STATUS ASSESSMENT AND CONSERVATION RECOMMENDATIONS FOR THE COMMON TERN *(Sterna hirundo)* IN THE GREAT LAKES REGION

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Information on the status of Common Terns in the Great Lakes region was obtained from many people. Most are listed in Appendix 3. We thank them for generously sharing their data, time and insights about this species. Of special help were: D. Best, USFWS, East Lansing, Michigan Field Office; K. Millenbah, Michigan State University; R. Miller, New York State Department of Environmental Conservation; L. Harper, St. Lawrence Bird Observatory, Inc.; M. LaBarr, Vermont Institute of Natural Science; H. Blokpoel, Canadian Wildlife Service; D.(Chip) Weseloh, Canadian Wildlife Service; R. Morris, Brock University; S. Maxson, Minnesota Department of Natural Resources; S. Mortensen, Leech Lake Indian Reservation; N. Horning, State University of New York-Buffalo; S. Matteson, Wisconsin Department of Natural Resources, and D. Brauning, Pennsylvania Game Commission and M. Tansy (USFWS Seney National Wildlife Refuge).

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The Common Tern has persisted in the Great Lakes region despite many significant threats to its local and regional survival. We acknowledge the consistent effort in monitoring, research and management by dozens of biologists throughout the Great Lakes; their dedication is the primary reason 10,000+ pairs of Common Terns still occur in this region. The work and leadership of two individuals, H. Blokpoel and R. Morris, have been particularly outstanding. With their colleagues they have published >50 articles on the status, management and biology of this species in the Great Lakes region and wintering grounds in the Caribbean and South America. Their work greatly enriched the quality of this report.

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EXECUTIVE SUMMARY

During the past several decades, a number of studies have reported significant declines in local populations of the Common Tern *(Sterna hirundo)* in the Great Lakes region. Concern for Great Lakes Common Terns is further supported by special listing status for this species in 6 of 9 states bordering the Great Lakes. Additionally, the Great Lakes population of the Common Tern is a U.S. Fish and Wildlife Service (USFWS) nongame bird species of management concern. The USFWS contracted the authors of this document to: evaluate the current status of the Great Lakes population in 1995, summarize Common Tern life history, determine major threats to Common Terns in the Great Lakes region and summarize management/protection efforts and priorities for this species. For this report, the boundaries of the Great Lakes population are assumed to be all islands and mainland shoreline of U.S. and Canadian portions of Lake Superior, Lake Michigan, the St. Marys River, Lake Huron, Lake St. Clair, the St. Clair River, the Detroit River, Lake Erie, Niagara River, Lake Ontario and the St. Lawrence River downstream to Cornwall, Ontario. Based on band recovery data and recommendations from state and provincial biologists we also include population estimates and biology from inland colony sites in Minnesota, Wisconsin, New York and Vermont.

The only binational censuses conducted to date (1989/90; 1997/98) estimated approximately 10,000 and 7,500 pairs of Common Terns within 1 km of Great Lakes shoreline. Adjusting this estimate to include adjacent inland sites indicates a regional population of about 8,500-11,000 pairs at the beginning of 21st century. When examined on a state or provincial basis, there is very strong evidence that Common Terns have experienced significant population declines between the time first estimates were made (1927-1960) and the present (1997). Using this historical perspective, only one state (Vermont) has recorded a population increase. Three populations in states with historically small numbers (<50 pairs) (Illinois, Indiana, Pennsylvania) are essentially extirpated. The remaining populations in 5 states (Minnesota, Wisconsin, Michigan, Ohio, New York) and 1 province (Ontario) all experienced significant declines during the 1900's.

Common Terns are affected by a diversity of threats in the Great Lakes region. The most serious problems include destruction and modification of habitat and predation. Habitat loss is caused by competition with Ring-billed Gulls (*Larus delawarensis*) for nest habitat and annual variation in amount of available habitat based on fluctuating Great Lakes water levels. Predation causes mortality of eggs, chicks and adults and results in significantly lowered reproductive success at some colony sites. Other important threats include human disturbance and contaminants.

Threats impacting terns have resulted in extensive knowledge and tested methodology to enhance colony productivity and protection in the Great Lakes. These include habitat management (e.g. habitat restoration, enhancement, creation, and acquisition), predator control, eliminating or minimizing competition for nest sites, and prevention of human disturbance.

Long term survival of the Common Tern in the Great Lakes region requires monitoring, research, intensive local management, communication and conservation. The following are region-wide research and management priorities: (1) a reliable, periodic, coordinated international census , (2) identification of a network of important breeding sites, (3) identification of important colonies in need of special attention, (4) communication with state and provincial governments regarding the importance of consistent and coordinated monitoring and management, (5) standardized methods for collecting and reporting population trend data, (6) collation of extensive information on methodology for enhancing Common Tern survival and reproductive success, (7) analysis of North American band recoveries to ascertain biological population boundaries and facilitate management coordination, (8) recognition of the important role contaminants may play in the long term survival of this species and (9) the need for information on the biology and distribution of Great Lakes Common Terns during migration and winter.

Preparation of this status assessment was initiated in 1995 and a draft report was completed in 1996. Shortly after its preparation, several related research efforts were undertaken by report authors (e.g. 1997 international census, an analysis of North American band recoveries, and prioritization of Common Tern breeding sites for conservation). The original report was delayed to incorporate results of these newer efforts into the final status assessment for this species. It is important to note that with the exception of the newer studies, most of the original information collected for the draft report is based on data collected in 1995.

BACKGROUND

INTRODUCTION

During the past several decades a number of studies have reported significant declines in local populations of the Common Tern *(Sterna hirundo)* in the Great Lakes region. Concern for Great Lakes Common Terns is further supported by special listing status for this species in 6 of 9 states bordering the Great Lakes. Additionally, the Great Lakes population of the Common Tern is a U.S. Fish and Wildlife Service (USFWS) nongame bird species of management concern.

The purpose of this document is to: evaluate the current status of the Great Lakes population, summarize Common Tern life history, determine major threats to Common Terns in the Great Lakes region and summarize management/protection efforts and priorities for this species. For this report, the boundaries of the Great Lakes population are assumed to be all islands and mainland shoreline of U.S. and Canadian portions of Lake Superior, Lake Michigan, the St. Marys River, Lake Huron, Lake St. Clair, the St. Clair River, the Detroit River, Lake Erie, Niagara River, Lake Ontario and the St. Lawrence River downstream to Cornwall, Ontario.

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This document is a compilation of biological data and a description of past, present, and likely future threats to the Common Tern in the Great Lakes region. It does not represent a decision by the U.S. Fish and Wildlife Service on whether this taxon should be designated as a candidate species for listing as threatened or endangered under the Federal Endangered Species Act. That decision will be made by the Service after reviewing this document, other relevant biological and threat data not included herein, and all relevant laws, regulations, and policies. The result of the decision will be posted on the Service's Region 3 Web site (refer to: http://www.fws.gov/r3pao/eco_serv/endangrd/lists/concern.html).

If designated as a candidate species, the Common Tern in the Great Lakes region will subsequently be added to the Service's candidate species list that is periodically published in the Federal Register and posted on the World Wide Web (refer to: http://www.fws.gov/r9endspp/endspp.html). Even if the tern does not warrant candidate status it should benefit from the conservation recommendations that are contained in this document. Candidate species receive no protection under the Federal Endangered Species Act. Rather, candidate status indicates that the Service has sufficient information to propose the taxon for threatened or endangered status, and intends to do so as higher priority listing actions are completed.

TAXONOMY

The Common Tern *(Sterna hirundo)* is in the Order Charadriiformes, Suborder Lari, Family Laridae, and Subfamily Sterninae (American Ornithologists' Union (AOU)1998). Several authors recognize subspecies (Harrison 1983) and races (Olsen and Larsson 1995). Harrison (1983) describes S. *h. hirundo* as breeding in eastern and central North America; he also recognizes an Old World component to this subspecies that is found in the eastern Atlantic on the Azores and Madeira and along the African coasts of Tunisia, Mauritania, Niger delta and across much of Europe. Other subspecies include S. *h. tibetana* (Turkestan and Tibet), S. *h. minussensis* (central Asia and Mongolia) and *S.h. longipennis* (NE Asia). Olsen and Larsson (1995) recognize 3 races and place S. *h. minussensis* in with *longipennis.* Birds breeding in the Great Lakes of North America are in the subspecies S. *h. hirundo.* Additional common names include Bass gull, Lake Erie gull, mackerel gull, redshank, sea swallow, summer gull, and Wilson's gull (Terres 1980).

PHYSICAL DESCRIPTION

Adult breeding plumage is usually acquired by the third spring (Olsen and Larsson 1995). Breeding terns have a gray mantle, with a black cap and nape. Breast feathers are paler gray relative to the mantle. The forked tail is white with gray outside edges. The pointed wings are gray above and white below; the primaries darken along the tips. The sharply pointed bill is red with a black tip. Legs are orange-red. Adults in winter plumage, and juveniles, have a white forehead and an incomplete black cap; there is a dark bar on the shoulders and the bill is dark in color. There are no significant plumage or morphometric differences between sexes.

After age 3-4 years, adult terns molt twice per year. The prebasic molt starts in August-September, then slows or is arrested during migration, and is finished by March. The prealternate molt overlaps with the prebasic molt and starts in December, finishing around April (Stokes 1989). The adult body length ranges between 32-41 cm (Harrison 1983) and adult body weight is approximately 125 grams (Olsen and Larssen 1995). Adult American terns have slightly shorter wing length (26.8 cm) than birds from the west Palearctic (27.1 cm) (Olsen and Larsson 1995).

According to Stokes (1989), there are five types of vocalizations used by Common Terns. Two different alarm calls are given when danger is imminent or during aggressive interactions with another bird: a sharp, low-pitched "kek-kek kek" call repeated in a long series and an extended, shrill "keeearr" call. A short, single, high pitched "kip" call is used as birds fly off territories and while hovering over water. The "kierr" call is a short, drawn-out, descending call used by terns returning to the nest with food. A shrill, high-pitched "ki-ki" call is given by an individual begging for food from another tem.

