

Progress Toward Colonial Waterbird Population Targets in Hamilton Harbour (1998–2000)

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In the 18th and 19th centuries, the water body and adjacent land areas known as Hamilton Harbour were a rich source of biological diversity. Extensive marshlands surrounded all sides of the harbour, with the greatest density of aquatic vegetation in the shallow west end of the bay, now known as Cootes Paradise. In the early months of the year, the littoral zone vegetation and wet uplands at the edge of the water presumably provided adequate cover for a diversity of breeding land and water birds, and in the months of September and October, the harbour served as a major staging area for migrating waterfowl. By the mid-1900s, the predictable changes associated with development of a major urban and industrial centre caused the nearshore areas around much of the harbour to lose the habitat diversity needed to sustain active breeding populations of wildlife species. Marshland on the south shore of the harbour had been drained to make way for heavy industry, and the north shore had been developed as an urban landscape with a golf course, yacht club and extensive housing. These and other details on the history and

more recent status of the harbour waters and adjacent land areas are found in the Remedial Action Plan for Hamilton Harbour (1989) and URL site (www.mcmaster.ca/eco-wise/what.htm). Gebauer et al. (1993) offer a historical review of waterbird species and populations in the harbour area.

Throughout the 1990s and into the new millenium, there are two general land locations around the harbour that remain relatively undeveloped: the southeast shoreline and Cootes Paradise at the extreme west end. Land on the southeast shore has been owned by the Hamilton Harbour Commissioners (HHC) since the mid-1960s, who manage it for current and future industrial and development activities. Portions of this land, and five islands in the northeast corner of the harbour, are occupied during the breeding season by six species of colonial nesting waterbirds (Quinn et al. 1996). The species are: Double-crested Cormorant (*Phalacrocorax auritus*), Black-crowned Night-Heron (*Nycticorax nycticorax*), Herring Gull (*Larus argentatus*), Ring-billed Gull (*L. delawarensis*), Caspian Tern (*Sterna caspia*), and Common

Tern (*S. hirundo*). Curry and Bryant (1987) recorded Snowy Egrets (*Egretta thula*) nesting in the harbour in 1986, but they have not been recorded there since.

Numbers of nesting pairs, nesting locations, and some management strategies for these species in the Hamilton Harbour area have been reported previously for the years 1959 through 1987 by Dobos et al. (1988), for 1988 through 1994 by Moore et al. (1995), and for 1996 and 1997 by Pekarik et al. (1997). Quinn et al. (1996) described three new wildlife islands whose construction was intended to reduce land-use conflict and help maintain avian biodiversity in the harbour. They also proposed long-term management procedures for the waterbirds nesting on mainland and island areas. Our objectives in this note are: (1) to record and comment on the numbers of nesting pairs in the years 1998, 1999 and 2000; (2) to note numerical trends associated with each species from their first nesting record to the present; and (3) to comment on progress toward achieving the numbers of nesting pairs projected in the Hamilton Harbour Remedial Action Plan (RAP) for the region.

THE STUDY SITE

Hamilton Harbour (43° 16' N, 79° 46' W) is at the extreme western end of Lake Ontario and connects to the lake through the Burlington Canal,

a narrow causeway that permits boat access to the harbour (Figure 1). It is separated from Lake Ontario by a sandbar, known locally as the Burlington Beach Strip.

The primary areas of undisturbed breeding habitat for all six species of colonial nesting birds are at the eastern end and southeastern shorelines of the harbour (Figure 1). The two most northerly nesting sites at the east end of the harbour (Farr and Neare Islands) are simple rock piles constructed to support hydro towers and cables (since removed) that crossed the harbour (Morris et al. 1976). Three new islands (North, Centre, and South Islands in Figure 1) built during the winter of 1995–96 (Quinn et al. 1996), to provide new nesting habitat in the harbour, are immediately to the southeast of Farr and Neare Islands. The largest nesting area for colonial waterbirds is adjacent to the QEW highway on property currently owned and managed by the HHC. In the three years of our study, all six species of colonial birds that breed in the harbour area nested at various locations on the island and mainland sites, including the dikes and area surrounding the confined disposal facilities locally known as Piers 25, 26 and 27 (Figure 1). Three of these species also were recorded at other locations within the harbour basin. Ring-billed Gulls nested on the east side of Windermere Basin to the south of Pier 25, and Common Terns occupied Spur Dyke Island in

