

The Terns of the Canadian Great Lakes



Caspian Tern colony on the Great Lakes

Hans Blokpoel

This factsheet describes the four tern species, reports on their status in the Canadian Great Lakes, examines the threats to their well-being, outlines some innovative conservation approaches, and highlights further conservation efforts and associated research.

The arrival of many species of birds in the spring and their disappearance at the end of the breeding season, is one of the most familiar aspects of North American bird biology. Like many of these species, the terns of the Great Lakes join this annual migration to distant tropical winter quarters each fall. Early each spring they rapidly wing their way north from the Caribbean and Central and South America to reclaim their breeding territories in the Great Lakes. While we may think of them as "our" birds that go south for the winter, it may be more logical to think of them as southern species that make a relatively brief foray north to breed.

Terns existed in the Lower Eocene, some 60 million years ago. Placed by taxonomists in the order Charadriiformes, family Laridae, subfamily Sterninae, they are closely related to gulls. There are 42 species of terns in the world, four of which nest in the Great Lakes. Caspian (*Sterna caspia*) and Common (*Sterna hirundo*) terns nest mainly on islands, while Black Terns (*Chlidonias niger*) and Forster's Terns (*Sterna forsteri*) nest in marshes.

Terns are readily distinguished from gulls by their forked tails, straight pointed bills, slender shape and long, narrow

wings. Their steady wing beats and buoyant movements have earned them the name "sea swallows". Although web-footed, they swim poorly and seldom rest on the water. Their plumage is predominantly white, grey and black and, as with many colonial waterbirds, the sexes are not easily differentiated.

Caspian and Common terns have been studied for many years by Environment Canada's Canadian Wildlife Service to monitor contaminant levels and the biological effects of these contaminants on waterbirds in the Great Lakes. Caspian and Common terns are useful indicators of ecosystem health because they are largely piscivorous (fish-eating) birds, feeding in the upper trophic levels of the aquatic food web.

Over 400 different man-made chemicals have been detected in Great Lakes biota. Research and monitoring have focused on heavy metals such as mercury, organochlorine pesticides such as dichlorodiphenyltrichlorethane (DDT), dieldrin and mirex, and other chlorinated organics such as polychlorinated biphenyls (PCBs), hexachlorobenzene (HCB), dioxins and furans. Since most of these toxic chemicals are soluble in fat and very resistant to breakdown or elimination, every time a tern eats a fish, it is also consuming all the pollutants that fish has consumed in its lifetime. Colonial waterbird eggs provide a direct index of these fat-soluble chemicals.

Wildlife researchers also monitor the distribution of terns in the Great Lakes basin to address the growing concern of loss of suitable nesting habitat. Two-thirds of Great Lakes coastal wetlands have been lost; many



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have been drained or reclaimed for land development purposes, including the need for prime farmland, new harbour facilities, and urban expansion.

The Forster's Tern and the Black Tern nest in wetlands. The Black Tern prefers shallow marshes associated with lakes, ponds, rivers and water impoundments, while the Forster's Tern is generally found in the inaccessible, deep-water portions of large cattail (*Typha* spp.) marshes. The number of wetlands suitable for nesting varies greatly among the lakes. Marshes are present mainly in the lower Great Lakes, Lake St. Clair and the St. Marys River. There are only a few marshes in southern Georgian Bay and virtually none in the North Channel and Lake Superior.

Caspian and Common terns prefer to nest on sparsely vegetated, uninhabited islands. In Lake Ontario, virtually all the islands are located at the eastern end, and in Lake Erie, all but one island are clustered in an archipelago at the western end of the lake. Between these two end points, terns are found nesting on mainland sites and breakwaters on the waterfronts of Toronto, Hamilton and Port Colborne. Due to habitat restrictions, colonies in the lower Great Lakes tend to be few in number, but large. In the upper Great Lakes there are literally thousands of small islands. Tern colonies here are more numerous, but generally much smaller.

Caspian Terns in the Canadian Great Lakes are increasing, but they are limited to only a few colony sites on three lakes. Common Terns are still, as their name suggests, fairly common, but are restricted in the lower Great Lakes to a few large colonies and are declining in numbers. Black Terns used to be a common marshbird, but now appear to be declining in the Great Lakes basin. Numbers of Forster's Terns were generally increasing in Ontario to the late 1980s, but have remained stable since then and are vulnerable because they are a small population, nesting largely in the marshes of Lake St. Clair.

This fact sheet describes the four tern species, reports on their status in the Canadian Great Lakes, examines the threats to their well-being, outlines some innovative conservation approaches, and highlights further conservation efforts and associated research. Official Endangered Wildlife Status Terns are protected in Canada under the Migratory Birds Convention Act, which is administered by the Canadian Wildlife Service. This act prevents the hunting, collecting and keeping in captivity of migratory birds and their eggs and nests, however it only protects habitat while it is occupied, for example during the

THE ISLAND-NESTING TERNS



John Mitchell

Caspian Tern

Wildlife in Canada (COSEWIC) is a committee of representatives from federal, provincial and private agencies which lists "species at risk" as extinct, extirpated, endangered, threatened or vulnerable. The Recovery of Nationally Endangered Wildlife (RENEW) is a committee which has grown out of COSEWIC. Its mandate is the recovery of threatened and endangered birds, mammals, reptiles and amphibians. In 1996, the federal government tabled an Endangered Species Act to establish a process to assess species at risk and to produce a list of nationally endangered or threatened species. This legislation will also require that action be taken to rehabilitate species under federal jurisdiction by such measures as developing recovery plans for threatened and endangered species, and management plans for vulnerable species.

Caspian Tern

Caspian Terns are a cosmopolitan species found nesting on all continents except South America and Antarctica. In North America, colonies are located in six widely separated geographical regions, with nesting on both the Atlantic, Gulf and Pacific coasts, as well as in the interior. In 1990, the population in the Canadian Great Lakes consisted of approximately 3,100 pairs, with three colonies in Lake Ontario (765 pairs) and eight colonies in Lake Huron (2,300 pairs). Approximately 3,400 pairs were found in the U.S. portions of the Great Lakes, 80 per cent of them in Lake Michigan and the remainder split between Lake Ontario and Lake Huron. Compared with 1963 data, numbers had more than tripled by 1990 with the greatest increases occurring on Lake Ontario, on average 22 per cent annually.

