1973	36	>3000	56	-	Morris & Hunter (1976)
1974	14	>3500	0	-	Morris & Hunter (1976)
1975	>38	4415-4379	0	0	P.M. Fetterolf (pers. comm.)

\*-: Unknown or not reported.  
 †ONRS: Ontario Nest Record Scheme.

When counting gulls in each grid square, birds that were on the top and left grid lines were considered to be inside the square; those on the bottom and right grid lines were considered to be outside.

The counts for all grid squares were recorded on a data sheet. Data sheets were 21 x 28 cm sheets of tracing paper laid over a grid with 6 x 6 mm squares. The counts for the 2 x 2 mm film grid squares were entered in the corresponding 6 x 6 mm grid squares of the data sheet. In addition to the counts of gulls which appeared to be nesting, the following annotations were used: F - flying, W - sitting on water, and S - loafing on sand beach.

**Results**

**A) Gull and tern colonies active in 1976**

The distribution of gull and tern colonies in 1976 is shown in Figure 1 and the numbers are shown in Table 1. For some islands, more detailed information and data for previous years are presented below:

**Hamilton Harbour.** In 1976 T.C. Dauphiné found seven nests that in all likelihood belonged to Herring Gulls. They were

located on an earth dam south of the Canada Centre for Inland Waters. There are no reports of Herring Gulls using the area in previous years.

In 1970 "dozens" of Common Terns were nesting on two small man-made islands in the northeast end of Hamilton Harbour (Gilbertson 1975). In 1972 more than 150 adults were present on the islands, but by 1974 no terns were observed (Morris and Hunter 1976). On 6 June 1976 no nesting terns were found on those two islands or the adjacent mainland (T.C. Dauphiné, pers. comm.).

**Mugg's Island.** The size of the Ring-billed Gull colony was difficult to determine from the air because most gulls nested under trees and bushes. An extensive ground census might have caused serious disturbance of the birds and would have jeopardized ongoing studies of gull behaviour by the University of Toronto. A rough estimate of 3391 to 4379 nests of Ring-billed Gulls in 1976 (based on counts for 10 plots and extrapolation of that information) was provided by P.M. Fetterolf (pers. comm.). On 9 June 1976 S.D. Jordan (pers. comm.) counted 45 Herring Gull nests.