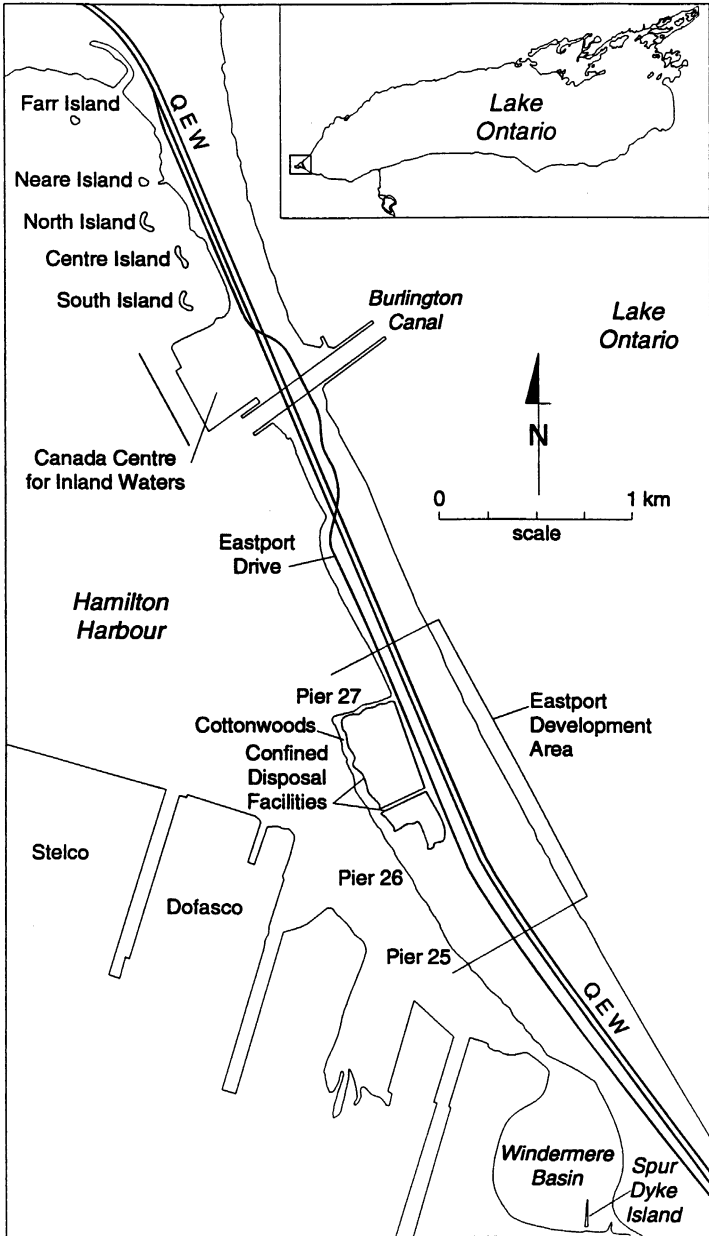


Figure 1: The study areas at the eastern end of Hamilton Harbour, Lake Ontario. The inset locates Hamilton Harbour at the extreme western end of Lake Ontario.

Windermere Basin and some small shoals offshore from LaSalle Park at the west end of Hamilton Harbour. Double-crested Cormorants nested at the extreme northwest end of the harbour at Carroll's Point, and on Hickory Island in Cootes Paradise, a marshland west of Hamilton Harbour and connected to it by a short abandoned channel (Desjardins Canal).

METHODS

General Principles of a Nest Census

For most colonial waterbird species that nest in Hamilton Harbour and elsewhere, patterns of clutch starts (laying of the first egg in a clutch) in a particular breeding season are characterized by a nesting "peak" that starts within 7–10 days after the first clutch appears, and continues for the next 7–10 days, with small numbers of clutches started thereafter. The optimal census protocol in a particular breeding season is to conduct a count of the number of nesting pairs during the final week of incubation for clutches initiated before and during the peak period of nest starts. A census conducted at this time (about 10 days after the last "peak" clutch is initiated) also counts clutches started in the 10 days following the peak of egg laying. Thus, the census counts 90–95% of all clutches started in a particular year, and takes place during a time when the majority of young chicks present are not yet mobile, and so

minimizes the risk of disturbance to the colony (see Brown and Morris 1995).