RANGE

The Common Tem is one of 44 tern species worldwide (Burger and Gochfeld 1991) and has an extensive range throughout Europe, Asia and the Americas (AOU 1983). In North America, breeding occurs by Common Terns in 3 general geographical areas: the Atlantic Coast, from Labrador to North Carolina; the Great Lakes and smaller inland bodies of water; and the northern Great Plains, including all the Prairie Provinces (AOU 1983, Coffin and Pfannmuller 1988). Common Terns also breed locally on the Gulf Coast in Texas, Mississippi, and western Florida (AOU 1983). Nonbreeding individuals occur during the summer on James Bay, throughout the Great Lakes region, along the Atlantic-Gulf coast, south in Middle America to Costa Rica, and throughout the West Indies (AOU 1998). Within the Great Lakes region, the Common Tem breeds on Lake Champlain (LaBarr 1995), Oneida Lake, the Thousand Islands area of the St. Lawrence River (Andress, pers. comm.), Lake Ontario, Niagara River, Lake Erie, Detroit River, Lake St. Clair (Millenbah, pers. comm., Tori, pers. comm.), Lake Huron including Georgian and Saginaw bays (Weseloh et al. 1986), Lake Michigan including Green Bay and the Winnebago pools (Matteson 1988, Winterstein and Millenbah 1995), southern Lake Superior (McKearnan and Cuthbert 1989, Matteson 1988), Lake of the Woods, Mille Lacs Lake, and Leech Lake (McKearnan and Cuthbert 1989).

The Common Tern's winter range extends from the southern edge of the breeding range (South Carolina, Florida and the Gulf coast) south through the Caribbean (West Indies) and coasts of Central and South America to Argentina (AOU 1983, Blokpoel et al. 1987, LaBarr 1995, Hays et al. 1997). During migration Common Terns occur regularly in interior North America in the Mississippi and Ohio River valleys (AOU 1983). At Punta Rasa, Argentina, Hays et al. (1997) reported 20,000-30,000 Common Terns and believe this is the most significant wintering area in Argentina and perhaps anywhere in South America for Commons from North America. Hays et al. (1997) also suggest that adult Commons winter further south (below 27 ° S) in South America than do subadults.

BAND RECOVERY DATA AND POPULATION BOUNDARIES

With the exception of Vermont, all other states covered in this report (Minnesota, Wisconsin, Illinois, Indiana, Michigan, Ohio, Pennsylvania, New York) have traditionally been included in reviews (e.g. Blokpoel and Scharf 1991 a, b) focusing on the Great Lakes population of Common Terns. We included Vermont in this status report because band recovery data indicate movement of individuals between Vermont, New York and sites along the St. Lawrence River (Bird Banding Laboratory, unpubl. data). Other exceptions were the inclusion of population data from inland nesting Minnesota, Wisconsin and New York terns. Band recovery data document exchange of birds among Lake Superior nesting colonies (Minnesota, Wisconsin) and inland sites in Minnesota (Burson 1990). Common Terns nesting at Lake Oneida, New York, and Lake Winnebago, Wisconsin, were also included in this survey because field workers believe there is exchange among these colonies and Great Lakes sites. Band recoveries of Common Terns indicate that natal or breeding dispersal can cover hundreds of kilometers between the northeastern U.S. and the Great Lakes colonies (Austin 1951, Haymes and Blokpoel 1978b, DiCostanzo 1980); potential for much further gene flow is suggested from distances covered during migration and the observation that Common Terns of the U.S. Midwest have been recovered in locations as far as the Azores, Hawaii, and Newfoundland (Burson 1990).

Following preparation of the draft status assessment report, a formal study was undertaken by Cuthbert and Wires (2002) to analyze all band recovery data for breeding Common Terns in North America. Following is a summary (see full report at http://www.waterbirds.umn.edu) of the results of the band analysis study that largely confirm the assumptions made regarding biological population boundaries in this status assessment. Austin (1953) identified three large breeding units in North America for the Common Tern: Northwest Unit (mainly birds breeding in Alberta and Saskatchewan; Central Unit (mainly birds breeding in the Great Lakes and central Minnesota); and Atlantic Coast Unit (birds breeding along the coast from Nova Scotia to Virginia). Although hypothetical boundaries were suggested for each unit, no band recovery data were available for large portions of the areas contained within these boundaries, and it was not clear that boundaries were accurate for all areas. To focus management and conservation efforts at a biologically meaningful level for this species, breeding population boundaries need more accurate delineation, especially in the Central Unit-Great Lakes region, where the species is endangered or threatened in several areas. To refine continental population boundaries, Cuthbert and Wires reviewed band recovery data obtained between 1922-2000 (96,059 recoveries) to examine intercolony movement. This review indicated that boundaries for the Atlantic Coast Unit should be expanded south along the North Carolina Coast. Boundaries for the Central Unit should include Oneida Lake and other inland New York locations, and Lake Champlain in Vermont. No additional data were available to more narrowly define boundaries in the northwestern and western portion of this unit; whether or not the Dakotas and inland northern Minnesota colonies should be considered part of this unit is a question that remains unresolved. Boundaries for the Northwest Unit could not be established based on the limited recovery data available for this region. Based on available recovery data, there is good justification for considering the Atlantic Coast Unit and the Great Lakes region (as defined in the status assessment) as appropriate biological units for management and conservation programs.

HABITAT

Breeding Season Habitat Requirements

As a colonial ground nesting bird, the Common Tern requires three features for an optimal colony site: 1) physical isolation from predators, 2) a constant supply of food nearby, and 3) flat relatively open habitat with good visibility and sparse vegetation (Austin 1929, Palmer 1941, Burger and Gochfeld 1991). Terns prefer nest sites on peninsulas or islands, presumably to limit or prevent access by ground predators (Nickell 1964, Courtney and Blokpoel 1983). Tern colonies typically are located in estuaries, bays, lakes, rivers and occasionally marshes (Bent 1921, Palmer 1941, AOU 1998). In the Great Lakes region, terns have established colonies on sandbars (Hicks 1935), shoals (Matteson 1988) natural and artificial islands (Palmer 1941, Scharf 1981, Smith et al. 1984, Matteson 1988, Penning and Cuthbert 1993, LaBarr 1995), platforms (Dunlop et al. 1991; Stricker 1995), breakwaters (Courtney and Blokpoel 1980a, 1983, Matteson 1988, Morris et al. 1992), along canal and lake shorelines (Morris and Hunter 1976a, Matteson 1988), and artificial structures surrounded by water such as pier remnants (Matteson 1988) and navigation cells (Karwowski et al. 1995).

Palmer (1941) stated that colony selection is influenced by the presence of a constant supply of food near the colony site. Terns tend to return to the same colony site each year if previous reproductive efforts have been successful at that site (Austin and Austin 1956, Erwin et al. 1981, Courtney and Blokpoel 1983). Because food availability influences reproductive success and Common Terns tend to return to sites where reproduction has been successful, food availability also is believed to influence colony site selection.

To assess if food availability was a factor limiting reproductive success at a Lake Ontario colony, Courtney and Blokpoel (1980a) measured the following parameters: food acceptance levels by chicks, adult foraging times, and chick weight at 15 days. Results showed food was available in large quantities, adult terns had little difficulty in obtaining food, and chicks were heavier than those reported by other investigators. A limited study conducted in 1995 indicated the northern portion of Mississquoi Bay, Lake Champlain, is a primary feeding area for terns nesting on Poposquash Island (LaBarr, pers. comm.). This area of the bay tends toward shallow, eutrophic waters ranging in distance from immediately around the island and north for 10-15 miles (LaBarr and Rimmer 1995, LaBarr pers. comm.). Other studies report a preference for foraging in eutrophic waters (Lemmetyinen 1976, Pinkowski 1980).

Unobstructed vision early in the nesting season also appears to be an important factor in nest site selection (Blokpoel et al. 1978. Burger and Gochfield 1991). If colony members cannot easily see or hear each other, then fear reactions cannot be communicated among individuals within the colony (Palmer 194 1, Blokpoel et al. 1978). Unobstructed vision also allows terns to detect approaching ground predators from a distance. Additionally, Common Terns may use visual and auditory cues to enhance breeding synchrony within the colony (Burger and Gochfield 1991). This has also been termed social stimulation (Palmer 1941, Blokpoel et al. 1980, Burger and Gochfeld 1991).

Other factors that may influence nest site selection are vegetation cover and substrate (Blokpoel et al. 1978, Burger and Gochfeld 1991). In the Great Lakes region, Common Terns tend to select sparsely vegetated areas in early stages of plant succession (Courtney and Blokpoel 1983). Palmer (1941) stated that too much vegetation is detrimental, but some provides refuge from predators and thermal exposure. Soots and Parnell (1975) reported that terns in North Carolina use sites with a broad range of percent cover but have a preference for 10-30% cover. Similar results were obtained at the Eastern Headland colony, Lake Ontario: terns avoided areas with little or no vegetation and tended to select nest sites with > 20% herbaceous cover (Blokpoel et al. 1978). Additionally, birds selected nest sites near individual plants where vegetation was widely scattered. Terns also use objects that protrude from the substrate (e.g. sticks, rocks) as focal points for nest sites (Palmer 194 1, Blokpoel et al. 1978). Todd (1940) described a colony site at Presque Isle State Park, Pennsylvania, as a sandbar with sunken logs and pieces of driftwood present. Richards and Morris (1984) reported that nesting terns showed a preference for high relief vegetated sites relative to sites with no relief. In western Lake Superior Penning (pers. comm.) observed terns nesting on bare sand next to human-made structures. Body structure is another factor that may influence nest site selection in sparse vegetation (Palmer 1941). Terns have difficulty moving around in dense vegetation because they have short legs, webbed feet, and long wings (Courtney and Blokpoel 1983). Palmer (194 1) reported Common Terns prefer to alight in open areas and walk to the nest.