Both adult and immature Caspian Terns from the Great Lakes winter along the Gulf of Mexico and Atlantic coast, the Caribbean islands, northwestern Venezuela and Colombia. Most immature birds spend the next 18 months in the wintering area, but some spend their third summer in the Great Lakes. In the fourth summer, the birds usually begin to breed.

Caspian Terns lay two to three eggs which are incubated for approximately 27 days by both members of the pair. Nests are simple hollows that they make in the gravel or sand and may be thinly lined with dried grass or surrounded by small pebbles. When the chicks hatch they are semi-precocial, meaning they are mobile, covered with down, and able to open their eyes. They remain in, or close to, the nest for the first week and then family groups move closer to the shore. Parents apparently recognize their own young within three days, while it takes the chicks somewhat longer to distinguish the calls of their parents. Caspian Terns have the longest period of parental care of any tern, and even though the chicks are capable of flying at 30 to 40 days, they remain partially dependent on their parents for food for another five to seven months. This means that they migrate to their winter habitat together, with one adult usually accompanying one juvenile. It is not known if pairs remain in close contact during the winter, but the majority have formed pairs for the spring migration.

Small fish make up most of the diet of Caspian Terns. When foraging for food, the birds fly with their bill held vertically down. When they see a fish, they hover briefly and then plunge-dive, often submerging completely. Information on the diet of Caspian Terns has sometimes been obtained from observing what they bring to their chicks, but it can also be determined by identification of the animal parts found in pellets. Approximately once a day, adult terns regurgitate a pellet containing indigestible food remains. Items found in Caspian Tern pellets include fish bones and scales, and sometimes the remains of insects, beetles, molluscs, crayfish, as well as bird eggshells and feathers, mammal bones and occasionally non-food items such as plastic, grit and vegetation.

Hatching success (defined as the proportion of all eggs laid that hatch) is a measure of egg survivorship. In Lake Ontario, from 1977 to 1991, hatching success has varied from 75 per cent to 82 per cent, however hatching success in Lake Huron has been lower, 47 per cent to 75 per cent in the few published studies. Low hatching success can

indicate a shortage of food, extensive predation, human disturbance, increased contaminant levels, or unusually stormy, cold or wet weather, or some interacting combination of these factors.

The average number of chicks per pair raised to first flight or fledging is a measure of overall reproductive success. Reproductive success in Lake Ontario (1980 - 1991) and Lake Michigan (1963 - 1991) has been similar, varying from 0.7 - 1.6 fledglings per pair, while it has often been lower in Lake Huron (1978 - 1991), 0.3 - 1.1 fledglings per pair. Most of these values are greater than the 0.6 fledglings per pair needed annually to maintain a stable population, however reproductive success in Lake Huron colonies is often only just above this value. Caspian Terns have an average adult life span of 12 years, although a few have lived as long as 26 years.



Common Tern

Lang Elliott

The North American population of the Caspian Tern is by far the largest of all worldwide populations, and the Great Lakes are home to at least one-third of the North American population. Although recent population increases are encouraging, this species has been identified by the Ontario Ministry of Natural Resources (OMNR) as "rare", due to the small number of breeding sites. Caspian Terns bred at only 13 sites in Ontario in 1994. In 1992, the Canadian population of Caspian Terns was recognized as "vulnerable" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

Common Tern

Common Terns nest across the northern hemisphere, from the Arctic edge south to the tropics, along the sea coasts, and on inland bodies of water. In Ontario, Common Terns are most abundant in the southern parts of the province, along the shores of the Great Lakes, the St. Lawrence and Ottawa Rivers, and in a band following the Trent-Severn

Waterway. They winter along the coastline of the Gulf of Mexico, from the tip of Florida to Mexico and Central America, in the Caribbean Islands, and on the Pacific coasts of Central and South America.

The most recent census of colonial waterbirds in the Great Lakes took place in 1989 and 1990. At that time there were 11 Common Tern colonies with more than 100 nests in Lake Huron, and five colonies with more than 100 nests in the lower Great Lakes and the upper St. Lawrence River. The total number of breeding pairs in the Canadian Great Lakes was estimated to be approximately 7,000.

In the Canadian Great Lakes, Common Tern numbers have changed more dramatically in Lake Erie and Lake Ontario than in Lake Huron. In the early 1960s, the population reached a peak of approximately 16,000 pairs. In the early 1970s, numbers started to decline and had fallen to 3,152 pairs by 1978, the first year a census was done. Populations were surveyed again in 1990, and numbers had declined a further 25 per cent to 2,347 nests.

There is less information for Common Tern populations in Lake Huron, but it appears that substantial declines have occurred. In the first census in 1980, 5,396 nests were counted. Historical data available for a third of these colonies showed a decrease of 42 per cent from 1962 to 1980, and in a second lake-wide census in 1989, Common Tern populations had decreased a further 15 per cent. There is always the possibility that these declines may not be as severe as they appear, as some birds may have moved from the Great Lakes proper to new locations in the wider Great Lakes Basin.

Many Common Terns in the Great Lakes are three to four years old at first breeding. Females lay clutches of two to three eggs, with an incubation period of three weeks, increasing to four weeks if predators cause frequent overnight desertions of the nest. Both sexes incubate the eggs, but the female takes the larger share. Like other tern chicks, Common Terns are born semi-precocial. They remain near the nest until fledging or first flight at about four weeks of age. Young continue to be fed by their parents for several weeks after fledging. Small fish from three to eight centimetres in length comprise 90 per cent of the diet of adults and juveniles, with the remaining 10 per cent consisting of insects and aquatic invertebrates.

Common Terns need the same type of nesting

habitat as Caspian Terns, sparsely vegetated islands and sand or gravel beaches on lakes and larger rivers. They will also nest on undisturbed mainland peninsulas, sand spits and on artificial nesting sites such as islands of dredged material, breakwaters, rafts and navigational aids. Their nests are shallow depressions in the sand, gravel or earth and are sometimes lined with grass, twigs, pebbles or bits of shell. In the Great Lakes, Common Terns often nest in association with Herring or Ring-billed gulls. This has both advantages and disadvantages. On the positive side, gulls can provide a buffer against mammalian predators in locations where Common Terns are nesting on mainland sites. On the negative side, terns return to their breeding colonies in the spring after the arrival of the gulls, often to find all the best nesting places taken. They may be forced to lay their eggs along the shore close to the water's edge, where they can be washed away in the next big storm.