Specific Nest Census Methods (1998–2000)

The census methods to estimate numbers of nesting pairs at the various locations within our study site generally replicated those described in detail by Pekarik et al. (1997), and used in previous years. Hickory Island, Carroll's Point and other locations around the Hamilton Harbour shoreline were surveyed for Double-crested Cormorant and Black-crowned Night-Heron nests from a boat or from the shore. Dates of these surveys were mid- to late May. The mainland nesting locations at Eastport (Piers 25, 26 and 27), the lands adjacent to Windermere Basin, and all six islands within the study area were surveyed from early May to mid-June in each year. In general, Ring-billed and Herring Gulls were censused from early to mid-May, whereas Common and Caspian Terns were censused from late May to mid-June. With the exception of Ring-billed Gulls, the census of all species was accomplished by counting "active nests" (nest scrapes, clutches, broods) within each relatively small nesting area. For the large nesting areas of Ring-billed Gulls, a team of field workers laid successive parallel lines approximately four metres apart across the length of each sur-

vey area. Individual members of the team walked along each line, counting "active nests" within the area between the two lines.

Management Methods

Four specific management methods were used in each year to encourage (or discourage) the nesting of individual species pairs at designated locations throughout the study area. First, in late March or early April each year, plastic sheeting was laid over the substrate of an elevated mound at the north end of North Island that was designated for Caspian Tern nests (Quinn et al. 1996). Ring-billed Gulls arrive earlier in a breeding season and begin nesting before Caspian Terns (cf. Morris et al. 1992 for Common Terns), and the purpose of the plastic was to restrict gulls from nesting on the mound. Second, a commercial falconry company was hired in each year to use raptors to restrict the nesting of Ring-billed Gulls on the new wildlife islands and portions of Piers 26 and 27. Raptors [primarily Saker Falcons (*Falco scherrug*), Harris's Hawks (*Parabuteo unicinctus*), and Ferruginous Hawk (*Buteo regalis*)] were in place from late March through late May. Third, Ring-billed Gull nests were destroyed and eggs collected under a federal permit in areas where the two previous techniques were unsuccessful at restricting nesting. Fourth, dead standing vegetation from the previous sea-

son was left in place on Spur Dyke in Windermere Basin, as the vegetation discouraged gulls from nesting there. In 1998, we removed the vegetation in late April, prior to occupancy by Ring-billed Gulls. In 1999 and 2000, Ring-billed Gulls colonized the Dyke despite the presence of dead standing vegetation, and we periodically collected their eggs from the site (under permit).

RESULTS

Numbers of Nesting Pairs

The numbers and locations of nesting pairs of Ring-billed Gulls, Herring Gulls and Double-crested Cormorants in the Hamilton Harbour area for the three years of our study are given in Table 1. Six sites contained Ring-billed Gull nests in 1998 and 1999, with two additional sites (shoals between islands) colonized in 2000. The greatest numbers of Ring-billed Gull nests in both years were at Windermere and Eastport, the two traditional nesting locations for gulls in the Hamilton Harbour basin over the past decade. Smaller numbers of nests were found on the three new wildlife islands, with the greatest number on Centre Island in each year. Herring Gulls nested on 7–8 sites, although only five sites had nests in all three years (Table 1). The greatest numbers of Herring Gull nests in each year were on Neare Island, with fewer nest numbers on the adjacent Farr Island to the north (Table 1). Of the three

Table 1: Numbers of nesting pairs of Ring-billed Gulls (RBGU), Herring Gulls (HEGU) and Double-crested Cormorants (DCCO) nesting in the Hamilton Harbour area in 1998–2000. Total numbers of all six species are summarized in Table 3.

Location	RBGU			HEGU			DCCO		
	1998	1999	2000	1998	1999	2000	1998	1999	2000
Hickory Isl.	0	0	0	0	0	0	218	222	197
Carroll's Point	0	0	0	0	0	0	13	0	0
Windermere ¹	9,337	10,080	7,829 ²	4	0	0	0	0	0
Spur Dyke	12	106	200	3	0	0	0	0	0
Eastport	5,902	11,072	14,616	16	39	43	588	820	873
Raft ³	0	0	0	0	1	1	0	0	0
Neare Isl.	0	0	0	114	109	111	0	0	0
Farr Isl.	0	0	0	34	43	43	23	40	48
North Isl.	49	137	135	62	74	66	0	0	0
Centre Isl.	1,275	2,000 ⁴	745	14	0	3	25 ⁵	25 ⁵	25 ⁵
South Isl.	0	195	159	0	0	0	0	0	0
Shoals (C-S) ⁶	0	0	51	0	1	0	0	0	0
Shoals (C-N) ⁷	0	0	24	0	0	1	0	0	0
Breakwall ⁸	0	0	0	NC ⁹	7	3	0	0	0