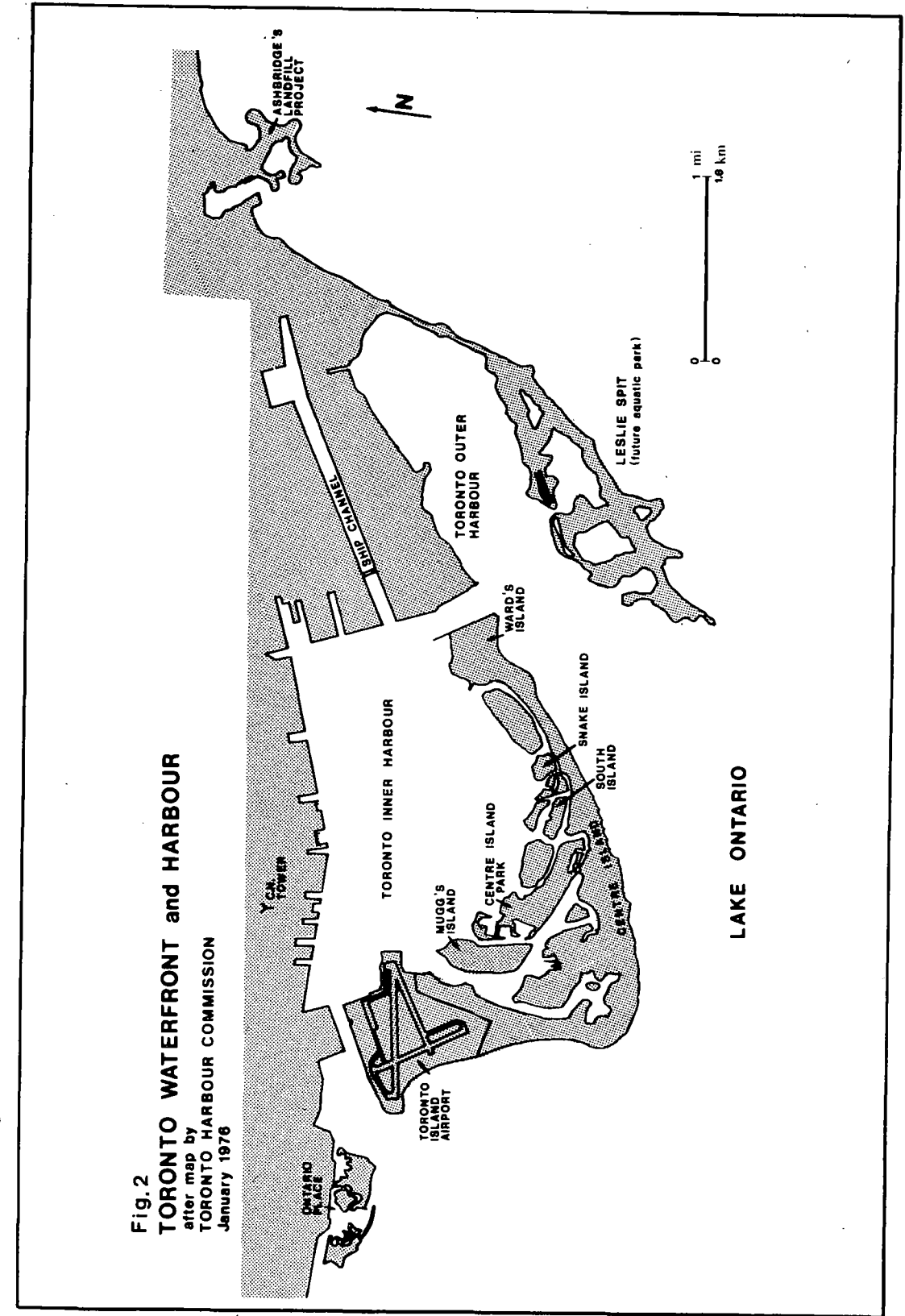


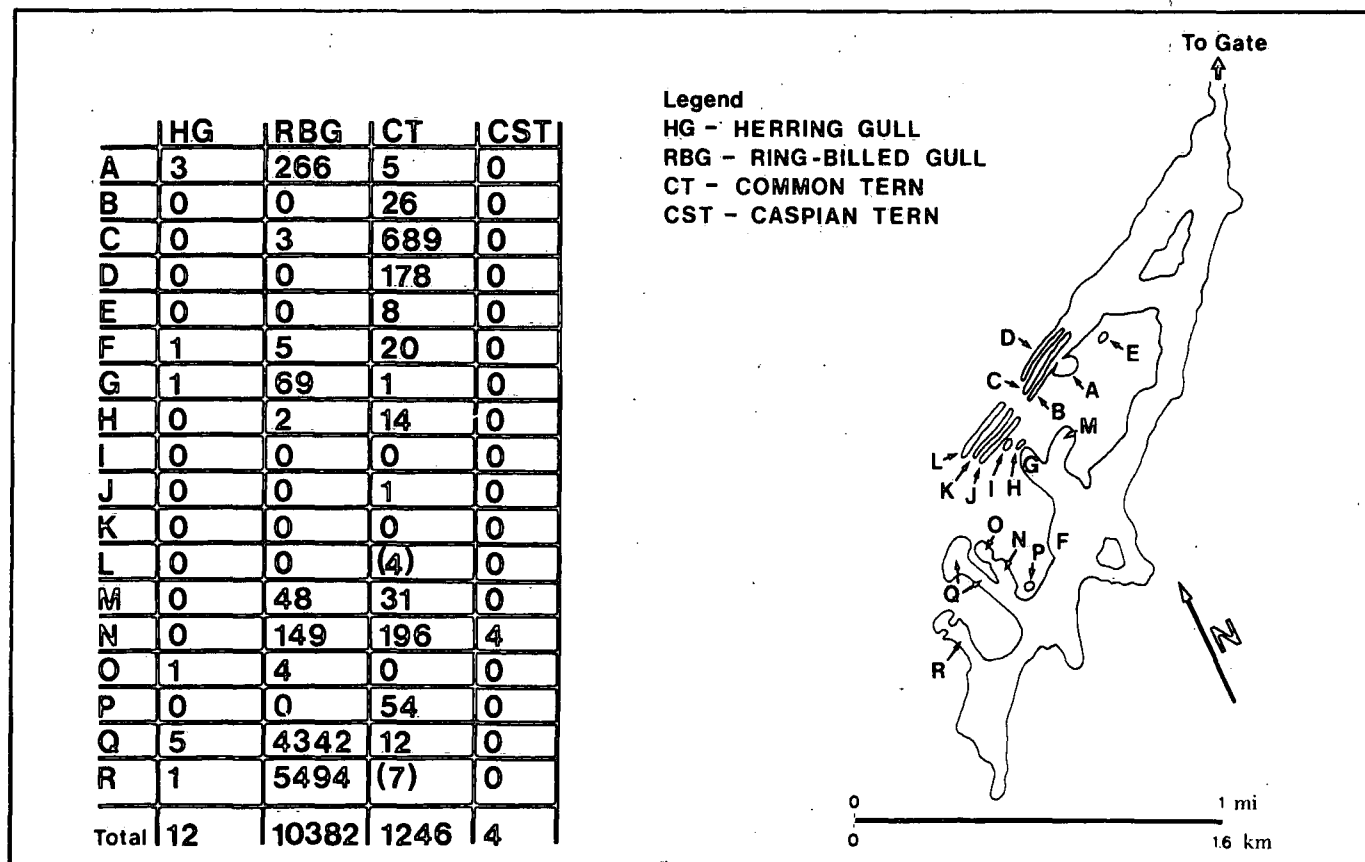
Figure 2  
 Toronto Waterfront and harbour after map by Toronto Harbour Commission Jan. 1976