Optimal colony sites have substrates that readily drain water (Courtney and Blokpoel 1983). Substrates used in the lower Great Lakes are composed of a diversity of materials (e.g. gravel, sand, dredge spoil, chipped concrete and iron slag) (Courtney and Blokpoel 1983). Common Terns nesting on Lake Champlain, Vermont, use loose shale and soil with some grass, bare rock, or rocky spits (LaBarr 1995). Matteson (1988) described nest site substrates in Wisconsin as bare ground, sand, gravel, chipped concrete, rip-rap, and boulder pockets. Marginal substrates, or substrates that contribute to lower reproductive success, were described by McKearnan and Cuthbert (1989). Nests constructed on snow piles at the Port Terminal colony, Minnesota, fell apart as the snow melted; chicks drowned in puddles of melted snow or died from hypothermia. Terns at the Spirit Island colony, Minnesota, nested in depressions in boulders. Eggs and chicks often fell out of the unlined nests and into the crevices between boulders where escape was not possible (McKearnan and Cuthbert 1989).

Post-Breeding Staging Habitat Requirements

Few studies have focused on terns during the transition between nesting and migration. After the breeding season, Common Terns on Lake Champlain, Vermont, use other roosting areas separate from colony sites. Post-breeding habitats used by terns in Vermont and Minnesota include rocky spits, partially submerged logs, sandbars, and artificial structures (LaBarr 1995, Penning, pers. comm.). LaBarr (1995) reported that post-breeding sites on Lake Champlain are near portions of the lake with moderate to high eutrophic waters. Blokpoel et al. (1987) recorded banded terns dispersing from the Eastern Headland colony, Lake Ontario, to Lake Erie; a few individuals moved to Oneida Lake and other parts of Lake Ontario. In northern Michigan, Cuthbert (unpubl. data) observed adult terns in August feeding juveniles at mainland shoreline sites distant from known colonies. Post-breeders in the Duluth Harbor use breakwaters for loafing sites (Penning, pers. comm.).

Winter Habitat Requirement

Little information is available on winter habitat requirements of Common Terns from the Great Lakes region (Blokpoel et al. 1982, Blokpoel and Tessier 1984b). However, a few studies have attempted to determine the distribution, physical status and habitat requirements of terns during the winter. During an investigative trip to Trinidad in 1982, Blokpoel et al. (1984b) observed that terns used beaches offshore boats, jetties, and unused docks as resting and roosting sites. The authors suggest that offshore roosting sites are more important than beach roosting sites. Food availability and roosting sites appear to determine the distribution of wintering terns along the coastline of Trinidad (Blokpoel et al. 1982, Blokpoel and Tessier 1984b).

BIOLOGY

Migration and Wintering Ground

Haymes and Blokpoel (1978b) reported the winter range of Great Lakes Common Terns as the Gulf of Mexico, Caribbean Islands and Central and South America (Blokpoel et a. 1989). Band recovery data suggest that most adults ($\geq$ 2 years) winter on the mainland, while juveniles ($\leq$ 1 year old) winter on the mainland and Caribbean Islands (Haymes and Blokpoel 1978b). Terns depart from their wintering grounds in March (Blokpoel et al. 1987) and arrive in the Great Lakes region in April or May (Harris and Matteson 1975b, 1975c). During a study of tern migration patterns, Blokpoel et al. (1987) received no tern sighting records during the spring migration up the Atlantic coast. The authors suggest this lack of data indicates Common Terns move quickly during spring migration. Movement of Common Terns in interior North America is not well documented. In

Europe, Common Terns exhibit a faster spring migration pattern relative to the fall migration schedule (Kasparek 1982). By August, terns have vacated their colony sites but remain in the Great Lakes region for up to 4 months (Austin 1953, Haymes and Blokpoel 1978b, Blokpoel et al. 1987). After post-breeding dispersal, fall migration begins in October. Limited data suggest that terns move south and east from the Great Lakes to the Atlantic coast and continue southward to their wintering grounds (Blokpoel et al. 1987). Common Terns arrive in the wintering grounds around December and remain there until March (Haymes and Blokpoel 1978b, Blokpoel et al. 1987).

Reproduction

In the Great Lakes region, Common Terns breed almost exclusively in colonies consisting of a dozen to several hundred nesting pairs (Matteson 1988, LaBarr 1995, Moore et al. 1995, Tansy, pers. comm.). This is in contrast to colonies on the Atlantic coast that may exceed several thousand pairs (Burger and Gochfeld 199 1). Occasionally, single pairs are recorded in the Great Lakes (Matteson 1988, Scharf and Shugart 1998, Gormley, pers. comm.)

Common Terns exhibit strong tendencies to return to colony sites in consecutive years (Palmer 1941, Austin 1951, Haymes and Blokpoel 1978). Austin (1951) described the characteristics of site tenacity (i.e., attachment to specific terrain) and group adherence (i.e., attachment to other members of the same group) as important influences in the annual return to breeding sites. Based on band return data from Lake Champlain, Vermont, individuals show high site tenacity to colonies of previous breeding (LaBarr and Rimmer 1994).

Common Terns can enter the breeding populations at 2 years but most individuals do not nest until 3-4 years of age (Austin and Austin 1956). Individuals usually remain on the wintering grounds until their third or fourth year (Austin 1953). Terns construct their nests on bare ground, gravel, rock depressions, sand, chipped concrete or wooden beams (Matteson 1988). Burger and Gochfeld (1991) described the typical Common Tern nest as a depression in soil, smoothed and shaped by adults sitting in the hollow and turning the body. Nesting territories are defended by both adults and vary in size among colonies and within the season; inter-nest distances on the Atlantic coast range from 45-300 cm.

Common Terns lay between 1-5 eggs; average clutch size is 2-3 eggs (Palmer 1941, Shields and Townsend 1985, McKearnan and Maxson 1994, Karwowski et al. 1995, Stricker 1995). The egg laying period commences in mid-to-late May and is completed by early June (Austin 1929, Nisbet 1973, Erdman, pers. comm., c.f. Matteson 1988). Harrison (1983) described the eggs as spotted, ranging in color from pale buff to cinnamon-brown. They average 41.5 x 30 min in size. If the first clutch is destroyed before hatching, the pair typically remains together and will renest and produce a second clutch (Burger and Gochfeld 1991). Some pairs of Common Terns have produced 3 clutches in one season if the first 2 were lost to predation or failed to hatch for other reasons (LaBarr, pers. comm.).

After the egg-laying period, which typically lasts about 4 days (Burger and Gochfeld 1991), both sexes incubate the eggs (Morris and Hunter 1976b). The average incubation period in an undisturbed colony is 21-24 days (Nisbet and Cohen 1975, Karwowski 1992). Mean incubation period in natural island colonies was significantly longer than the incubation period on man-made navigational aid colony sites (30-31 days vs. 22-23 days, respectively) along the St. Lawrence River in 1984 and 1986. The difference was attributed to disturbance by Great Horned Owls at the natural island sites (Karwowski 1992). LaBarr and Rimmer (1993) reported incubation periods extended up to 32 days as a result of nocturnal desertion. Eggs are incubated immediately after deposition in the nest and hatching occurs asynchronously over a 1-3 day period (Palmer 1941, Nisbet and Cohen 1975).

Chicks are semi-precocial and able to move out of the nest within 3-5 days (LeCroy and Collins 1972). Both parents participate in parental care (Wiggins and Morris, 1987). Age at fledging ranges between 22-30 days (Palmer 1941, Nisbet 1972, Nisbet and Drury 1972, LeCroy and Collins 1972). Full juvenal plumage is attained by 28-32 days (Harris and Matteson 1975a).

Annual reproductive success varies within colonies. The number of young fledged/pair at the Lake of the Woods colony, Minnesota, was 0.17 in 1984, 1.04 in 1993, 0.87 in 1994, and 1.23 in 1995 (McKearnan and Cuthbert 1989, McKearnan and Maxson 1994, Maxson and Haws 1995). Tern reproductive success was 0.77 in 1989, 0.87 in 1993, and 1.19 in 1995 at the Interstate Island colony, Wisconsin (Strand, pers. comm., Matteson, pers, comm.). Common Terns breeding at Pipe Creek Wildlife Area, Ohio, produced 0.04 and 0.00 young fledged/pair in 1993 and 1994 (Stricker 1995).

Annual reproductive success also varies among colonies within the same region. In 1995, 3 Minnesota colony sites (Lake of the Woods, Duluth/Superior Harbor, and Mille Lacs Lake) fledged young per nest at rates of 1.23, 1.19, and 0.20, respectively (Maxson and Haws 1995, Strand, pers. comm., Matteson pers. comm., Lapp 1995). This same trend has been observed in Atlantic Coast colonies. During a 13-year study, the weighted mean of young fledged/ pair in 9 New Jersey colonies ranged from 0.41-1.41 (Burger and Gochfeld 1991).

Annual reproductive success also varies between artificial and natural nest sites. Harper (1993) reported that productivity on navigation cells in the St. Lawrence River ranged from 0.57-2.08 chicks fledged/pair, while the number of chicks fledged on natural islands ranged from 0.0-0.39 young/pair. This difference is likely due to lack of or limited predation on the navigation cells.

Diet and Foraging Ecology

In North America, Common Tem food habits have been studied along the Atlantic coast (Palmer 1941, Nisbet 1973, Erwin 1977), western Canada (Vermeer 1973), Lake Erie (Ligas 1952) and the Canadian Great Lakes (Courtney and Blokpoel 1980a). Studies generally reflect what is known to be eaten (probably based on size and proportion to availability) and do not imply preference for particular species. They feed mainly by plunge-diving, also by contact-dipping and aerial-dipping, and occasionally aerial hawking. Ligas (1952) reported that tern diet on Lake Erie consisted of 90% fish and 10% insects. The fish are small, typically 6-15 cm in length. Emerald shiner *(Notropis atherinoides)* was the most common cyprinid species taken by terns at the Starve Island colony, Lake Erie (Marshall 1942). Smelt *(Osmerus mordax)* are thought to be a major prey item for terns at the Lake Champlain colonies (LaBarr, pers. comm.).