¹ east side of Windermere Basin

² east and west sides of Windermere Basin

³ artificial wooden raft anchored in pond south of Pier 27

⁴ estimate based on nests in 2–3 1 X 1 m quadrats, extrapolated to dimensions of the island

⁵ nests on five ledges attached to each of five telephone poles (25 ledges each year)

⁶ two shoals between Centre and South islands; 36 nests on north shoal and 15 nests on south shoal

⁷ two shoals between Centre and North islands; all 24 nests on south shoal

⁸ west of Canada Centre for Inland Waters

⁹ NC = not censused

new wildlife islands (North, Centre, and South), North Island contained the largest numbers of nesting pairs. Nests at the Eastport site were concentrated along Pier 27 at the north edge of the confined disposal facility. Double-crested Cormorants nested at the same four locations in each year (Table 1), and at Carroll's Point. The Eastport site contained the greatest number of nesting pairs.

The numbers and locations of nesting pairs of Common Terns, Caspian Terns and Black-crowned Night-Herons for the three years of our study are given in Table 2. Common Terns nested at seven locations in 1998, although the greatest numbers of nests were on two islands, Spur Dyke and Centre Island. In 1999, Spur Dyke again contained the greatest number of nesting terns, although the number

was estimated upwards from an actual count of 242 clutches on 14 May, shortly after peak nesting. Nest numbers on Centre Island dropped to zero in 1999, balanced by an increase in numbers of nesting pairs on South Island. The most significant change in 2000 was a decrease in the number of nests on Spur Dyke (Table 2). The LaSalle Park Shoals contained small numbers of pairs in all years. Nesting of Caspian Terns was restricted to the same two locations in each year, with the North Island site favoured over the Centre Island location (Table 2). Black-crowned Night-

Hérons nested at four locations in 1998, and two locations in 1999 and 2000, with consistent numbers of nests on North Island in all years. The Eastport site had the largest number of nesting pairs in 1999 and 2000.

A direct comparison of numbers of nesting pairs over the three years for all six species is in Table 3. Ring-billed Gulls were clearly the numerically dominant species, followed by Double-crested Cormorants, Common Terns, Caspian Terns, Herring Gulls, and Black-crowned Night-Hérons. While the actual numbers of nests for the different

Table 2: Numbers of nesting pairs of Common Terns (COTE), Caspian Terns (CATE) and Black-crowned Night-Hérons (BCNH) nesting in the Hamilton Harbour area in 1998–2000. Total numbers of all six species are summarized in Table 3.

Location	COTE			CATE			BCNH		
	1998	1999	2000	1998	1999	2000	1998	1999	2000
LaSPSh 1 ¹	8	7	8	0	0	0	0	0	0
LaSPSh 2	19	5	17	0	0	0	0	0	0
Spur Dyke ²	339	363 ³	292	0	0	0	0	0	0
Eastport	0	0	0	0	0	0	7	68	96
Neare Isl.	0	0	0	0	0	0	4	0	0
North Isl.	0	0	0	303	280	309	31	36	37 ⁴
Centre Isl.	166	0	0	130	141	106	10	0	0
South Isl.	75	247 ⁵	232	0	0	0	0	0	0
Shoal (C-S) ⁶	1	0	0	0	0	0	0	0	0

¹ LaSalle Park Shoals (N = 5)

² Spur Dyke in Windermere Basin (Figure 1)

³ estimated from mainland on 18 June (242 clutches counted 14 May)

⁴ abandoned or washed away by high water sometime after 24 May 2000

⁵ nests with immobile chicks counted on 14 June; additional nest numbers estimated from chick groups

⁶ north shoal between Centre and South islands

Table 3: Estimated total numbers of nesting pairs of six colonial waterbird species in the Hamilton Harbour area in 1998–2000. The percentage change is from 1998 to 2000.