Fig. 2  
 TORONTO WATERFRONT and HARBOUR  
 after map by  
 TORONTO HARBOUR COMMISSION  
 January 1976

Information for previous years is summarized in Table 2.

**Leslie Spit.** Leslie Spit is the popular name for the Eastern Headland of Toronto's Outer Harbour (see Fig. 2). The distribution of gull and tern nests on 10 and 11 June 1976 is shown in Figure 3.

**Figure 3**  
Gull and tern nests on Leslie Spit, Toronto, 10 and 11 June, 1976. Rough sketch based on map prepared by the Toronto Harbour Commission (Jan. 1976) and visual observations



The files of the Ontario Nest Records Scheme record 30-40 Common Tern nests in 1971 and 24 Common Tern young in 1974. One ONRS report mentioned that the Common Tern colony started in 1970 or 1971. If that report was correct, then the Common Tern colony has expanded rapidly from just a few nests in 1970 to well over 1200 nests in 1976. A more detailed report on the development of the gulleries and terneries on Leslie Spit is in preparation.

**Gull Island.** Because only three marked sample plots were used, the confidence interval for the number of Ring-billed Gull nests was large:  $23\,707 \pm 4652$  (see Methods and Table 1). Details of the statistical calculations are given in Appendix 1. Data for previous years are summarized in Table 3.

No Caspian Tern nests were found in 1976 (J.C. Chardine and I. Kirkham, pers. comm.), but in the early sixties an occasional nesting pair was observed (Ludwig 1974).

**Scotch Bonnet Island.** Because nest-attentiveness studies (by the CWS Toxic Chemicals Division) were underway, no sample plots were marked on this island. Air photographs showed 157 birds sitting on the island and 998 birds flying away from the island. It is likely that all birds that remained on the island were breeding Herring Gulls (A.P. Gilman, pers. comm.). Thus the minimum number of Herring Gull nests, based on the air photographs, would be 78, only one less than actually counted three days earlier (see Table 1). As there were probably 78 or 79 Herring Gull nests on the day of the air photographs, there were apparently two, or