Courtney and Blokpoel (1980a) evaluated the diet of nesting Common Terns based on observations of fish carried by birds and collections of fish from the nest. They found that most birds foraged 510 km from the colony, but ranged from coastal waters adjacent to the colony to 15 kin distant from the site. At the three colonies studied on the lower Great Lakes, adult terns ate fish almost exclusively; more than 99% of food offered to chicks was fish. They found that insects were fed to young chicks only 4 times at the Eastern Headland colony, Lake Ontario. Principal and secondary food items at this colony were alewife *(Alosa pseudoharengus),* smelt, and emerald shiner. Fathead minnow *(Pimepheles promelas)* composed < 6% of the observed diet in late June. At the Niagara River colony, smelt, emerald shiner and common shiner *(Notropis cornutus)* were important food items. During June, smelt continued to be the principal food item, but bluntnose minnow *(Pimephales notatus)* and spot tail shiner *(Notropis hudsonius)* replaced emerald shiner and common shiner as a secondary food item. At the Lake Erie colony, smelt and emerald shiner were the principal food items during the early season. Smelt was the principal food item after 24 June and trout perch *(Percopsis omiscomaycus)* and emerald shiners were occasional food items.

Mortality and Longevity

Mortality typically is highest during the first several days after hatching and again between fledging and first reproduction. Chicks are very vulnerable immediately following hatching (Matteson 1988). LeCroy and Collins (1972) reported that most chick deaths occur within 3 days of hatching. In Europe, more than 80% of chicks died in the first 5 days after hatching (Langham 1972). The mean age at death or disappearance of chicks was 2-5 days at island colonies in the St. Lawrence River, New York (Karwowski et al. 1995). At a Minnesota colony, 35% of chicks died within 8 days of hatching (McKearnan and Maxson 1994). In 1990, 90% of dead chicks at a colony in Ontario died during the first 4 days after hatching (Dunlop et al. 1991).

Penning (1993) modeled population dynamics of Common Terns in Minnesota. His synthesis of survivorship estimates in the published literature follows. Austin (1942) and Austin and Austin (1956) used life tables to calculate yearly adult survival rates of 71-75% and predicted that at least 20% of fledged chicks must return to breed at age 4 to maintain population stability. However, Nisbet (1978) pointed out errors in their methodology, re-examined their data and disputed their conclusions. Nisbet's (1978) own calculations estimate annual adult survival at 87% with 10% of fledged chicks surviving to enter the breeding population. Both the Austins and Nisbet worked at tern colonies that are in long term decline (Nisbet 1973). Therefore these populations may be under constraints different from those of a stable population (DiCostanzo 1980). DiCostanzo (1980) modeled population parameters from a stable colony. He estimated an annual adult survival rate of 92% and a mean survival rate of 14.3% for fledglings returning to breed at age 4. Several studies indicate that breeding birds <3 years old comprise a small portion of the breeding population and are less successful than older birds (> 4 years) at fledging chicks (Austin and Austin 1956, Nisbet 1978, DiConstanzo 1980).

Using the mean annual mortality rate of 8%, DiCostanzo (1980) estimated the average life expectancy for a Common Tem, surviving to age 4, to be 12 years. Burger and Gochfeld (1991) reported that many terns live more than 15 years. LaBarr (pers. comm.) reported a banded bird from Lake Champlain that was 17+ years of age. A reproductive rate of 1.10 young fledged/pair is estimated to be sufficient to maintain a stable breeding population (Nisbet 1978, DiCostanzo 1980, Penning 1993).

POPULATION SIZE AND TRENDS

Population trends for the last two decades (1977-1997) were reviewed for one Canadian province (Ontario) and nine U.S. states. This status assessment was initiated prior to the 3rd binational colonial waterbird census (1997-99) but results from this census are included in this final report. Table 1 summarizes Common Tern pairs by state/province and Table 2 summarizes Common Terns by water body. Appendix 1 provides a list of all known Common Tern colonies in the U.S. Great Lakes region 1977-97 and land ownership and monitoring effort information (for U.S. colonies) are summarized in Appendix 2. Finally, we attempted to obtain "first estimate" data for state and regional populations to evaluate long term population trends. See Table 3 for this information. Figure 1 shows subpopulation estimates for U.S. and Canadian colonies at the time of the 1997/98 binational census and figures 2 and 3 show locations of all known Common Tern colony sites in the U.S. Great Lakes region as of 2001.

REGIONAL CENSUS BACKGROUND AND TRENDS

The first published comprehensive effort to summarize the status and conservation of Great Lakes Common Terns was produced by Blokpoel and Scharf (1991) and includes data from the period 1976-1987. Their general conclusion regarding Common Terns was that the species has declined in some parts of the Great Lakes, but no complete assessment was available for a specific time period. The first binational coordinated census was conducted 1989-1990; this effort estimated the number of pairs of Common Terns nesting in the Great Lakes region (except lakes Oneida and Champlain) and established protocol to evaluate future population trends of Common Terns in the Great Lakes. Scharf and Shugart (1998) reported 3,439 pairs at colony sites in the U.S. within 1 km of the shoreline. The survey in Canadian waters estimated 6,626 pairs (Blokpoel and Tessier 1993,1996,1997). Therefore, 10,065 or approximately 10,000 pairs of Common Terns nested at 124 sites within 1 km of Great Lakes shoreline in 1989-1990. The 2nd binational coordinated survey was completed in 1997/98 (Pekarik 1998, Cuthbert et al.

2003) and estimated 7359 (almost 3,000 fewer breeding pairs) nesting at only 94 colony sites.

Because band recovery data indicate that the Great Lakes population also uses inland sites in Minnesota, New York, Vermont and Wisconsin, we adjusted the Great Lakes regional estimate by +837 pairs. This adjustment suggests a Great Lakes regional population of about 11,000 pairs in 1989/90 and 8,340 pairs in 1997/98.

STATE AND PROVINCIAL CENSUS BACKGROUND

Of the states/province where Great Lakes Common Terns breed, significant numbers (>1,000 pairs) occur only in Michigan, New York, and Ontario (Scharf and Shugart 1998, Moore et al. 1995, Blokpoel and Tessier 1996, Pekarik 1998, Cuthbert et al. 2003) (Table 1). Minnesota and Wisconsin typically have had smaller numbers over the past several decades. Estimates have ranged from about 200-500 for Wisconsin and Minnesota, respectively (Matteson 1988, Lapp 1995, Mortensen 1995, Maxson and Haws 1995, Strand, pers. comm., Matteson pers. comm., Cuthbert et al. 2003). Vermont has maintained approximately 50-150 pairs during the past decade. Three states (Illinois, Indiana, Pennsylvania) have had 0 to < 50 pairs (Gormley, pers, comm., Brock, pers. comm., Herkert, pers. comm., Tori, pers. comm., Castrale, pers. comm.). In terms of historical breeding population size (i.e. since early 1900s) no comprehensive estimates exist for Ontario, Michigan, New York and Wisconsin until the 1960s and 70s. The breeding population of Common Terns in Minnesota in the 1930s was estimated at about 2,600 pairs (McKearnan and Cuthbert 1989) and in Pennsylvania in 1937 there were about 200 breeding pairs (Todd 1940). The population in Ohio in the 1960s was as high as 5,000 pairs (Peterjohn 1989) and two states, Indiana and Illinois, had historically small populations known from the early part of the 1900s and again in the 1930s (Bohlen 1989, Mumford and Keller 1984). Finally, Vermont's terns occupied a single nest site in the state for the first half of the 1900s (LaBarr 1995). Then the population grew to >750 birds in 1970 (LaBarr 1995). In summary, historical data do not exist that allow an estimate of the number of Common Terns in the Great Lakes region prior to human settlement and during the period of more intensive development in this century.

TREND CONCLUSIONS

(1) It is not possible to interpret regional population trends based on coordinated binational census efforts because only two have been conducted (1989/90 and 1997/98) approximately a decade apart. Although a significant decline occurred between the 80s and 90s estimates, the censuses were conducted during years of contrasting water levels in the Great Lakes. Lack of habitat in the second survey may have prevented many birds from breeding. Alternatively, they may have moved to sites that were not visited during the census.

(2) When examined on a state or provincial basis, there is very strong evidence that Common Terns experienced significant population declines between the time first estimates were made (~1927-1960) and 1997/98.This information is summarized in

Table 3. Using this historical perspective, only one state (Vermont) recorded a population increase. Three populations in states with historically small numbers (Illinois, Indiana, Pennsylvania) are essentially extirpated. The remaining populations in 5 states (Minnesota, Wisconsin, Michigan, Ohio, New York) and 1 province (Ontario) all declined during the 1900s.

(3) The Breeding Bird Survey data indicated a decline of 5.4% from 1966-1993. Between 1984-1993, a sharper and significant decline of 67% was recorded (Price et al. 1995). It is important to note that in isolation from other data the BBS survey is not a reliable indicator of population trends because of study design. However, the declining trend is similar to that summarized in Table 3.

(4) Because Common Terns are quick to colonize new suitable habitat and often change colony sites within and between seasons, monitoring regional trends is very difficult without a coordinated single season effort among field investigators. To detect trends with confidence, a more frequent census effort is required.

STATE AND PROVINCIAL SUMMARIES

ILLINOIS

***Protective Status*: Illinois Endangered Species**

Summary

Within Illinois, the Common Tern population has always been relatively small and nesting data are sparse (Bohlen 1989, Herkert 1992). In the late 1800s, the Common Tern was an abundant migrant, but breeding colonies were rarely observed (Nelson 1876). A small breeding colony was established at Waukegan between 1934 and 1936 but the birds experienced low reproductive success due to predation and human disturbance (Bohlen 1989).