Species	1998	1999	2000	Percent change (1998–2000)
Black-crowned Night-Heron	52	105	133	+155.8
Ring-billed Gull	16,575	23,590	23,884	+44.1
Double-crested Cormorant	867	1,107	1,143	+31.8
Herring Gull	247	273	271	+9.3
Caspian Tern	433	421	415	-4.2
Common Tern	620	626	562	-9.4
Total	18,789	26,016	26,408	+40.5

species varied over several orders of magnitude, the greatest percentage increase was experienced by Black-crowned Night-Herons (Table 3). Four of the six species realized a percentage increase in numbers of nesting pairs; both tern species decreased over the three years, with Common Terns losing almost 10% of their nest numbers between 1998

and 2000. The total number of nesting pairs increased by 40.5%.

Specific Nesting Sites

The numerical data provide no information on specific sites within the nesting locations that contained the greatest number of nests. Accordingly, we briefly comment on these details for each major location.

Eastport

Eastport contained nests of Ring-billed Gulls, Herring Gulls, Double-crested Cormorants, and Black-crowned Night-Herons (Tables 1 and 2). The nests of cormorants and herons were concentrated in a small grove of willow (*Salix* sp.) and Manitoba (Ashleaf) Maple (*Acer negundo*) bushes, and dead Eastern Cottonwood (*Populus deltoides*) trees along the west edge of the confined disposal facility (CDF) between Piers 26 and 27 (see Figure 1). Heron nests were restricted to the willow bushes; cormorant nests were in the maple and cottonwoods. The cottonwoods supported substantial numbers of cormorant nests in earlier years, but by 1998 were largely collapsed and the birds were mostly nesting on the remaining low branches of broken tree stumps or on the ground. Ring-billed Gulls nested on all land areas around the CDFs, while the smaller numbers of Herring Gull pairs nested primarily along the dike on the edge of the most northerly CDF (Figure 1). The Hamilton Harbour Commissioners contracted with falconry companies in each of the three years to position raptors at strategic locations along the southern edge of Pier 26 to control the nesting of Ring-billed Gulls. Gulls were permitted to nest on land areas north of a point about 20 m south of the southerly CDF.

Windermere and Spur Dyke

The land areas around Windermere Basin and Spur Dyke on the west side of the Basin contained nests of Ring-billed Gulls, Herring Gulls and Common Terns. The highest density of Ring-billed Gull pairs was on the east side of Windermere Basin in a narrow strip of approximately 30 m along the shoreline, extending northward to the bridge across the Windermere

Channel (Figure 1). Ring-bills also nested along the northern edge of Windermere Basin. The few Herring Gull nests were on the east shore of the Basin and on Spur Dyke. Common Terns nested exclusively on the eastern half of Spur Dyke in all three years.

Neare and Farr Islands

Each island contained nests of two species: Herring Gulls and Black-crowned Night-Herons on Neare Island, and Herring Gulls and Double-crested Cormorants on Farr Island. Nests were evenly distributed around each island. Cormorants nested on the ground and in a single Manitoba Maple on Farr Island.

Wildlife Islands (North, Centre, and South)

While the substrates on each of the three islands were constructed to encourage colonization by particular species of colonial waterbird (details in Quinn et al. 1996, Pekarik et al. 1997), settlement in the three years of our study was not always as planned. Heavy vegetation covered South Island, and only Ring-billed Gulls and Common Terns nested there, with tern nests concentrated around the northern (1998 and 1999) and southern (2000) edges. Gull nesting on South Island was successfully prevented with the use of a raptor in 1998, but pairs again colonized the island in 1999 and 2000 (Table 1) despite the presence of a raptor there. Centre Island supported nests of all six species in 1998, three species in 1999, and four species in 2000 (Tables 1 and 2). Double-crested Cormorants nested exclusively on the ledges on poles in the middle of the island; none nested on the ground. Caspian Terns nested on an elevated mound at the north end of Centre Island, while Ring-billed Gulls nested throughout. On North Island, Caspian Terns nested on mounds at both the north and south ends of the island, while Black-crowned Night-Herons nested in the rocks around the edges of the island. Herring and Ring-billed Gull nests were distributed throughout.

Hickory Island/Carroll's Point

Double-crested Cormorant nests were exclusively in trees on Hickory Island and at Carroll's Point.