**Table 3**  
Numbers of gull and tern nests, Gull Island, 1953-75

	Herring Gull	Ring-billed Gull	Common Tern	Reference or source
1953	-	colony established	-	Ludwig (1974)
1967	-	23 000	-	Ludwig (1974)
1969	-	$\pm 25\,000$	-	H. Richards (pers. comm.)
1972	18	$\pm 25\,000$	>1000	H. Richards (pers. comm.) and M. Gilbertson (1974 and pers. comm.)
1975	-	$\pm 25\,000$	79	H. Richards (pers. comm.) and J.C. Chardine (pers. comm.)

almost two, gulls present for each nest. That suggests a high level of nest-guarding, possibly in response to the large number of non-breeders that occupied the edges of the island.

There are no published records of nesting by Ring-billed Gulls, Common Terns or Caspian Terns for this island. Reported numbers of Herring Gull nests in recent years are shown in Table 4.

**West Brother Island.** On 21 April 1976, 21 Herring Gull nests were found. After 21 April the lake level rose and washed out several nests. On 20 May, 16 nests were found.

In 1972, 40 pairs of Herring Gulls (Gilbertson 1974) and 3 pairs of Common Terns (on 29 June; Gilbertson, pers. comm.) nested on the island.

**Pigeon Island.** Although air photographs were taken, sample plots were not marked. The total count on the pictures was 5777 birds. According to I.M. Price (pers. comm.) there were no Common Terns on the island on 13 May when the pictures were taken. Thus the birds involved were almost all Ring-billed Gulls with a small number (probably fewer than 150) of Herring Gulls and Caspian Terns. It is unlikely that large numbers of non-breeding Herring Gulls were present, because there were no good loafing areas. Assuming that no non-breeding Ring-billed Gulls were at the island, the most conservative estimate of Ring-billed Gull nests for 1976 was 5777-150 or 2813 nests.

<sup>2</sup>  
Reported information regarding numbers of nests (having eggs or young) in previous years is shown in Table 5.

**Table 4**  
Numbers of Herring Gull nests, Scotch Bonnet Island, 1972-75

	Herring Gull nests	Source
1972, 6 May	122	M. Gilbertson, pers. comm.
1972, 23 May	145	M. Gilbertson, pers. comm.
1973	188	A.P. Gilman, pers. comm.
1974, 23 May	109	I.M. Price, pers. comm.
1975	101	A.P. Gilman, pers. comm.

**Table 5**  
Numbers of gull and tern nests, Pigeon Island, 1961-75

	Herring Gull	Ring-billed Gull	Common Tern	Caspian Tern	Ref. or source
1961	150	$750 \pm 250$	-	$50 \pm 10$	Edwards (1970)
1962	$150 \pm 50$	$2000 \pm 500$	$120 \pm 40$	approx. 50	Edwards (1970)
1963	$175 \pm 25$	$1850 \pm 150$	87	195	Edwards (1970)
1964	$100 \pm 50$	$3405 \pm 400$	$84 \pm 30$	$235 \pm 35$	Edwards (1970)
1966	>30	>1000	1	115	Edwards (1970)
1967	50	>1000	9	>100	Edwards (1970)
1968	46	>1000	0	approx. 150	Edwards (1970)
1969	64	>1000	0	>113	Edwards (1970)
1970	51	>1000	0	>116	Edwards (1970)
1971	78	>1000	0	>104	Edwards (1972)
1972	74	>1000	0	> 30	Edwards (1972)
1973	35	< 500	0	> 50	Edwards (1973)
1975	50	-	0	50-75	S.M. Teeple (pers. comm.)

**Snake Island.** In 1976 only Herring Gull nests were found on the island. At the beginning of the century Clarke (in Quilliam 1973) saw 300-400 mostly immature Ring-billed

Gulls, but including 6 Herring Gulls, on Snake and Salmon islands and wondered where these gulls nested. Some reported information for later years is shown in Table 6.

**Table 6**  
Numbers of gull and tern nests, Snake Island, 1927-72

	Herring Gull	Common Tern	Ref. or source
1927	1st nest	—	Quilliam (1973)
1950	146	—	Quilliam (1973)
1972, 9 May	79	0	J.A. Keith (pers. comm.)
1972, 24 May	87	0	M. Gilbertson (pers. comm.)
1972, 5 July	—	3	M. Gilbertson (pers. comm.)