Hatching and fledging success vary considerably between years and among colonies. The mean reproductive success for several colonies in the lower Great Lakes from 1972 to 1977 was 0.9 fledged chicks per pair, with a range of 0.13 fledglings per pair to 1.7 fledglings per pair. More recently, in 1982 at the Port Colborne breakwater colony in Lake Erie, reproductive success varied from 0.6 fledglings per pair to 1.6 fledglings per pair. In contrast with these relatively high values, reproductive successes of 0.2 to 0.3 chicks per pair were obtained in the Lake Huron in 1980 and the St. Lawrence River and eastern Lake Ontario in 1982. Extensive population studies of Common Terns in Massachusetts and New York have determined that an annual production of 1.1 chicks per pair is necessary for population stability. Such a figure is seldom obtained in Great Lakes colonies.

Although Common Tern populations in the Canadian Great Lakes have been declining, these declines are not serious enough yet to warrant provincial designation of "vulnerable" to Common Terns in Ontario. However, the demographics of Common Terns in the lower Great Lakes are cause for concern, as 83 per cent of the population in 1990 nested in only two colonies, located at Hamilton Harbour and Port Colborne. The shores of the lower Great Lakes are heavily urbanized and there are few locations suitable for nesting terns. The situation is not as serious in Lake Huron as there appears to be an abundance of suitable habitat. Common Tern populations have also declined throughout the rest of Canada, but the numbers are sufficient to not require designation by COSEWIC. On the U.S. side

THE MARSH-NESTING TERNS



Black Tern

Douglas M. Guay

of the Great Lakes, Common Terns have been listed as endangered, threatened or of special concern by most states bordering the Great Lakes, however numbers have increased from 2,200 pairs in the mid-70s to 3,433 pairs in the international census of 1990.

Black Tern

The Black Tern breeds in shallow freshwater marshes in the middle latitudes of North America and Europe. Historical records from the early 1900s indicate that Black Terns were once common in marshes along the Great Lakes, but numbers have declined since then. In 1991, the Long Point Bird Observatory conducted a survey of marsh-nesting terns in Lake Huron and the lower Great Lakes for

the Canadian Wildlife Service. Black Terns were found to be breeding at 65 colony sites within a 5 km band of the Canadian shores of the Great Lakes and St. Lawrence River, with a total estimate of 545 nests. Declines have also been reported in most states bordering on the Great Lakes and throughout the rest of the North American breeding range. They winter along the coasts of Central and northern South America, in the Caribbean and the Pacific, and are especially common off the coasts of Costa Rica, Panama and Columbia.

Black Terns usually return each spring to the same wetland area, although often to a different site. Muskrat (*Ondatra zibethica*) activity, drought, floods and winter storms can change the characteristics of the marsh, in particular the proportion and distribution of live emergent vegetation, dead floating vegetation and open water. As a result of this instability in their breeding habitat, both species of marsh-nesting terns exhibit less "site tenacity" than island-nesting terns, and abandon sites when they become unsuitable. Black Terns seem to prefer hemi-marsh conditions, which are emergent vegetation and open water in a roughly equal ratio. The most prominent types of emergent vegetation are cattails and bulrush (*Scirpus* spp.), and less commonly, burreed (*Sparganium* spp.).

They nest in loose groups of a few to 30 or more pairs. Their shallow nests are made of dead vegetation, and are found on mats of floating plant material lodged in emergent vegetation, or on patches of mud, floating boards, muskrat feeding platforms and occasionally on muskrat houses. Nests are fragile

OFFICIAL ENDANGERED WILDLIFE STATUS

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and only a few centimetres above the water, consequently they are often damp and easily flooded by rain, wind or waves.

Females lay clutches of one to four eggs, but three-egg clutches predominate. After an incubation period of approximately 21 days, the chicks hatch. They mature quickly, and can swim one to two days after hatching, and can fly in 20 to 24 days. The juvenile terns may then begin to forage for themselves, but are also fed by the parent birds for two weeks or more.

Ornithologists have determined that during the breeding season Black Terns eat mainly insects: dragonflies (Odonata), moths (Lepidoptera), grasshoppers and crickets (Orthoptera), beetles (Coleoptera), spiders (Araneida), water scorpions (Hemiptera), mayflies (Orthoptera) and caddisflies (Trichoptera) and smaller amounts of grubs, larvae, small fish, molluscs and crayfish. On the wintering grounds, adult and juvenile Black Terns eat mainly small marine fishes.

The hatching success for Black Terns is variable and usually low, from 18 per cent to 45 per cent in most studies. Fledging success is seldom reported because Black Tern chicks are so mobile, and easily concealed by the marsh vegetation. In most cases it is likely that less than one chick is raised per nest.

The maximum age of a Black Tern in North America, determined from the recovery of a banded bird, is approximately eight years. It is estimated that approximately 70 to 75 per cent of adult birds survive each winter to breed again the following spring. This figure is based on the number of young produced and the assumption of a stable population. Given that Black Tern populations are declining in much of their range, this may mean that fewer adults are surviving each year than estimated. Survivorship is more accurately determined from band returns, but few adults have been banded.

In 1996, COSEWIC designated Black Terns as "not at risk" in Canada. To justify their decision, they stated that the decline had slowed substantially in the last ten to fifteen years and most biologists in the prairie provinces, the stronghold of the species in Canada, felt there was little cause for concern. Black Terns are still widespread and common in many areas, but will need to be monitored, particularly in Ontario.



Cornell Lab of Ornithology

Forster's Tern

Forster's Tern

The Forster's Tern nests only in North America in large freshwater marshes in the interior and salt-water marshes along the Atlantic, Pacific and Gulf Coasts. In Canada, their centre of abundance is in the prairie provinces, with small populations in interior British Columbia and southern Ontario. Surveys of marsh-nesting terns in the Canadian Great Lakes in 1991 revealed the vast majority of birds (555 nests) to be breeding in the Lake St. Clair marshes, while the rest (13 nests) are in Lake Erie at the Long Point marshes and at Rondeau Provincial Park.