Historical data

Numbers of nesting pairs using the Hamilton Harbour area in 1998 and 1999 can be better placed into perspective by comparing them with numbers recorded in earlier years (Table 4). Common Terns were the first recorded nesters in Hamilton Harbour (1946), while Caspian Terns were the most recent arrivals (1986). In the 12 years after systematic counting began in 1987, numbers of Common Tern and Herring Gull pairs remained relatively constant. Numbers of Caspian Tern pairs have experienced a three-fold

increase, whereas numbers of Double-crested Cormorants have increased by a factor of 20. Conversely, numbers of nesting Black-crowned Night-Heron pairs declined through the mid-1990s, but experienced a resurgence in 1999 that brought numbers to about half those present in 1987. Numbers of Ring-billed Gull pairs appear stable. However, there was only one systematic count of Ring-billed Gull nests in Hamilton Harbour between 1987 and 1999, and numbers of nesting pairs in that year (1990; Blokpoel and Tessier 1996)

Table 4: Estimated numbers of nesting pairs of waterbirds in the Hamilton Harbour area from the year when nesting was first recorded through successive major count dates. The target numbers were established by an ad hoc committee of research and policy personnel with the objective of reaching them by 2003 (see text).

Species	Number of nesting pairs					
	First count ^{1,5}	1987 ²	1994 ³	1997 ⁴	2000	Target
Black-crowned Night-Heron	15 (1959)	212	90	20	133	200
Ring-billed Gull	2 (1961)	21,207	NC ⁶	NC	23,884	5,000
Double-crested Cormorant	1 (1984)	51	451	495	1,143	200
Herring Gull	7 (1976)	225	303	342	271	350
Caspian Tern	48 (1986)	134	313	399	415	>200
Common Tern	15 (1946)	553	868	753	562	>600

¹ year of first count in parentheses

² numbers from Dobos et al. 1988

³ numbers from Moore et al. 1995

⁴ numbers from Pekarik et al. 1997

⁵ from citations in Dobos et al. 1988

⁶ no count; 39,621 pairs counted by Blokpoel and Tessier (1996) in 1990 (see text)

were almost double (39,621) that reported in 1987 and 1999. The most probable reason for the decline in the 1990s is related to management activities contracted by the Hamilton Harbour Commissioners (see below).

DISCUSSION

In recent historical times (since the mid-1970s), the land areas designated as Piers 25 through 27, and that surrounding Windermere Basin, have been owned by the Hamilton Harbour Commissioners who have used it for their own purposes (J. Brookfield, pers. comm.). Because access to these properties is restricted by the HHC, the sites provide relatively secure nesting habitat for colonial nesting waterbirds. Details on general nesting location and numbers

of breeding pairs for the six waterbird species nesting in the Hamilton Harbour area have been reported for the years 1959 through 1997 (Dobos et al. 1988, Moore et al. 1995, Pekarik et al. 1997), and Dobos et al. (1988) provided details of historical nesting data for some of the species.

Numerical patterns over the years since the first count (Table 4) can be taken as representative of local population changes for five of the six species in the Hamilton Harbour area; the pattern for Ring-billed Gulls cannot. The dramatic increase in the numbers of breeding pairs in the 26 years between 1961 and 1987 (+ 21, 205) probably is an accurate indication of the exponential numerical increase of which this species is capable. Ring-billed Gulls are tolerant to disturbance in their

breeding colonies (Brown and Morris 1994), are adaptive omnivores compared to Herring Gulls (Chudzik et al. 1994), and have experienced eruptive growth in numbers at colonies in the lower Great Lakes between 1976 and 1990 (Blokpoel and Tessier 1996). Conversely, while the relatively small increase in numbers of breeding pairs in the 12 years between 1987 and 2000 (+ 2,677) might suggest habitat saturation, the more likely explanation is the management activities of the HHC that operate to control the nesting locations of gulls. Management techniques have included pyrotechnics, physical disturbance, egg collection, and the use of falconry. Without these controls that started in the early 1990s, the colony is likely to have increased at the average annual growth rate of 11.6 – 12.6% reported for colonies elsewhere in Lakes Erie and Ontario (Blokpoel and Tessier 1996). Some evidence for this suggestion comes from the only systematic count of Ring-billed Gull nests in Hamilton Harbour between 1987 and 1999; numbers in that year (1990) were almost double (39,621) that reported in 1987 (21,207). Accordingly, the decrease in nesting pairs from the 1990 numbers to 23,884 pairs in 2000, is apparently the result of the use of falconry and other procedures to restrict nesting to areas designated by the Hamilton Harbour Commissioners.