**Table 7**  
Numbers of gulls and terns, Black Ant Island, 1916-75

	Herring Gull	Ring-billed Gull	Common Tern	Ref. or source
1916	—	—	island covered with eggs	Quilliam (1973)
1949	15 birds	5000 birds	no nests	Quilliam (1973)
1970	45 nests	—	no nests	Quilliam (1973)
1972, 24 May	21 nests	no nests	no nests	I.M. Price (pers. comm.)
1974	11 nests*	no nests*	no nests*	Woods (1975)
1975	15 nests*	no nests*	no nests*	Woods (1975)

\*In both years, the Herring Gull was the "principal species" nesting on the island.

**Ice Island.** In 1976 this island had a sizeable Common Tern colony which had increased over the past few years. Woods (1975) visited this island and found Common Terns to be the "principal species". He estimated the numbers of breeding pairs in 1973, 1974, and 1975 as 65, 70, and 68, respectively.

**Griswold Island.** Twenty adult Herring Gulls flew off the island when the colony was visited on 3 June 1976. Ten empty Herring Gull nests and two nests that each contained one cold Herring Gull egg were found. Only three Herring Gull young were found, indicating very poor reproductive success.

Woods (1975) visited this island and found Herring Gulls to be the "principal species". He estimated the numbers of breeding pairs in 1973, 1974, and 1975 as 11, 9, and 5, respectively. One deserted Common Tern nest (one egg) was found in 1976.

**Murray Island.** In 1976, 13 Ring-billed Gull nests and 13 Common Tern nests were found. In 1975, Woods (1975) found 20 nests with the Common Tern being the "principal species". There appeared to be additional available gull nest habitat on the island.

**Strachan Island.** Because of the high water levels in 1976, Strachan Island was partially flooded and consisted of five smaller islands. During a preliminary visit on 6 May 1976,

**Black Ant Island.** The reproductive success of the Herring Gulls on Black Ant Island was poor in 1976. On 8 May, E.M. Waltz (pers. comm.) found 12 nests, all with three-egg clutches. On 20 May, our party found 22 nests of which five had deserted clutches. There were 12 active three-egg nests; the other nests had smaller clutches and one nest contained one young and an addled egg.

On 30 May, Waltz found 12 "recognizable" nests, and five old, scattered nests. Of those 12 nests only three were intact, all others were empty or contained one or more smashed eggs and dead young. He also found three dead adults and speculates that a mammalian predator had visited the island (E.M. Waltz, pers. comm.). Some reported information for past years is shown in Table 7.

three islands were completely covered with Ring-billed Gull nests and had no nests of other species. Another island had five Ring-billed Gull nests (four of which were deserted), three Mallard (*Anas platyrhynchos*) nests, at least three Canada Goose (*Branta canadensis*) nests and ample unused breeding habitat for gulls. The fifth island had Ring-billed Gull nests on one end, one Canada Goose nest in the middle and a second Canada Goose nest at the other end.

No published reports for this island were available. In the early 1960's gulls were nesting on the island (H. McLeod, pers. comm.). On 21 May 1973 an estimated total of at least 3000 pairs of Ring-billed Gulls were nesting on the island, as well as one pair of Herring Gulls (J.A. Keith, pers. comm.).

**B) Gull and tern colonies active prior to 1976**

Some information is given below on a few islands which used to have gull or tern colonies but had none in 1976.

**Toronto Island Airport.** Because Common Terns and Ring-billed Gulls were a proven threat to the safety of aircraft using the airport (Fig. 2) a campaign to eradicate their colonies was begun in 1966 (Lewis 1967). Some 7000 Common Tern eggs were destroyed. The gulls and terns were further harassed with shell-crackers and car horns (Dunston 1967).

Information for previous years was obtained from the Ontario Nest Record Scheme (see Table 8).