Numbers at Long Point have decreased 90 per cent from 1981 to 1991, and at Rondeau, although 200 pairs nested there as recently as 1990, now there are just a few pairs. Populations in the Lake St. Clair marshes appear to be increasing. Forster's Terns may be expanding their breeding range in the Great Lakes region, as a small colony was found at Kettle Point Marsh in Lake Huron in 1985. Breeding Bird Survey data for North America show an increasing trend during the period 1966 to 1988 and a stable population thereafter.

The Forster's Tern winters relatively far north for a tern, not reaching South America or southern Central America. Great Lakes birds are found on the Atlantic and Gulf coasts from Virginia south to Florida, and then west to eastern Mexico. Small numbers are also found in the Bahamas and the Greater Antilles.

Forster's Terns lay two to four eggs (usually three) and incubation by both members of the pair lasts 23 to 25 days. After hatching, the young remain in the nest for a few days, but then leave the nest to hide in the vegetation if they are disturbed. It is not known at what age Forster's Tern chicks fledge or take their first flight, but shortly after this occurs both adults and juveniles disperse.

In the Great Lakes, Forster's Terns are usually associated with the inaccessible deepwater portions of large freshwater marshes, containing cattails and bulrushes. Forster's Terns group their nests more closely together than Black Terns, and nests are found in scattered groups of 10 to 150 or 200 pairs on floating mats of dead vegetation lodged in cattail and reed grass (*Phragmites communis*) islands and on mud hummocks, muskrat houses and floating logs. They also nest readily on artificial nest platforms. Their nests are well-built with a deep, rounded cup compactly woven with bits of reed and grass.

Forster's Terns nest in marshes with deeper water and more open expanses, giving them greater protection from mammalian predators, but making their nests more vulnerable to destruction by wind and waves. When nesting on the same substrate, Forster's Tern nests are higher (an average of 21 cm versus 3 cm), and consequently drier, than those of the Black Tern. Floating vegetation occurs around the nest sites of both species, but is more abundant around Black Tern nests, and Black Terns also prefer to have emergent vegetation surrounding the nest site. Forster's Terns will nest on very isolated muskrat lodges in the middle of open water.

Little research has been done on the diet of Forster's Terns, however it seems they eat fish as their staple food, and chicks are fed minnows almost exclusively. They also hawk insects in the air, eat frogs, scavenge dead fish and occasionally take the eggs of American Coots (*Fulica americana*).

Forster's Terns have variable and often low reproductive success. There is very little information on Forster's Tern life expectancy and mortality rates, so it is not possible to calculate the level of reproductive success they require to sustain their population. For the similarly-sized Common Tern, 1.1 chicks per pair are needed each year for a sustainable population. This level of reproductive success would be achieved if, for example, hatching success was approximately 67 per cent and fledging success was slightly greater than 50 per cent. These values are far greater than those recorded for Forster's Terns anywhere in North America.

The total Canadian population of Forster's Terns is quite small, consisting of 2,200 to 4,200 pairs. While it seems to be a fairly common species, having recently expanded into British Columbia and possibly Ontario, it is numerous in very few locations, and there are indications that the Forster's Terns

have decreased recently in the prairies. Despite the small number of breeding pairs and evidence of a population decline, in 1996 COSEWIC assigned the status of "indeterminate" to Forster's Terns in Canada. The committee decided there were not enough recent population figures to verify any trend.

The general increase in Forster's Tern numbers in Ontario suggests that the species is not endangered or threatened in the province at this time. However, as 98 per cent of the provincial population nests in Lake St. Clair, a status report prepared for the Ontario Ministry of Natural Resources has recommended that this species be listed as "rare" in Ontario.

PARTNERSHIPS IN WETLAND CONSERVATION

In July 1994 the governments of Canada and Ontario signed a major agreement detailing their cooperative activities to restore, protect and conserve the Great Lakes basin ecosystem. With respect to Wetlands, the Agreement's objectives are: (1) to achieve no loss of Great Lakes coastal wetlands; and (2) to rehabilitate and protect 30,000 hectares of degraded wetland habitat across the basin by the year 2020. These goals will be achieved through the Great Lakes Wetlands Conservation Action Plan (GLWCAP), a series of five-year action plans which began in 1994. The focus of the first plan is the coastal wetlands of the lower Great Lakes. GLWCAP objectives will be realized through partnerships built on the support and expertise of Environment Canada's Canadian Wildlife Service, the Ontario Ministry of Natural Resources, and non-governmental organizations such as the Nature Conservancy of Canada, Federation of Ontario Naturalists, Ducks Unlimited Canada, Ontario Federation of Anglers and Hunters, Wildlife Habitat Canada and the Long Point Bird Observatory.