According to Bohlen (1989), the Waukegan ComED coal plant colony was successful in 1979 (30 nests plus young), 1982 (16 young) and 1983 (21 young). The Waukegan colony was abandoned in 1993, but A. Horstman (pers. comm.) reported 10 nests at the Waukegan site on a fly ash pond "island" in 1997. No young fledged in 1997 at Waukegan because of a predator. Another colony was established during the 1960's at the Powderhorn Marsh, southern Lake Michigan (Bohlen 1989). There are no data on reproductive success at this site. In 1994 and 1995 terns nested near the Johns-Mansville Power plant settling ponds immediately north of the Waukegan site. Nests numbered about 5 and 13 in the respective years (Herkert pers. comm.). Thirty-seven adults with 22 young were observed at the Mansville colony in July 1995. About 6 pairs were reported in 1997 (A. Horstman pers. comm.) The current population trend is described as "stable" with a few dozen birds present at one of the colony sites annually (Kleen, pers. comm., Herkert, pers. comm.). The 1997 estimate for Illinois was 13 pairs at 2 sites (Cuthbert et al. 2003).

Limiting Factors

Predation was the major factor limiting tern productivity at the Illinois colony in 1995. Information on specific species is unavailable but potential predators include raccoon, skunk, feral cats, and red fox (Herkert, pers. comm.). In some years, predator activity reduced productivity to zero (Herkert, pers. comm.). Competition with gulls, human disturbance, habitat deterioration, and habitat loss are also suspected to be limiting factors (Kleen, pers. comm.).

Research/Monitoring

Surveys of colonies are attempted each year (Kleen, pers. comm., Herkert, pers. comm.).

Management

Successful nesting should occur in Illinois if breeding colonies are protected from predator and human disturbance. Bohlen (1989) stated that preservation and proper management of the entire beach shoreline and offshore islands of Lake Michigan are needed to enhance the probability of continued breeding status of the Common Tem in this state.

During the 1993 breeding season, the Illinois Department of Natural Resources maintained an electric fence as a predator deterrent and removed vegetation from the Waukegan colony site. The fence was not maintained in 1994 and 1995 and the colony probably moved north to the Johns-Manville Power plant (Herkert, pers. comm.). In 1997 a 1 m high chain link fence with an extra 0.3 m on top angled outward was constructed at the Waukegan site (A. Horstman pers. comm.). In 1998 a strand of electric wire was added. The substrate was modified by adding sand and small rock. Vegetation was controlled by hand.

INDIANA

Protective Status*: *Extirpated as a breeding species

Summary

In the early 1900s, the Common Tern was an abundant migrant along the Indiana portion of Lake Michigan (Butler 1937). The first documentation of terns nesting in Indiana was in 1934, when a single nest was discovered at the Commonwealth Edison Power plant in Lake County. In 1935, a nest with 5 eggs was found at the same site. The breeding pair probably re-nested as another nest was found on 2 July 1935 (Mumford and Keller 1984). The last record of Common Terns nesting at the power plant site was 1 nest with 2 eggs in 1936 (Mumford and Keller 1984).

Systematic surveys for Common Terns are not conducted in Indiana, but independent observer counts have been collated by Kenneth Brock, Indiana University-Northwest.

Migration data from 1978 through 1995 show spring and fall numbers fluctuate from year to year despite an increase in observer effort in the last decade (Brock, pers. comm.). Between 1990 and 1995, spring migrant numbers ranged from 0 birds in 1990 and 1994 to a high of 466 birds in 1993. Fall migrant numbers ranged from a low of 179 birds in 1993 to a high of 4,400 birds in 1994 (Brock, pers. comm.). The number of migrating terns declined from a maximum of 10,000 birds in May 1957 to a minimum of 0 birds observed in springs 1989, 1990 and 1994 (Brock, pers. comm.). No Common Terns were reported nesting in Indiana during the 1997 Great Lakes Colonial Waterbird Census (Cuthbert et al. 2003).

Limiting Factors

The Indiana portion of Lake Michigan is highly industrialized and most of the suitable Common Tern habitat has been modified or destroyed. Ring-billed Gulls may limit potential nesting by terns (Castrale, pers. comm.).

Research/Monitoring

There are no surveys conducted specifically for Common Terns but Kenneth Brock collates numbers of migrating birds recorded along the Lake Michigan shoreline by independent observers.

Management

There are no Common Tern management programs within the State of Indiana.

MICHIGAN

***Protective Status*: Michigan Threatened Species**

Summary

Historically colony sites were located in Saginaw Bay and along the shores of western Lake Huron, northern Lake Michigan, and southern Lake Superior. Ludwig (1962) conducted partial surveys of Michigan waters excluding Green Bay, the Manitou Islands, and western Lake Erie in 1962 and reported 2,885 breeding pairs, The first comprehensive effort to inventory Common Terns in Michigan was done in 1976-77 (Scharf 1978) and the number of nesting pairs was estimated to be 2,092 in 1976. Later surveys reported 1,390 (1977), and 2,058 (1980) (Shugart and Scharf 1983). The 33% decline between the 1976 and 1977 estimate of nesting pairs was attributed to abandonment of 2 colony sites in response to rat and canid predation in 1976 (Shugart and Scharf 1983). In the late 1970s, terns shifted from natural colony sites (e.g. islands, shoals, sandbars) to artificial sites (e.g., breakwaters, dikes, dredge spoil) (Shugart and Scharf 1983). The 1982 breeding population was estimated at 2040 pairs (Blokpoel and Scharf 1991) and was similar to the 1980 estimate. In 1989 and 1990, the Michigan Common Tern population was re-surveyed as part of a multi-species inventory (Scharf and Shugart 1998) and 1577 nests were counted in 20 colonies (Cuthbert et al. 2003).

The 1997 estimate for Michigan was 1,221 pairs nesting at 7 colony sites (Cuthbert et al. 2003). The drop in colony number between the last 2 census periods was due to high water in 1997 that inundated low elevation shoals and small islands that Common Terns use during low water level periods.

Limiting Factors

A number of historically important tem colony sites with optimal habitat features (gravel/sand substrate and 10-30% vegetation cover) have been taken over by earlier nesting Ring-billed Gulls. For example, Ludwig (1962) reported almost complete displacement of terns on Grassy Island, Thunder Bay. In 1960, 1,500 Common Tern pairs nested on the main island and 258 Ring-billed Gulls nested on a narrow, low-lying spit. Two years later, only 75 tern pairs nested on the island and were confined to the spit (which was subjected to storm wash over); 5,000 pairs of Ring-billed Gulls nested on the main body of the island.

Research/Monitoring

The State of Michigan has no formal monitoring or management plan for Common Terns. Periodic monitoring and banding have been done by a number of individuals since the early 1900s. In 1995, K. Millenbah studied 2 colonies in Saginaw Bay to test the effectiveness of nest platforms (Winterstein and Millenbah 1995). The Michigan Department of Natural Resources (MI DNR) has supported monitoring efforts throughout the state. Because nesting is typically widespread at unpredictable locations throughout Michigan Great Lakes, formal monitoring is challenging to fund, coordinate and accomplish. In 2002, F. Cuthbert received funding from FWS to develop a monitoring plan for Common Terns in Michigan that relies on sharing of data by multiple cooperators

Management

Individual investigators working in selected Common Tern colonies in Michigan have initiated a variety of management efforts. In the early 1980s, F. Cuthbert fenced off the northeast point on High Island to prevent canids from entering the colony. She also removed approximately 350 Ring-billed Gulf eggs (under USFWS permit) annually for several years to discourage gulls from nesting in habitat typically occupied by terns (Cuthbert, unpubl. data). Recent management efforts have focused on Lime Island, St. Marys River. In 1997 it was the largest colony in the U.S. Great Lakes with 628 pairs (F. Cuthbert and J. McKearnan unpubl. data). The MI DNR and USFWS have funded management projects at this site that include habitat restoration, signage to protect the nest site and a viewing area for the public (Lewis, pers. comm.). Since 2000, M. Tansy and G. Corace (Seney National Wildlife Refuge) have taken an active role to protect and manage two sites in the Upper Peninsula (Sand Products, St. Ignace Coast Guard Station). Primary activities included vegetation control, predator removal (skunk, domestic cat) and construction of a chain link fence at St. Ignace.

MINNESOTA

***Protective Status*: Minnesota Threatened Species**

Summary

Common Terns are regular spring and fall migrants, but nest at a limited number of locations within the state (Janssen 1987). Historically, 8 lakes are known to have supported nesting terns. Four sites are considered long-term colony locations: Leech Lake, Lake of the Woods, Mille Lacs Lake, and Duluth Harbor (McKearnan and Cuthbert 1989).

Data from Roberts (1932) and unpublished data from the Minnesota Department of Natural Resources (MNDNR) indicate that about 2,600 Common Tern pairs nested annually at 4 locations in the early 1930s (McKearnan and Cuthbert 1989). By 1988, breeding pair numbers dropped to about 630 (MNDNR unpubl. data). In 1993, 1994, and 1995, the number of breeding pairs in Minnesota was 541, 633 and 744, respectively (McKearnan and Cuthbert 1989, Penning and Cuthbert 1993, Mortensen 1993, 1994 and 1995, Lapp 1994 and 1995, Maxson, pers. comm.). The 1997 estimate was 508 pairs at 4 sites (Cuthbert et al. 2003, Mortenson 1998).

Common Tern breeding and reproductive data for the Leech Lake colony are not available prior to 1933 (Mortensen 1993). Bird banders estimated more than 2,000 nests on Gull Island in 1933. Banding efforts continued sporadically between 1933 and 1960, but reproductive data were not recorded. Between 1968 and 1972, about 1,000 pairs nested annually on Gull Island (Mortensen 1993). After 1972, tern numbers declined to 150 pairs in 1981. The tern population partially recovered in 1993 and 1984 when nests numbered about 375 and 489, respectively (Miller and Bosanko 1989). Between 1985 and 1987, the number of tern nests on Gull Island ranged from about 219 to 276. In 1988, 142 pairs of terns nested at the colony, but only 4 eggs hatched (Miller and Bosanko 1989). In 1989, Common Terns abandoned Gull Island and nested on Little Pelican Island (Reed et al.1991). That year reproductive success was near zero due to predation. In 1991 and 1992, only 61 and 75 nests were counted on the Little Pelican Island complex, respectively (Mortensen 1993). Again in 1994 and 1995, the local tem population partially recovered and the numbers of nests counted were 172 and 257, respectively (Mortensen 1995). In 1995, reproductive success was 1.22 young fledged/pair.