**Table 8**  
Numbers of gulls and terns, Toronto Island Airport, 1964-67

	Herring Gull	Ring-billed Gull	Common Tern
1964	—	—	275 nests
1965	1 nest with young	—	breeding, but no estimate
1966	—	about 350 nests	about 2000 nests (destroyed)
1967	—	—	about 500 nests (destroyed)

**Bald Head Island.** On 14 June 1972, M. Gilbertson (pers. comm.) found 18 Common Tern nests (16 with eggs). A search was made in 1976 but the colony could not be found. An increase in density and height of the vegetation and in human disturbance were probably the main factors in the disappearance of the colony.

**Nicholson Island.** On 23 May 1972, M. Gilbertson (pers. comm.) found five Herring Gull nests on this island. Although the island was not visited in 1976, other observations in the area suggest that few, if any, gulls were nesting on the island in that year.

**Salmon Island.** In 1976 most of this island was flooded and there were no gulls or terns nesting. Information for previous years (from Quilliam 1973) is shown in Table 9.

**Table 9**  
Numbers of gulls and terns, Salmon Island, pre-1900-72

	Herring Gull	Ring-billed Gull	Common Tern	Caspian Tern
before 1900	—	—	breeding in numbers	—
early 1900's	—	numerous immatures, no nests	—	—
1927	—	2 nests	>500 nests	—
1928	1 nest	18 nests	—	—
1929	—	84 nests	—	—
1930	—	150 nests	—	1 nest (3 young)
1940	—	—	—	1 nest
1949	—	1000 birds	—	—
1950	—	—	17 nests	—
1972, 31 May*	2 nests	2 nests	170 nests	0
1972, 6 June*	2 nests	—	228 nests	0

\*Data provided by M. Gilbertson (pers. comm.).

**Horseshoe Island.** Quilliam (1973) reported that 5000 ± 500 Ring-billed Gulls were nesting on this island in 1961. In 1976 a thorough search was not made, but observations in the area suggest that few, if any, gulls were nesting on the island.

**Goose Island.** This small island was not noticed in 1976, probably because it was flooded. According to Quilliam (1973) 40 pairs of Common Terns nested there in 1966.

**Scorpion Island.** Woods (1975) found 24 Herring Gull nests on this island in 1975, but none in 1973 or 1974. When the island was visited on 30 May 1976, only two Herring Gull "scrapes" were found.

**Discussion and conclusions**

**Methods**

The inventory had a few shortcomings: (1) incomplete coverage, (2) in general only one count per colony, and (3) too few test plots on Gull Island and no test plots on Pigeon Island.

Although the area was not completely covered, either by boat or by aircraft, I believe that we did not miss any important gull or tern colony. I would appreciate receiving information on any colonies not mentioned in this report.

The maximum number of active nests at any time during the breeding season is probably the best measurement of colony size. As the number of active nests varies during the season (due to late nesting and re-nesting), a nest count on a particular day can only serve as an estimate of the size of the breeding population (see the numbers of nests for Scotch Bonnet Island, West Brother Island, and Ice Island, Table 1).

Because only three test plots were marked in the big Gull Island colony, the confidence interval for the estimate of nests in that colony was very large. For Pigeon Island, no confidence interval could be given.

In comparing ground counts to air photography, the ground counts have as advantages: (1) direct nest counts, and (2) relatively low costs. Disadvantages are: (1) disturbance of the colony, (2) hazardous boat trips (or delays), and (3) need for large teams for large colonies (or longer disturbance, or larger confidence interval). Air photographs provide a picture of the total undisturbed colony. This is an advantage if one is interested in the structure or density of the colony. In order to arrive at nest estimates, however, test plots have to be marked (requiring boat trips and causing disturbance of the colony). Air photography is expensive and requires good weather conditions and a skilled pilot. Also, the success of an air photo flight remains uncertain until the film has been developed. Analysis of the air photos is time-consuming. In general, with the technique used, sitting gulls and terns could not be distinguished even as to genus.

Once it is decided what constitutes a nest, the sources of error in ground counts are (1) overlooking nests, and (2) poor counting. Such errors probably constitute less than 10% of the total count. In air photography, the main problems are (1) the difficulty of distinguishing birds from the background (especially sand or excrement-covered rocks), (2) poor counting, (3) sampling errors of the test plots, and (4) variance of the "birds/nests" ratio between different plots.