FOUR TERN SPECIES IN THE CANADIAN GREAT LAKES

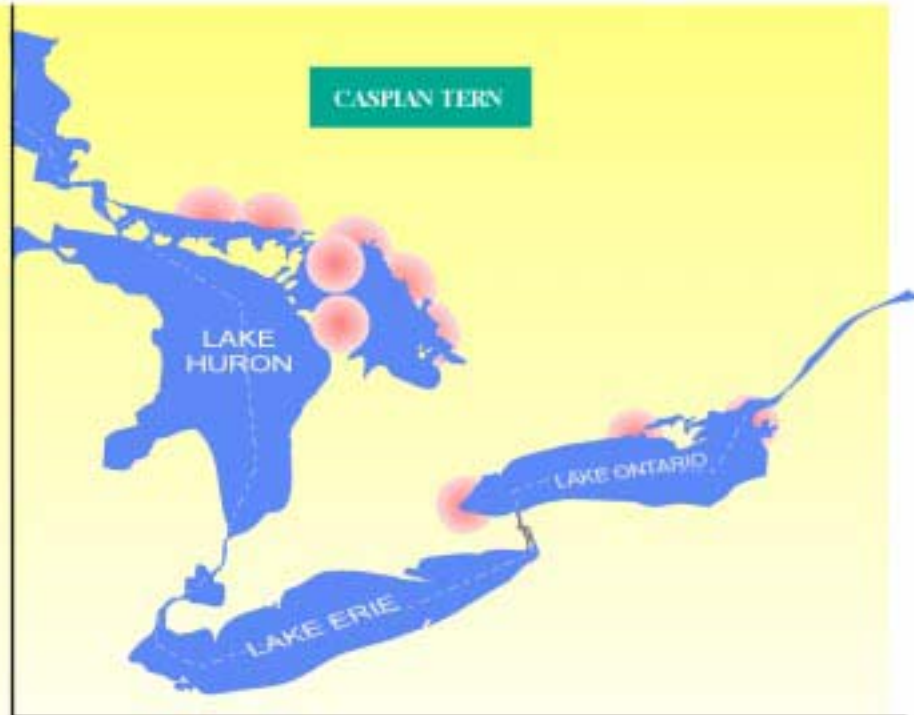
FORSTER'S TERN

- 17 colonies
- approximately 570



CASPIAN TERN

- 11 colonies
- approximately 3,100



*Data taken from 1989 - 1991 census of colonial waterbirds.
Sketches by S. House*

BLACK TERN

- 65 colonies
- approximately 550 nests



COMMON TERN

- 64 colonies
- approximately 7,000 nests



THREATS TO TERNS NESTING IN THE GREAT LAKES

Loss of Suitable Habitat

The most serious threat faced by all tern species in the Great Lakes is the loss or deterioration of high-quality nesting habitat. Uninhabited, sparsely vegetated islands, the preferred nesting sites of Caspian and Common terns, are scarce in the lower Great Lakes, and nesting space on those that do exist has been reduced. Gull populations have exploded in the last few decades, and in some colonies, nest sites of Common and Caspian terns have been invaded by the earlier nesting and more aggressive Ring-billed Gulls. Huge numbers of gulls also mean huge quantities of feces falling to the ground and this causes some types of vegetation to flourish. Ring-billed Gulls have less of a problem with tall plants than do terns with their short legs and long wings. High water levels have also caused habitat loss by inundating or eroding away low-lying parts of colonies, reducing the nesting area available for all species. In other areas, nests have become more vulnerable to submersion by storm waves.

The combined effects of encroachment by vegetation and displacement by gulls were probably important factors causing the enormous decline of two large tern colonies in Lake Ontario, at Tommy Thompson Park on the Toronto waterfront in the late 1980s, and on Gull Island in Presqu'île Provincial Park in the mid-1970s. However, if a site can be kept clear of gulls until the terns are ready to nest, there is no evidence that interference from gulls reduces their reproductive success.

Flooding, vegetational succession and earlier nesting by gulls have likely affected Common and Caspian terns throughout their evolutionary history. They will move considerable distances between nesting attempts, and as long as other nesting areas were available, colony extinctions would have a minor effect on the population. Unfortunately, this is not the case in the 1990s; optimal nesting habitat is limited in the lower Great Lakes and there are fewer suitable locations to which they can move. In 1980, 70 per cent of the Common Terns in the lower Great Lakes nested on artificial sites that did not even exist 20 years earlier.

Habitat loss is perhaps an even more important issue for marsh-nesting terns. Development pres-

ures have resulted in the loss of 80 per cent of the marshes that once existed along the shores of Lakes Ontario and Erie. Threats to the remaining wetlands include agricultural reclamation, human disturbance, shoreline hardening, eutrophication and the introduction of exotic species (e.g. purple loosestrife *Lythra salicaria* and zebra mussels *Dreissena polymorpha*). Artificial control of Great Lakes water levels for shipping and to prevent shoreline erosion has caused a reduction in the size of the remaining marshes, which gradually fill in with vegetation when water levels are not allowed to fluctuate. Many marshes have been invaded by dense stands of a single species such as cattails or purple loosestrife, changing the mix of open water, live emergent vegetation and floating dead vegetation these birds need. Artificial control of lake levels has been shown by many researchers to contribute to this process.

Lake levels have been relatively high over the past decade and this can cause additional problems for marsh-nesting terns. In the U.S. portions of Lake St. Clair and Saginaw Bay, numbers of Forster's Terns are declining because of lost vegetation due to excessive boat wakes and ice damage, both of which are related to high lake levels. The decline in numbers of Forster's Terns at Long Point in Lake Erie is also thought to be due to a lack of floating vegetation caused by high lake levels. Black Terns are similarly affected.

Contaminants in the Aquatic Environment

Toxic chemicals were an important threat to the reproductive success of terns in the early 1970s, when many fish-eating birds in the Great Lakes were experiencing severe reproductive problems, such as egg-shell thinning and birth defects. With the advent of legislative controls and restrictions on the use and disposal of many persistent toxic chemicals, concentrations in the tissues of these birds began to decline after the mid-1970s. By 1980, levels of persistent toxics, such as DDT, had decreased considerably and it looked like the control strategies were working.

By the mid-1980s, improvements had stopped. Although direct industrial discharge is being controlled, contaminants are coming into the lakes from atmospheric deposition and diffusing into the water column from the bottom sediments (resuspension). There is also a suggestion that very small amounts of such compounds as chlorinated hydrocarbons can cause sub-lethal effects in wildlife, leading to decreased fertility. These synthetic chemicals mimic natural hormones, upsetting normal reproductive

and developmental processes. The avian (bird) model for organochlorine endocrine disruption is the best described to date. Due to similarities in avian and mammalian endocrine systems, humans may be affected in similar ways by these chemicals.

As predators at the top of the food chain, Common, Caspian and Forster's terns have all been used at one time or another to monitor the presence and effects of contaminants in the Great Lakes. Caspian Terns are larger and have a lower metabolic rate than other terns and are likely to be less affected by contaminants than the smaller species. In fact, current levels of contaminants in Caspian Terns do not appear to be having an effect on reproduction. The most recent data were collected in 1991 from selected colonies on the Great Lakes, and clutch size, hatching success and overall reproductive output were high relative to other studies, and the numbers of breeding birds are increasing.