Terns have nested at Lake of the Woods since at least 1932 (McKearnan and Cuthbert 1989). The number of active nests on Pine and Curry Island ranged from about 25-485 between 1979 and 1986 (MNDNR). By 1988 colony size declined to only 52 nests and no young fledged due to predation. The population size recovered to 186 active nests in 1992 but reproductive success was 0. Following intensive monitoring and management in 1993, 156 active nests were recorded and reproductive success was 1.04 young fledged/ pair (McKearnan and Maxson 1994). In 1994, 3 79 active nests were observed and the estimated number of young fledged/pair was 0.87 (Maxson and Haws 1994). The number of active nests recorded in 1995 was virtually identical to the 1994 tally (378) and the estimated reproductive success increased to 1.23 young fledged/pair (Maxson and Haws 1995).

Two islands in Mille Lacs Lake, Mille Lacs Lake National Wildlife Refuge, are used as nesting sites by Common Terns. Breeding records for Hennepin and Spirit islands date to 1976 and 1978, respectively (Lapp 1994). Between 1976 and 1994, the number of nesting pairs on Hennepin Island ranged from zero in 1980, 1982 and 1983 to a high of about 190 pairs in 1989. Between 1978 and 1994, the number of pairs nesting on Spirit Island ranged from 0 in 1980 to about 50 in 1987 (Lapp 1994). For both islands, nesting pairs numbered 104 in 1993 and 10 1 in 1994; reproductive success ranged between 0 and 0.22 fledglings/pair (Lapp 1994). In 1995, nesting pairs on Spirit and Hennepin Islands increased slightly to 109 (Lapp 1995). The nesting effort on both islands resulted in little or no reproductive success; no young fledged on Spirit Island and only 0.20 young fledged per pair on Hennepin Island (Lapp 1995).

Since 1937, terns have nested at different Wisconsin/Minnesota sites in the Duluth/Superior Harbor area of the St. Louis River estuary. All colonies listed in this section are located in Minnesota with the exception of Interstate Island that is administered by both states. The Minnesota-Wisconsin state boundary runs through Duluth Harbor; since 1988 management responsibilities of Interstate Island have been shared by the Minnesota and Wisconsin Departments of Natural Resources (Penning and Cuthbert 1993). Nesting records between 1937 and 1976 are incomplete (Penning and Cuthbert 1993). In 1946, terns established a colony on Hearding Island and continued nesting on the island through 1955. In the late 1950s, the tern colony moved to Barker's Island, Wisconsin. Between 1960 and the early 1970s, the main colony in the harbor may have been located at Minnesota Point (Cohen 1960, Cohen and Cohen 1961).

In 1971, a colony was established at the Port Terminal and this remained the major nesting location through 1984. During the same time period, a smaller colony was located at Sky Harbor Airport. Despite efforts initiated in 1983, nesting tem numbers remained low; in 1989, management was terminated (Penning and Cuthbert 1993).

Beginning 1984, a management was initiated (Penning and Cuthbert 1993) to actively discourage terns from nesting at 3 colonies in the Duluth Harbor. These sites were determined non-productive for multiple reasons. The Sky Harbor Airport and Port Terminal colonies were subjected to high levels of human disturbance and had persistent problems with predation that limited reproductive success (Cuthbert et al. 1984, McKearnan and Cuthbert 1989, Penning and Cuthbert 1993). The Erie Pier colony experienced high human disturbance from construction equipment and nest sites were vulnerable to storm wash-over (Penning and Cuthbert 1993). The goal of the disturbance program was to relocate the terns on Interstate Island. After vegetation was partially removed from Interstate Island in 1984-1985, 50 pairs of terns nested at this site, a dredge-spoil island constructed prior to 1940 by the Army Corps of Engineers (Penning and Cuthbert 1993). No nests were observed between 1986-1988, probably due to vegetation encroachment. In 1988, the island was placed under the joint jurisdiction of

Minnesota and Wisconsin Departments of Natural Resources and all vegetation was removed prior to the 1989 breeding season (Penning and Cuthbert 1993). Easements for the 3.42 ha owned by private corporations were obtained at this time (Penning and Cuthbert 1993). Interstate Island was the only St. Louis estuary colony site used in 1989, 1990, and 1991; the number of breeding pairs was 81, 124, and 152, respectively. Reproductive success in 1991 and 1992 was greater than 1.3 young fledged/pair, but declined to 0.88 in 1993 (Penning and Cuthbert 1993).

The Shipwreck Island colony in Lake Kabetogama, Voyegeurs National Park, has been monitored by National Park Service biologists since 1973. Information concerning colony population size prior to 1973 is not available (Grim and Benedict 1990), but between 1973 and 1989, 14-21 breeding pairs nested at the colony. No young fledged during this time period (Grim and Benedict 1990, Penning, pers. comm.). In 1995, terns were present, but no breeding occurred (Lynch, pers. comm.).

Limiting Factors

Multiple factors, often site-specific, have contributed to poor reproductive success in Minnesota's tern colonies (McKearnan and Cuthbert 1989, Cuthbert, pers. obs.). Gull encroachment has been a significant problem at most sites. The number of Ring-billed Gull nests increased more than 87% between 1976 and 1991. The increasing gull population nesting on Leech Lake during the 1970s-1980s coincided with a decrease in tern numbers (Mortensen 1993). In 1993, gull nests declined to about 500 in response to gull control efforts by the Leech Lake Reservation Division of Resources Management (LLRDRM) (Mortensen 1993). At Voyageurs National Park, Grim and Benedict (1990) reported Herring Gull breeding territories expanded toward the tern nesting sites on Shipwreck Island and suggested a potential impact on tern productivity,

Predation has been a limiting factor at Pine and Curry Island, Lake of the Woods (McKearnan and Maxson, 1994). In 1984, red foxes were at least partially responsible for low reproductive success (McKearnan and Cuthbert 1989). Repeated nocturnal nest desertions by adults were caused by a Great Horned Owl in 1993 and one owl was removed (McKearnan and Maxson 1994). Again in 1994 and 1995, there was evidence that a Great Horned Owl visited the colony (Maxson and Haws 1994, 1995).

Human disturbance is a factor limiting tern productivity at several colony sites in Minnesota. At Shipwreck Island, Voyageurs National Park, fisherman and boaters often anchor near the colony and were observed on the islands during the breeding season (Grim and Benedict 1990). Anglers and investigators have caused disturbance to Leech Lake colonies, but no link between disturbance and lower productivity has been documented (Miller 1988, Mortensen 1993).

Inclement weather and high lake levels reduce tern productivity. In 1984, storm wash over flooded Hennepin Island, Mille Lacs Lake and 10 nests were lost (McKearnan and Cuthbert 1989). In 1995, 70% of the nests on Hennepin Island were lost to storm wash over. High lake levels in conjunction with strong winds caused flooding and destruction of nests on Pine and Curry Island, Lake of the Woods (McKearnan and Cuthbert, 1999). Fluctuating water levels at Mille Lacs Lake may have a negative impact on tern reproductive success due to loss of nesting habitat and increased susceptibility to storm-generated waves when terns nest close to the waterline (Lapp 1994, 1995).

Research/Monitoring

Since 1983, the Minnesota Department of Natural Resources Nongame Wildlife Program has played a significant role in funding and coordinating conservation and management of Common Terns in the State. In addition, monitoring of Leech Lake colonies is conducted annually and supported by the Bureau of Indian Affairs Circle of Flight Initiative (Mortensen 1995). Colonies in the Mille Lacs National Wildlife Refuge are monitored each season by USFWS and the Mille Lacs Band (Lapp 1995).

Management

Preventing human access to active colony sites is a common strategy to reduce disturbance. Shipwreck Island has been closed to the public during the tern breeding season since 1985. The island closure is signified with buoys placed around the island and signs posted at boat launch ramps and visitor areas (Grim and Benedict 1990). Hennepin and Spirit islands have no public access during the breeding season. Buoy signs are used to prevent people from visiting the islands (Lapp 1993, 1994).

Except for annual monitoring of the tern populations, little or no management efforts were implemented at Leech Lake prior to 1993 (Mortensen 1993). Management methods employed since 1993 include predator removal, gull control, habitat creation and improvement, closure of islands to the public during the breeding season, monitoring of populations for numbers and reproductive success, and officer patrols to deter people from visiting the islands. Management and monitoring has continued through 2003 with current focus on predator removal (USDA Wildlife Services, string grids to discourage gull nesting). Vegetation encroachment and expanding populations of gulls and cormorants are the current concerns for this important site (Mortenson pers. comm.).

Lake of the Woods colonies have been intensively managed since 1993 (Maxson, pers. comm.). Colony disturbance is reduced by preventing recreational visitation during the tern breeding season. Trees and shrubs are removed when necessary to maintain suitable habitat (Maxson and Haws 1994, 1995). Annual predator management efforts include removal of mammalian and avian predators (mink, red fox, striped skunk, Great Homed Owl, American Crow (Corvus *brachyrynchos)* and Common Raven (*Corvus corax*)), and removal of crow, raven and gull nests and eggs. Parallel rows of elevated nylon string are erected annually during the tern breeding season to deter gulls from nesting in traditional colony sites (Maxson and Haws 1994, 1995, Maxson et al. 1996).

Management at Mille Lacs National Wildlife Refuge entails placement of gull deterrents similar to those suggested by Blokpoel and Tessier (1983), population monitoring (Lapp 1993, 1994), and filling deep crevices (death traps for chicks) with gravel. Installation of nest platforms and establishment of additional colonies are suggested for the future (Lapp 1994, Lapp 1995).

In 1989, all vegetation was removed prior to the breeding season at Interstate Island, Duluth Harbor. This location was the only colony site used in the harbor from 1989 to 1993. Creation of suitable habitat used in concert with other management strategies (e.g gull discouragement, predator control) led to fledging of chicks for the first time in 5 years.

In 1990, a management plan was developed to restore and maintain the natural distribution and abundance of the Voyageurs National Park tern population. As of 1995, lack of funding prevented implementation of the management recommendations put forward in the 1990 management plan (Lynch, pers. comm.).