I consider ground counts a better method for colonies that can be reached reasonably safely by boat. Disturbance of the colony can be reduced by keeping visits to the island as brief as possible and by making the visits during early incubation (birds will re-lay if their eggs are destroyed) or late in the season when the young are almost fully fledged.

(predation by large gulls is less severe than). In situations where the bird colonies are difficult to reach by boat or where the birds are breeding on steep cliffs, air photography (vertical or horizontal) is the only possible method. To compare results for different years, the photographic flights should be carried out as much as possible during the same phase of breeding season and at the same time of day (in order to reduce variation in the ratio "birds/nests" for the different years).

#### Results

The number of nesting Ring-billed Gulls was very large compared to the numbers of nesting Herring Gulls and the two tern species (Table 1). Ludwig (1974) documented the very rapid population increase of the Ring-billed Gull in all of the Great Lakes up to 1967. The data presented here suggest that in Lake Ontario Ring-billed Gulls have continued to increase since that year. Although the Gull Island population may have reached a saturation point some 10 years ago, the Leslie Spit colony with well over 10 000 nests developed after 1970. The Horseshoe Island colony of 2500 pairs (Quilliam 1973) no longer exists.

The nesting Herring Gull population did not appear to be thriving. In recent years reproductive success has generally been poor (Gilbertson 1974). In 1976, the colonies on Black Ant Island and Griswold Island reproduced very poorly, but reproduction was good on Mugg's Island (Fetterolf, pers. comm.). The number of non-breeding Herring Gulls on Scotch Bonnet Island in 1976 was at least six times larger than the number of nesting gulls. One small colony (Scorpion Island) has disappeared, whereas a few Herring Gulls began nesting at Hamilton Harbour in 1976. Nest counts for different years are often not strictly comparable because the counts were not made during the same phase of the nesting period. Nevertheless, when comparing the nest totals for each of the years in the period 1970-1975 with the 1976 totals for the same colonies, there was a marked decline (varying from 19% to 36%) for all but one year: compared to the 1974 total for four colonies, the 1976 total for those colonies was 15% higher. In summary, the available data show that in recent years numbers of nesting Herring Gulls have been low, somewhat fluctuating, but generally declining.

There are few data available regarding Common Tern numbers in Lake Ontario, even for recent years. In the immediate past, Common Tern colonies disappeared on Mugg's Island (Morris and Hunter 1976), the Hamilton Harbour islands (Morris and Hunter, 1976), Pigeon Island (Edwards 1970) and Weller's Bay (this report). The big tern colony on Gull Island has decreased to less than a tenth of its former size, probably due to some combination of extensive vegetation growth, predation by resident Black-crowned Night Herons (*Nycticorax nycticorax*) and interference by resident Ring-billed Gulls (Morris 1975). The situation in the Toronto area (Fig. 2) is noteworthy in that a large colony (about 2000 nests in 1966) on Toronto Island Airport was destroyed, whereas a new colony (over 1200 nests in 1976) became established on Leslie Spit only a few miles away from the airport. Although the data are incomplete they indicate

a serious decline in numbers of nesting Common Terns in recent years.

Caspian Terns have never been common nesters in the Canadian part of Lake Ontario (Quilliam 1973), and Bull (1974) did not report any nesting in the U.S. part. In 1917, a nest was found in the Common Tern colony on Gull Bar near the False Duck Island (Sprague 1969). In 1976 there was no nesting on Gull Bar, probably because of the high lake level. In 1930, three young were found on Salmon Island, and in 1940 at least one other nest was found there. In the early 1940's, Green Island, off Waupoos, held a Caspian Tern colony among Ring-billed Gulls (Sprague 1969), but no nesting birds were found there in 1976. Ludwig (1974) reported the nesting of an occasional pair of Caspian Terns at Gull Island. On 13 May 1976, J.C. Chardine and I. Kirkham (pers. comm.) observed 80 Caspian Terns off Barcovan Beach, a few miles east of Presqu'île Provincial Park. At Mugg's Island, a Caspian Tern nest with young was found in 1969 (Ontario Nest Record Scheme), but in the last few years the species has not nested there (P.M. Fetterolf, pers. comm.). The only colony that is firmly established in eastern Lake Ontario is the one at Pigeon Island, and although it has decreased considerably since the early sixties, it is still a sizeable colony. The new small colony (seven nests) at Leslie Spit will probably disappear in the near future when the area is developed into an "aquatic park".