Raptors were the principal means used to control nesting by Ring-billed Gulls during the three years of our study. Although the control objectives were the same in each year (to restrict Ring-billed Gull clutches from major sections of Eastport, from most of the land on the east shore of Windermere Basin, and from the three new wildlife islands), there was a significant increase in the total number of clutches recorded at all locations in 1999 (23,590) compared to 1998 (16,575). Conversely, in 2000, numbers remained relatively stable (23,884). The increase in 1999 followed by relative stability in 2000, may reflect differential efficiency in the use of raptors to control nesting gulls. Two different falconry companies were employed by the HHC and the Canadian Wildlife Service in 1998 [Bird Control International Inc. (BCI)] and 1999 [Falcon International (FI)]. BCI was again employed in 2000 to control gull nesting and there was no increase from the number of nests in 1999. Furthermore, the use of a large raptor on Centre Island in 2000 significantly reduced numbers of Ring-billed Gulls nesting there compared to the previous year (Table 1). Whether the required five-fold reduction to the target numbers of nesting Ring-billed Gulls is possible will depend on the continued and efficient use of raptors at Eastport, Windermere Basin and the new wildlife islands.

Targeted Numbers of Nesting Pairs

The Remedial Action Plan for Hamilton Harbour (1989) identified a need to create permanent habitat for colonial nesting birds within the harbour area (J. Hall, pers. comm.), and Quinn et al. (1996) argued for the importance of maintaining avian biodiversity there. As an integral part of the creation of new habitat on the three new wildlife islands, and the management of waterbird species using existing and new nesting substrate, an informal Colonial Waterbird Nesting Committee was struck to establish desirable targets for each species nesting in the harbour area. The Committee, composed of personnel from the Fish and Wildlife Habitat Restoration Project, the Canadian Wildlife Service, McMaster University and Brock University, established target numbers of nesting pairs for each species with the objective of meeting the numbers with appropriate management procedures by the year 2003.

Targets for Common Terns and Caspian Terns were approached or exceeded in 2000 (Table 4). Management efforts used to date (cf. Morris et al. 1992, Quinn et al. 1996) indicate that both tern species can likely be sustained at their current nesting locations on the new wildlife islands and Spur Dyke. However, both species require the implementation of special management procedures each year. Ring-billed Gulls are prevented from nesting on Common Tern

and Caspian Tern substrate by a combination of egg removal and raptor use. In addition, sections of the Caspian Tern substrate on the new wildlife islands are covered each spring by PVC sheeting until terns arrive. Despite these efforts, the gradual decline in numbers of Caspian Terns over the past three years, and the 10% reduction in numbers of Common Terns since 1998, indicate the importance of continued vigilance.

Black-crowned Night-Herons were at the target number in 1987 and will likely reach the number again in the next 3–4 years, given the substantial increase in pairs from 1997 to 2000 (Table 4). Hawthorn (*Crataegus* sp.) bushes on South Island were planted specifically to encourage herons to nest there, and we anticipate that pairs now nesting on the ground on North Island will settle into the more suited arboreal habitat as trees mature in the next few years. While the number of Herring Gull pairs declined in 2000, the species clearly has potential to reach levels that were already at the target number in 1997 (Table 4). We anticipate little difficulty in maintaining target numbers for these two species.

Current numbers of nesting pairs of Double-crested Cormorants and Ring-billed Gulls are each about five times higher than target levels (Table 4), and will be difficult to reduce by 2003 without the use of major and intrusive management procedures.

Greater use of raptors and more intensive egg collections are almost certainly required in future years to reduce numbers of Ring-billed Gulls. We note that the target number for Ring-billed Gulls may be subject to revision (in either direction) based on the outcome of discussions currently underway between the City of Hamilton and the HHC concerning the ownership of the land east of Windermere Basin.

In our view, the most serious problem is with Double-crested Cormorants that were already well over the target number of pairs in 1994, and that have increased dramatically in the three years since 1997 (Table 4). The nesting poles on Centre Island supported the maximum number of nesting pairs in each of the past two years, and Hickory Island may also be at carrying capacity (Table 1). Numbers of tree-nesting pairs at these two locations can likely be maintained

because of limited branch nesting sites. The greatest concentration of nesting pairs in Hamilton Harbour is at Eastport in the northwest corner of Pier 27 (Figure 1). Many of the birds there construct nests on the ground, and as space is not yet limiting, there is a potential for continuing increase. Accordingly, unless the target number for this species is revised upward, intrusive management procedures will be needed to discourage nesting at this site.

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