An informational brochure concerning the detrimental effects of human disturbance to Common Tern breeding colonies was developed and distributed by the Minnesota Department of Natural Resources and the U.S. Fish and Wildlife Service.

NEW YORK

***Protective Status*: New York Threatened Species**

Summary

In upstate New York, Common Terns nest on Oneida Lake, the St. Lawrence River, eastern Lake Ontario, the Niagara River, and eastern Lake Erie. Historical records of terns in New York are present in the literature, but region-wide breeding data are limited. Terns were first recorded breeding in New York along the St. Lawrence River (SLR) in 1917 (Merwin 1918). Breeding records are intermittent between 1917-1960, but large colonies were reported at Oneida Lake (Burch 1936, 1941), eastern Lake Ontario (Belknap 1968, Bull 1974), and the St. Lawrence River. Bull (1974) reported 800 pairs in Buffalo Harbor, Lake Erie, during the same time period. In total, about 3,200 pairs probably nested in the New York Great Lakes region during the early 1960s (Smith et al. 1984, Bull 1974).

According to Courtney and Blokpoel (1983), the Common Tern population of the eastern Great Lakes region, including Canada, probably peaked in the early 1960s and was relatively stable into the early 1970s. In 1982, Smith et al. (1984) estimated about 1,000 pairs nested on Oneida Lake, the upper St. Lawrence River and eastern Lake Ontario. This number is a 60% decline in the population from the same geographical area in the early 1960s (Smith et al. 1984). Since the initiation of active management strategies in the 1980s, the number of birds breeding has ranged from 1,600 to >1,900 pairs in 1995 (Harper 1993, Adams, pers. comm., McBrayer et al. 1995, Klinowski and Richmond 1992, Levine 1998). The State of New York Endangered Species Working Group listed the Common Tern population trend and essential habitat status as declining (Anon.

1994). The 1997 estimate for New York birds nesting in the Great Lakes and Oneida Lake was 1,923 pairs at 41 sites (Cuthbert et al. 2003).

Limiting Factors

Competition with Ring-billed Gulls, predation and human disturbance are the most frequently listed factors limiting tern productivity in New York. Vegetation encroachment and flooding are also described as important.

Smith et al. (1984) identified Ring-billed gull encroachment as the primary cause of colony abandonment in Lake Ontario and the St. Lawrence River during the 1960s and 1970s. Cormorant loafing or nesting on structures located over a tern colony caused the abandonment of the Reef Lighthouse colony in the Niagara River (Horning pers. comm.). Harper (1993) reported that cormorant feces on a navigation cell changed the gravel substrate to smooth, hard aggregate. He proposed that eggs roll out of nests on smooth aggregate substrate easier than from nests on the loose aggregate substrate therefore reducing productivity.

Observation of Great Horned Owls and presence of owl feathers and decapitated terns (both adults and chicks) were evidence of direct predation by owls at a St. Lawrence River colony in the 1980s (Smith et al. 1984, Karwowski 1992). Repeated nocturnal nest desertions by adults were attributed to a Great Horned Owl at the Eaglewing Island colony, St. Lawrence River, in 1984 and 1986 (Karwowski 1992). In 1993, a decrease in owl predation was associated with an increase in hatching and fledging rates on a St. Lawrence River navigation cell colony site (Harper 1993). Severinghaus (1982) reported high chick mortality at an Oneida Lake colony due to predation but did not identify the predator(s). In 1994, a mink was observed carrying a tern chick away from a Lake Erie colony (McBrayer et al. 1995).

Human disturbance directly reduced tern productivity at numerous colonies in upstate New York. Bull (1974) reported off-road vehicle, airplane, and pedestrian traffic as the primary cause of abandonment of the Sandy Pond, Lake Ontario, colony. In 1993, a Niagara River colony site was trampled and littered with beer cans; the eggs in 64 of 69 nests were crushed (McBrayer et al.1995). All chicks were killed at a navigation cell colony in the St. Lawrence River in 1995; vandalism was suspected (Harper 1995). Harper (1993) suggested that maintenance activities at navigation cell colony sites reduced tern productivity in 1993.

The only reported incident of storm wash over reducing tern reproductive success occurred at the Eagle Wing Island colony in the St. Lawrence River when 44% of egg loss was attributed to storm-driven wave action (Karwowski 1992). Several days of cold, rainy weather was believed to cause nest failure at Gull, Tidd, and North Grindstone island colonies, St. Lawrence River, in 1993 (Harper 1993).

Research/Monitoring

Annual monitoring of the breeding tern population occurred in the following 4 regions in 1995: Oneida Lake, (since 1979); upper St. Lawrence River, (since 1982) eastern Lake Ontario, (since 1984) Buffalo Harbor, Lake Erie and Niagara Frontier, (since 1986) (Klinowski and Richmond 1992, Harper 1993, McBrayer et al. 1995, Horning et al. 1995, Adams, pers. comm., Miller, pers. comm.).

A Common Tern banding program has been in effect for the St. Lawrence River colonies since 1990; 3,900 chicks have been banded (Harper 1995). Band recovery locations include: the St. Lawrence River (5+), western Lake Ontario (2), Maine (1), the gulf coast of Florida (1), Cuba (1), Guatemala (1), El Salvador (2), Panama (1), Colombia (1), Ecuador (1), Trinidad (1), Guyana (1), and Brazil (1).

Chick shelters were placed on an island colony in Oneida Lake in 1995 to assess the benefits of this management technique, Results were inconclusive because vegetation encroachment prevented comparison between experimental and control sites (Adams, pers. comm.).

Harper (1993) investigated the effects of loafing cormorants on terns nesting on a navigation cell in the St. Lawrence River. A higher fledging rate was documented in the loose substrate not affected by the cormorants; (2.11 chicks fledged/nest) as compared to the fledging rate on the hard substrate (1.47 chicks/ nest).

Management

Colonial waterbird deterrent structures have been used on Oneida Lake colonies since 1986
(Adams, pers. comm.). In 1986, Ring-billed Gulls displaced terns from Little Island and Wantry Island. Monofilament grids were placed on both islands. The grids successfully keep gulls and cormorants from nesting on these islands (Adams and Richmond, pers. comm.; Claypoole 1986). Signs around islands and information brochures have been used to alert boaters to nesting areas. On the nesting areas, managers have added gravel to enhance nest sites on Oneida Lake, the St. Lawrence and the Niagara Frontier.

OHIO

***Protective Status*: Ohio Endangered Species**

Summary

Common Terns occur throughout Ohio as migrants but breeding colonies are limited to the western basin of Lake Erie (Peterjohn and Rice 1991). Records prior to the 1950's are intermittent. The species was described by Jones (1903) as breeding less numerously on a few of the smaller islands within the Ohio boundary. Peterjohn (1989) reported 1,000-2,000 pairs nesting on Lake Erie islands and 1,000-5,000 pairs nesting at mainland sites in 1939. Breeding colonies were present on the following islands: Starve, Green, Rattlesnake, Lost Ballast, and West Sister. Additional colony sites were Bay Point, Little

Cedar Point and human-made sites at Maumee Bay and Cedar Point (Ohio Department of Natural Resources 1992).

In the 1950s, many traditional breeding sites were abandoned following establishment of nesting Herring Gulls (Peterjohn 1989). Gulls completely displaced terns on Starve and Rattlesnake Islands in this decade (Peterjohn 1989). A single large Common Tern colony nested along western Lake Erie during the 1950s and 1960s. The specific location is not reported. This colony usually contained about 1,500 pairs, but in 1967 about 5,000 pairs were observed (Peterjohn and Rice 1991). The western Lake Eric population declined to 1,000+ pairs by 1970. Between 1971 and 1974, high lake levels eliminated all tern colonies (Peterjohn and Rice 1991). In 1975, a new colony (>350 pairs) was established on a dredge site at Maumee Bay. By 1982, only 100 pairs nested at this site, none raised chicks to fledging and the colony was abandoned in 1983. Scharf and Shugart (1998) reported 63 pairs at 2 colonies in 1990. Since 1993, about 65110 pairs have nested at Pipe Creek Wildlife Area and Ottawa National Wildlife Refuge (Peterjohn and Rice 1991, Tori, pers. comm.). The tern breeding population changed from about 5,000 nesting pairs in 1967 to about 100 pairs in 1995, a decline of 98% (Peterjohn and Rice 1991, Jones 1903, Tori pers. comm.). The 1997 estimate of nesting terns in Ohio was 119 pairs at 2 sites (Cuthbert et al. 2003).

Limiting Factors

Habitat loss and displacement by gulls are the major factors limiting tern productivity in Ohio (Stricker 1995). Between 1971-1974, terns did not nest in Ohio because all colony sites were inundated due to unusually high lake levels (Courtney and Blokpoel 1983, Peterjohn and Rice 199 1, Stricker 1995). The Ohio Department of Natural Resources (1992) lists competition for nest sites as the most significant problem in the population decline of breeding terns in Ohio. Earlier nesting Ring-billed and Herring gulls forced terns to nest in sub-optimal habitats where they experienced greater susceptibility to predators (Peterjohn and Rice 1991). Other factors that may limit Common Tern populations include: predation by aerial and terrestrial predators, contaminants, and human disturbance.

Research/Monitoring

Surveys and banding programs have been carried out sporadically since 1926 (Ohio Division of Wildlife 1995). ODW conducts aerial surveys in June to look for additional tern colonies along the western basin of Lake Erie In cooperation with ODW and USFWS, a graduate student from Ohio State University compared nesting success at natural and human created sites at the 2 remaining colony sites in Ohio; Ottawa National Wildlife Refuge and Pipe Creek Wildlife Area (Stricker 1995).

Management

Management efforts were initiated in 1987, when the ODW attempted to establish a nesting colony at Ottawa National Wildlife Refuge. Terns were successfully attracted and nested but reproductive success was limited due to ground predators, human disturbance and displacement by gulls.