However, in a U.S. study done in Saginaw Bay on Lake Huron following a record-high flood event, Caspian Tern reproduction collapsed. In 1986, the heaviest rainstorm in 100 years occurred (35 to 45 cm in 30 hours) and the scouring effect of this sudden flood of water released contaminants from bottom sediments. Over 50 per cent of the Caspian Tern chicks that died showed signs of having "wasting syndrome". Chicks with wasting syndrome are lethargic and very thin, even though food is obviously abundant. A small number of PCB (polychlorinated biphenyls) isomers with toxicological properties similar to dioxin were implicated as the cause of these abnormalities.

The effects of toxic chemicals on the reproductive success of Forster's Terns have only been studied in heavily polluted Green Bay, Lake Michigan. A study done in 1983 showed that contaminant levels were impairing reproductive success in a number of ways. When comparisons were made with a "clean" colony inland, organochlorine concentrations in eggs were higher, hatching success was lower, the incubation period was longer, parent birds were less attentive, and chicks that hatched weighed less and had larger livers in the Green Bay colony. Further study of contaminant levels in Forster's Terns in the less polluted waters of Lake St. Clair and Lake Erie are needed before contaminants can be eliminated as a possible cause of the low hatching success in these locations.

Due to legislative bans and controls, contaminant levels had decreased 80 to 90 per cent in Great Lakes Common Tern eggs between 1969 and 1981. It is not clear how much of a factor toxic chemicals now play in the population dynamics of this species. Recent laboratory studies using embryo cell cultures show that they are ten times more sensitive to chlorinated hydrocarbons than Herring Gulls. Common Terns are declining in the Canadian Great Lakes, and while habitat loss may be the major factor responsible for this, toxic chemicals cannot be ruled out as a contributing factor. Because of their sensitivity to organochlorines, the potential for endocrine disruption is currently being investigated in Great Lakes Common Terns.

The very small amount of contaminant analysis that has been done so far on Black Tern eggs indicates that organochlorine levels are below those thought to cause reproductive problems. However, no studies were done during the "pesticide era" of the late 1960s and early 1970s to use as a basis of comparison. Black Tern eggs are now being collected from four sites in the Great Lakes and one inland colony for further analyses. Contamination of wetlands from aerial spraying of pesticides, insecticides and herbicides may be having an indirect affect on Black Terns by reducing their insect prey base.

Habitat loss is perhaps an even more important issue for marsh-nesting terns.

Human Disturbance

Caspian Terns are particularly sensitive to people visiting their colonies, and in a few cases, extreme disturbance has caused them to desert their colony that year. Common Terns tolerate the presence of humans to some extent as many island colonies are near urban areas, but their recent shift to a number of mainland sites, often beaches and other recreational areas, has made them more vulnerable to disturbance. The presence of people in the colonies causes the terns to leave their nests, exposing the eggs or chicks to predation by gulls. For these reasons, recreational boaters and other members of the general public should not visit tern colonies during the nesting season and researchers should make their visits as brief as possible.

To some extent, the frequently inaccessible locations of Forster's and Black tern colonies protects them from human interference. The places they choose to nest are not, for the most part, suitable for recreational boating. However in Lake St. Clair,

where the majority of Great Lakes Forster's Terns nest, several colonies border on well-travelled channels and bays where boat washes may inadvertently drown nests, as they are often close to the waterline. The shallow, weedy water of marshes favoured by nesting Black Terns often keeps boat speeds low and nests are usually protected behind a barrier of cattails which dampens the wake. Canoes have the potential to be a more serious problem, as curious canoeists can penetrate nest clusters, where they may tip over nests and disturb adults and chicks.

Predation

Caspian and Common terns nest in dense colonies on the ground and this makes them particularly vulnerable to predation by mammals. This is why they prefer to nest on islands. Islands are relatively inaccessible and this gives some protection from disturbance by ground predators and humans. When island sites are unavailable, terns are forced to nest on the mainland where their eggs and chicks may be taken by foxes (*Vulpes vulpes*), raccoons (*Procyon lotor*), mink (*Mustela vison*), skunks (*Mephitis mephitis*) and cats. Dogs can also be a serious problem in mainland colonies because they trample on eggs and chicks and cause major disruption, although they do not normally eat eggs or birds.

Avian predation can also occur. Great Horned Owls are known to prey on adult terns and large chicks, while Herring Gulls, Northern Harrier (*Circus cyaneus*), Great Blue Herons (*Ardea herodias*) and Black-crowned Night-Herons (*Nycticorax nycticorax*) will eat eggs and chicks. More recently, migrating Ruddy Turnstones (*Arenaria interpres*) have begun to prey on Common Tern eggs.

Marsh-nesting terns, especially those nesting in shallow marshes or close to the shore, can be affected by some of the same mammalian predators as the island-nesting terns, but they also have a few predators that are peculiar to them. Northern water snakes (*Natrix sipedon*) and snapping turtles (*Chelydra serpentina*) have been known to take eggs and small chicks, while carp (*Cyprinus carpio*) and muskrats, although not predators, can inadvertently destroy marsh tern nests or eggs. Spawning carp may knock eggs into the water, while muskrats, rebuilding their houses after storms and heavy rain, may cover over or damage nests and their contents.

CONSERVATION ACTIVITIES

Conservation activities for terns in the Great Lakes focus on enhancing existing nesting habitat and creating new habitat. Methods of habitat enhancement include: improvements to the nesting substrate; protection of tern nesting areas from encroachment by gulls; the control of avian and mammalian predation; and, the prevention of human disturbance. Methods of habitat creation include: the construction of nesting rafts and wildlife islands. Most of the conservation efforts to date have focused on Common Terns as they have been the most affected by habitat loss.

The first documented efforts to manage a declining Common Tern colony in the Great Lakes occurred at the ternary on Gull Island in Presqu'île Provincial Park near Brighton, Ontario. This colony contained more than 7,000 nests in the early 1950s and only 79 nests by 1975. In 1976, all gull nests were removed within the designated tern nesting area and vegetation was cut back weekly to a height of 10 to 15 centimetres. The colony was clearly more successful in 1976, as control of vegetation extended the nesting season and reproductive success at the hatching and fledging stages was greater than in 1975, but management efforts may have started too late, as only three pairs of Common Terns attempted to nest on Gull Island in 1977. Between 1980 and 1995 colony size ranged from a low of one nest in 1986 to a high of 225 nests in 1985, with 96 nests in 1995.