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#### Appendix 1

Calculation of estimate of Ring-billed Gull nests on Gull Island, Presqu'île Provincial Park

A total of 35 894 nesting white birds was counted on the air photographs which were taken on 12 and 13 May. On 10 May there were 41 Herring Gull nests on the island. On 13 May the first nest start of Common Terns was observed (R.D. Morris, pers. comm.). There were no Caspian Terns nesting in 1976 (J.C. Chardine, pers. comm.). Thus the number of nesting Ring-billed Gulls on 13 May was 35 894-82 = 35 812 birds (assuming two birds per Herring Gull nest).

Three sample plots were marked with markers that could be readily identified on the air photographs (see Methods). The nests in the sample plots were counted on 13 May. Results for the 3 plots were as follows:

Sample plot	No. of nests counted on the ground (n)	No. of air photographs (g)	No. of gulls on air photographs (g)	Ave. no. of gulls on air photographs ( $\bar{g}$ )
1	54	2	89, 97	93
2	46	3	57, 59, 66	60.66
3	21	4	28, 29, 30, 30	29.25

The estimate of the total number of nests,  $\hat{N}$ , is given by:

$$\hat{N} = G \bar{r} \quad (\text{eqn. 1})$$

where  $G$  = the total number of gulls counted on the aerial photographs, and  $\bar{r}$  = the estimate of the ratio of nests to gulls, as obtained from the test plots.

The variance of  $\hat{N}$  is given by:

$$\text{var } \hat{N} = G^2 \text{ var } \bar{r} \quad (\text{eqn. 2})$$

There were no data to show that nests were homogeneously distributed. As the sample plots had different numbers of nests and had slightly different sizes, each plot should be treated as a cluster. The ratio of nests to gulls in the  $i^{\text{th}}$  cluster is given by:

$$r_i = \frac{n_i}{g_i} \quad (\text{eqn. 3})$$

where  $n_i$  = the number of nests in the  $i^{\text{th}}$  cluster, and  $g_i$  = the number of gulls in the  $i^{\text{th}}$  cluster. In cluster sampling the value of  $\bar{r}$  is given by:

$$\bar{r} = \frac{\sum n_i}{\sum g_i} \quad (\text{eqn. 4})$$

i.e. the weighted mean of the sample plots.

The variance of  $\bar{r}$  is given by (Cochran 1963, p. 65):

$$\text{var } \bar{r} = \frac{\sum n_i^2 - 2\bar{r} \sum n_i g_i + \bar{r}^2 \sum g_i^2}{(S-1) \frac{(\sum g_i)^2}{S}} \quad (\text{eqn. 5})$$

where  $S$  = the number of clusters (sample plots) in the colony.

Substituting the numbers of nests, the averaged numbers of gulls in the three sample plots, and the total number of Ring-billed Gulls counted, one obtains:

$$\begin{aligned} \bar{f} &= 0.662 && \text{(eqn. 4)} \\ \hat{N} &= 23\ 707 && \text{(eqn. 1)} \\ \text{var } \bar{f} &= 0.004\ 22 && \text{(eqn. 5)} \\ \text{var } \hat{N} &= 5\ 412\ 147.2 && \text{(eqn. 2)} \\ \text{sd } \hat{N} &= 2\ 326 && \text{(var. } \hat{N}) \end{aligned}$$

The estimate of the number of nests =  $\hat{N} \pm 2 \text{sd } \hat{N}$ ,  
or  $23\ 707 \pm 4\ 652$

This result does not completely take into account the variability in the numbers of gulls per sample plot for the different air photographs.