The most successful measures to enhance habitat for Common Terns have been implemented at the Port Colborne breakwater in Lake Erie. Signs were erected to inform people that trespassing or disturbing the birds was prohibited by law. Nesting substrate material was replaced as often as necessary when severe storms or routine maintenance of the breakwater removed the layer of small rocks, gravel and clumps of driftwood and low-lying plants that covered the bare concrete surface. Each April since 1977, Ring-billed Gull nests found in the tern nesting area have been destroyed. These techniques have been successful in maintaining this colony at approximately 1,000 pairs for many years.

Similar management techniques were attempted at the large Common Tern colony at Tommy Thompson Park on the Toronto waterfront in the middle to late 1980s. As this is a mainland colony close to the largest urban area in Canada, human disturbance is a big problem. Signs were erected, but continued acts of vandalism and footprints of people and dogs throughout the colony showed they were often ignored. Vegetation control was carried out for one year, and encroachment



G. McKeating

Nesting raft for Common Terns

by Ring-billed Gulls was controlled with the installation of monofilament lines. Despite these efforts, the Common Tern colony at Tommy Thompson Park declined from 1,694 pairs in 1982 to 108 pairs in 1989. The management techniques had only limited success as they were not carried out consistently enough and experimentation proved some techniques to be unsuitable for that location. At a few other locations in the Great Lakes, carefully installed monofilament lines have had excellent success in excluding gulls and thus allowing Common Terns to recolonize former sites.

Common Terns adapt easily to artificial nesting sites. In 1990, the Toronto and Region Conservation Authority (MTRCA) and the Canadian Wildlife Service created new habitat for Common Terns in Tommy Thompson Park when they installed four large wooden rafts, surfaced with a mixture of sand and gravel, in water adjacent to the park. Common Terns colonized the rafts almost immediately and raised chicks to fledging. The project was continued with great success for the next two years and in 1993, modifications were made to the rafts so they would not need to be removed from the water in the fall. Plastic snowfence was suspended in the water below the rafts to provide an artificial reef for fish. These new "reefrafts" have been used by the terns every year since then. A video demonstrating the use of reefrafts and a manual with step-by-step building instructions and guidelines for operation



Cynthia Pekarik

Artificial islands in Hamilton Harbour

and maintenance can be obtained from the Canadian Wildlife Service or the Metropolitan Toronto and Region Conservation Authority (for addresses, see "Additional Information" at the end of the Fact Sheet).

The most exciting and significant effort at habitat creation for Caspian and Common terns anywhere in Canada has occurred in Hamilton Harbour, one of the most important nesting sites for colonial waterbirds in the Great Lakes in terms of both species diversity and number of breeding birds. The birds are currently nesting on land owned by the Hamilton Harbour Commission and scheduled for development. Hamilton Harbour is one of the 42 Areas of Concern in the Great Lakes, meaning that water quality there is particularly poor. One component of the Remedial Action Plan (RAP) for the restoration of the harbour was the construction of three wildlife islands, primarily to provide habitat for the waterbirds to be displaced by development, but also to provide protected habitat for amphibians, reptiles and fish. The federal contribution to this project was funded by the Great Lakes Action Plan through Environment Canada's Great Lakes 2000 Cleanup Fund.

The islands were constructed during the winter of 1995/96 and are 100 to 125 metres long and approximately 50 metres wide. Each of the islands has been designed so it will not be washed over during storms and was landscaped to suit the species desired in a particular location. Raised knolls were created on the north and centre islands and surfaced with sand and gravel for the Caspian Terns and gravel alone for the Common Terns. Plastic was laid down over these areas in mid-March, 1996, to keep the gulls away. When the terns were ready to nest in early May, the plastic was removed and tern decoys were placed on the site. Gull nests were then removed (under Canadian Wildlife Service permit) from the tern nesting areas on a daily basis.

The Caspian Terns immediately colonized the area that had been prepared for them on the North Island. They were not actively discouraged from nesting on the mainland, but colonization of the island may have been facilitated by extensive fox predation in the mainland colony the previous season.

Unlike the Caspians, the Common Terns did not nest on the sites that were prepared for them on the islands, but chose another location that had been surfaced with topsoil in preparation for the planting of shrubs later in the season. This substrate was similar to that found in the mainland colonies and

may have appealed to them for that reason. The Common Terns were not actively discouraged from nesting on the mainland either, but mammalian predation, deliberate human disturbance and truck traffic from routine filling operations in Windermere Basin caused poor reproductive success in recent years, encouraging their move to locations on the wildlife islands.

The first breeding season on the wildlife islands has been a success for the terns, but for that success to continue in the future, the islands will need to be actively managed. As they become colonized with plants, vegetation must be controlled in the tern nesting areas on an annual basis. Their nesting sites will also need to be protected from encroachment by Ring-billed Gulls. The conservation efforts for Common and Caspian terns in Hamilton Harbour have contributed to the protection of biodiversity in the harbour, and wildlife biologists have also gained valuable experience in the active management of these species in an urban environment.

An attempt has been made to enhance habitat for Black Terns in a few locations in Lake Ontario, by providing nesting platforms to augment the natural substrate available. This has been done most successfully in the extensive marshes of Presqu'ile Provincial Park in Presqu'ile Bay on the north shore of Lake Ontario. In the early 1950s, approximately 250 Black Terns were seen in a single day in the Presqu'ile Marsh. By the early 1980s there were estimated to be only 25 to 30 pairs.

In the summer of 1990, park staff began a yearly census of adult Black Terns and documented a further 57 per cent decrease in the population from 1990 to 1992 (see Table 1). In 1993, Lake Ontario



Douglas M. Guay

Nesting platform for Black Tern

water levels were exceptionally high and submerged much of the vegetation that the Black Terns would normally nest on, so a number of artificial nest platforms were set out. As the platforms were used with some success that year, they were installed in subsequent years as well. In 1995, researchers moved platforms originally placed in different areas of Presqu'ile Marsh closer to nests built on natural substrate. This may explain the large proportion (78 per cent) of platforms used that year. The results show that Black Terns do not seem to take as readily to artificial nest platforms as do some other species of terns, but where natural nesting substrate is limited platform use may improve reproductive success.

No conservation activities have been undertaken for Forster's Terns in the Great Lakes, but a very successful nesting platform study was carried out in Wisconsin. The Department of Natural Resources put out approximately 250 nesting platforms and achieved 95 per cent occupancy, doubling the number of breeding pairs during a three year study. They were also successful in luring Forster's Terns to

Table 1 - The number of Black Tern nest and the use of artificial nesting platforms in the Presqu'ile Marsh, 1992-1995

	Presqu'ile Marsh			
	1992	1993	1994	1995
maximum weekly number of adult birds ¹	25	29	11	24
total number of nests	- ²	15	10	36
number of artificial nest platforms	0	20	22	48
number of platforms used by Black Terns	0	6	1	28
number of nests on natural substrate	- ²	9	9	8

¹ Counts were made 2-4 times per week from May 1 to Sept. 3 and from these daily totals, weekly averages were calculated.

² no data available

nest in previously unused locations. The results of this one study clearly indicate that Forster's Terns will nest readily on artificial platforms in certain situations. Platforms may be useful in breeding colonies in the Great Lakes if there is not enough natural substrate available, or to attract established colonies to nest in safer locations.

Caspian Tern populations in the Great Lakes have been increasing gradually since the early 1960s and appear to be doing well at the present time. However, as they nest in relatively few locations, this increases their vulnerability. The majority of the Great Lakes population of Forster's Terns nests in the Lake St. Clair marshes, where their numbers also appear to be increasing. They should be closely monitored as there has been a substantial decrease in Forster's Terns elsewhere in Ontario. Common Tern populations have been declining since the early 1960s in the lower Great Lakes, although the rate of decline seems to have slowed since the early 1980s. Populations have declined more gradually in Lake Huron. Black Tern populations have declined in the Great Lakes, although difficulties in conducting a census for this species make it hard to say how much of a decline has occurred. The greatest numbers have been found in a few large and productive marshes (Lake St. Clair, Point Pelee, Rondeau, Long Point and Presqu'île) fairly consistently for many years. However, most Black Tern colonies in the Great Lakes have fewer than ten nests and are quite ephemeral.

It is a tribute to the adaptability of terns that they continue to breed and, in some cases, thrive in such a heavily developed area as the lower Great Lakes. Some colonies have existed near urban areas for decades, but their nesting sites are not secure for posterity. The importance of preserving habitat for these buoyant and graceful birds cannot be overemphasized. They are an intrinsic part of summer in the Great Lakes, giving great pleasure to many regardless of their ecological interests. They also afford an opportunity for contemplation and wonder. A Common Tern weighs only 4 ounces (120 grams), and yet this tiny mass of feathers and bone completes a 15,000 kilometre round trip journey each year to its tropical wintering grounds. The global phenomenon of migration serves to remind us that birds know no borders, and in order to preserve them work must be

done, not just here in their northern home, but nationally and internationally. Habitat loss is a pervasive threat. As an expression of its commitment to maintain biodiversity and conserve habitat, Environment Canada has forged partnerships with the governments of other countries, with provincial wildlife agencies, and with national and international non-government organizations. Terns are our shared natural heritage and as such are deserving of continued conservation efforts.



Caspian Tern in flight

For further reading:

Austen, M.J., H. Blokpoel and G.D. Tessier. 1996. Atlas of Colonial Waterbirds Nesting on the Canadian Great Lakes, 1989-1991. Part 4. Marsh-nesting terns on Lake Huron and the lower Great Lakes system in 1991. Technical Report Series No.217. Canadian Wildlife Service, Ontario Region.

Austen, M.J., M.D. Cadman and R.D. James. 1994. Ontario Birds at Risk: Status and Conservation Needs. Federation of Ontario Naturalists and Long Point Bird Observatory.

Blokpoel, H. and W.C. Scharf. 1991. Status and conservation of seabirds nesting in the Great Lakes of North America. In International Council for Bird Preservation (ICBP) Technical Publication No. 11, pp. 17-41.

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Dunn, E.H. and D.J. Agro. 1995. Black Tern (*Chlidonias niger*). In The Birds of North America, No. 147 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, and the American Ornithologists Union, Washington, D.C.

Ewins, P.J., D.V. Weseloh, R.J. Norstrom, K. Legierse, H.J. Auman, and J.P. Ludwig. 1994. Caspian Terns on the Great Lakes: organochlorine contamination, reproduction, diet, and population changes, 1972-1991. Occasional Paper No. 85. Canadian Wildlife Service, Ottawa, Ontario.

Quinn, J.S., R.D. Morris, H. Blokpoel, D.V. Weseloh and P.J. Ewins. 1996. Design and management of bird nesting habitat: tactics for conserving colonial waterbird diversity on artificial islands in Hamilton Harbour, Ontario. Canadian Journal of Fisheries and Aquatic Sciences 53: 45-57.

Additional Information

Additional information on terns and tern conservation programs may be obtained from the following address:

Canadian Wildlife Service
Environment Canada
49 Camelot Drive
Nepean, Ontario K1A 0H3

To obtain the video or the construction manual for reefrafts, or for further inquiries, contact:

Dr. Hans Blokpoel Mr. Scott Jarvie
Canadian Wildlife Service Metropolitan Toronto and Region
Environment Canada Conservation Authority
49 Camelot Drive 5 Shoreham Drive
Nepean, Ontario K1A 0H3 Downsview, Ontario M3N 1S4

Information on Great Lakes issues in general may be obtained from the following address:

Environment Canada
4905 Dufferin St.
Downsview, Ontario M3H 5T4

and Environment Canada's Greenlane on the World Wide Web:

<http://www.on.ec.gc.ca/glimr/intro.html>

For information on toxic chemicals and associated monitoring programs for fish-eating birds and other wildlife in the Great Lakes Basin, contact:

Canadian Wildlife Service
Environment Canada
P.O. Box 5050
Burlington, Ontario L7R 4A6

To learn more about bird conservation efforts in Canada, contact:

Bird Studies Canada
c/o Long Point Bird Observatory
P.O. Box 160
Port Rowan, Ontario N0E 1M0

Important Bird Areas Program
c/o Canadian Nature Federation
1 Nicholas St., Suite 520
Ottawa, Ontario K1N 7B7

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**Authors: Jan Neuman and Hans Blokpoel,
Canadian Wildlife Service**

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