Future management goals include identifying all potential tern nesting sites, establishing and maintaining at least 5 Common Tern breeding colonies (2 will be source colonies > 100 pairs), attaining an overall reproductive success rate of 0.8-1.2 young/pair, increasing public awareness of Common Tern biology and conservation, and a long-term monitoring program for existing colonies (ODW 1995). An artificial nesting platform was placed at Magee Marsh in 1996 to initiate a third colony (Tori, pers. comm., ODW 1995). In 1995, Ohio State, ODW, and the Ohio Audubon Council evaluated nest productivity, colony disturbance, and contaminant levels in Common Tern eggs.

PENNSYLVANIA

<u>Protective Status</u>: Extirpated

Summary

Historically, large populations of migrating Common Terns were recorded in the Lake Erie region of Pennsylvania (Todd 1940). The first account of terns breeding was in 1926 at Gull Point, Presque Isle State Park (Todd 1940). In 1927, birds returned to nest at Gull Point and the area was declared a tern sanctuary (Todd 1940). The colony increased from about 25 nesting pairs in 1927 to about 200 pairs in 1937 (Todd 1940). Birds were still nesting on the site in the early 1950's despite recreational use. During this time, a large colony was described as using the best high drift beach away from the storm over wash area. Downy young and immatures associated with adults were described in field journals in 1958 at Gull Point Natural Area. The last recorded nesting attempt was in July 1966. Between 1966 and 1993, terns were not observed nesting at the site or at any other location in Pennsylvania. In 1994, the historical colony site was again closed off to the public. The following year, terns nested for the first time since 1966. The 3 eggs observed in the nest disappeared. The same pair is thought to have renested but this attempt was also unsuccessful. To date, Gull Point remains the only known colony site within Pennsylvania (Gormley, pers. comm., Stull, pers. comm., McWilliams and Brauning 1999). No Common Terns nested in Pennsylvania in 1997 (Cuthbert et al. 2003).

Limiting Factors

Habitat loss, predation, and recreational use of the beach zone are the most important factors leading to abandonment of the Gull Point colony. The site is located on a peninsula and eroded materials are deposited on the peninsula. Fill material containing sand and gravel with a high soil content was used as beach replacement up current from Gull Point. The change in substrate deposition from sand to a sand/soil mix altered the habitat from a sandy substrate with sparse vegetation to cottonwoods, grasses and shrubs. Breakwaters built by the Army Corps of Engineers between 1978 and 1992 also contributed to habitat alteration (Stull, pers. comm.). J. Stull stated that recreational use of the beach near the colony is the primary reason terns left Gull Point.

Research/Monitoring

Gull Point Natural Area will be monitored for tern nesting activity and if nesting is discovered, the USFWS and state resource agencies will be notified. There were no research efforts in 1995 (Brauning pers. comm.).

Management

In response to the 1995 nesting attempt, the USFWS convened a meeting to discuss strategies to encourage terns in the future (Gormley, pers. comm., Brauning, pers. comm.). Tern decoys and sound recordings were recommended to attract birds back to the site. A monitoring regime was planned for 1996. The area continues to be closed to the public. No habitat restoration or predator control efforts are planned at this time.

VERMONT

***Protective Status*: Vermont Endangered Species**

Summary

Common Terns were first recorded on Lake Champlain in 1892. Historical surveys indicate that terns nested only on Popasquash Island until the 1960s, when they expanded nesting sites to Hen, Rock, Grammas, Gull Rock and Savage islands. Based on the early surveys (1947-1978), the state population fluctuated from year to year; estimates range from 30-40 birds on one island in 1953 to approximately 750 birds on 4 islands in 1970. LaBarr (1995) noted that regular surveys initiated in 1980 showed that the number of breeding terns on Lake Champlain declined from levels reported in the 1960s and 1970s. Common Tern numbers continued to decline during the 1980s and reached a historical low of about 50 pairs in 1989. This decline led to listing the Common Tern as a state endangered species in 1989 and the implementation of an intensive monitoring and management program. The 1995 tern population increased to about 150 pairs (LaBarr, pers. comm.). LaBarr described the population trend in 1995 to be slowly increasing.

Birds nest on 3-6 rocky islands. Popasquash and Rock Islands are used annually while Hen, Grammas, Gull Rock, and Savage Islands are used sporadically. Four of the islands (Popasquash, Rock, Hen, and Grammas) are < 0.5 ha and are a mosaic of gravel, bare rock, grass, sedge and woody vegetation. Gull Rock and Savage are accessible only after spring water levels have receded (LaBarr 1995). In 1997, 166 pairs nested at 2 sites in Vermont (Cuthbert et al. 2003); in 1999, 140 pairs nested and fledged 96 chicks (LaBarr, pers.comm.).

Limiting Factors

Predation, displacement by Ring-billed Gulls, human disturbance, and seasonal overgrowth of vegetation on nest sites are all factors contributing to low reproductive success of Common Tern's on Lake Champlain (LaBarr 1995).

Nocturnal aerial predators are considered to be the most important factor limiting Common Tern reproductive success in Vermont. Great Homed Owl predation on chicks directly reduces the number of fledglings produced annually. In addition, predation by owls causes regular nightly desertion of nesting sites by adult terns, leaving nests vulnerable to other nocturnal aerial predators such as the Black-crowned Night-Heron. Nocturnal aerial predators are suspected to be the primary cause for low Common Tern reproductive success in the 1970s and 1980s.

Tiny thief ants *(Solenopsis molesta)* enter the nest from below and feed on newly hatched chicks or pipping eggs and cause nest failure. This type of predation was first documented in 1989 and occurs in Vermont only on Popasquash Island (LaBarr 1995).

The Ring-billed Gull population on Lake Champlain is relatively stable; it was approximately 30,000 pairs in 1995. Unless gull deterrent methods are used, these birds out-compete Common Terns for nest sites on Popasquash and Rock Islands.

Humans entering or approaching nesting colonies can result in reduced reproductive success. According to LaBarr (1995), anglers approach the nesting islands too closely and are currently the most serious human disturbance threat on Lake Champlain.

Late seasonal vegetation growth can invade nest sites, ultimately resulting in nest abandonment. Vegetation has reduced tern reproductive success on Popasquash and Hen Islands (LaBarr 1995).

Research/Monitoring

Surveys were conducted sporadically between 1947-1978. During this time, Common Tern numbers were reported in qualitative terms such as "many nests", "here in numbers", and "nesting", or quantitative terms including "numbers of chicks banded", "number of adult terns", or "number of nests".

Regular surveys were conducted between 1980-1995 (excluding 1982). Between 1980 and 1986, nesting islands were monitored 3-4 times/year. In 1987, an intensive monitoring and management program was initiated in response to the addition of the Common Tern to the State Threatened Species list (1987). Nesting areas were monitored almost daily to document reproductive success, nocturnal predation, and nightly desertion of colony sites.

There have been 2 banding efforts implemented since monitoring started in 1947. Common Tern chicks were banded on Popasquash Island between 1957-1974. Two were recovered as adults in Ecuador and Trinidad. The second banding project was initiated in 1987. Both adults and chicks were banded with a USGS band and colored leg bands.

Banded adult breeding birds from the St. Lawrence River, Lake Oneida, Lake Ontario, and Faulkner Island, Connecticut, have been trapped on Lake Champlain.

Management

In 1987, the Vermont Fish and Wildlife Department and Vermont Institute of Natural Science started an aggressive management strategy to increase productivity of the Lake Champlain Common Tern. This effort included: 1) placement of signed buoys around nesting islands to limit human disturbance; 2) shelters for chicks, constructed and placed near tern nests to provide protection from predators; 3) removal of Ring-billed Gull nests on Popasquash and Rock Islands to maintain adequate nesting space for terns; 4) use of an ant-specific bait and barrier system to control ants; 5) limited vegetation control; and 6) education of lake users about Common Tern natural history and conservation. Intensive management is responsible for recent increases in population size and reproductive success in Vermont (LaBarr, pers. comm.). Since 1998, the Green Mountain Audubon Society has assumed much of the management for this species.

WISCONSIN

***Protective Status*: Wisconsin Endangered Species**

Summary

Historically, Common Terns have been present in Wisconsin as migrants and breeders. Most historical records place breeding terns in the eastern and east-central counties, with a few occurrences in northern counties (Matteson 1988). Common Terns are frequently described in the literature as "a migrant", "a common migrant", or "spring and fall migrants" (King 1883, Cooke 1888, Cory 1909, Cahn 1913, Lowe 1915). Historical observations prior to 1945 were primarily in the eastern counties (Brown, Jefferson, Milwaukee, Sheboygan, and Waukesha). Cooke (1888) recorded terns in the Mississippi River Valley. Barger et al. (1975) described the status of the Wisconsin's Common Tern as "a common transient visitant" in 1960. Matteson (1988) estimated approximately 1,000 breeding pairs in Wisconsin in the 1960's. In 1970 and 1975, the tern’s status was described as a "regular breeder" (Robbins 1970) and a known breeder (Barger et al. 1975). By 1977, Common Tern populations were characterized as declining in Wisconsin (Matteson 1988, Robbins 1991), coinciding with the general trend throughout the Great Lakes region (Courtney and Blokpoel 1983).

Between 1850-1945, nesting records are limited. Some are vague, and geographical locations are difficult to pinpoint. For example, Hoy (1852) recorded terns nesting on a small, rocky island in northern Lake Michigan. Common Terns were observed to breed in numbers "in the marshes and ponds about the lakes" of northern Wisconsin and in scattered numbers in southern Wisconsin (Carr 1890). In 1926, nesting terns were banded on a dry shoal that may have been located in lower Green Bay (Erdman 1976a).

Nesting records with site descriptions are primarily in eastern Wisconsin. In the late 1800s, terns nested on Lake Koshkonong, Jefferson County, and Pewaukee Lake, Waukesha County (Goss 1881, Baird et al. 1884, Kumlien and Hollister 1903). A colony on Jackson Reef, Green Bay, with "several hundred" birds was recorded in 1935 (Matteson 1988). In 1937, about 100 pairs nested on Strawberry Island or on Horseshoe Island Reef (Matteson 1988). Terns were observed nesting at the mouth of the Pensaukee River in 1940 and 1941 and in 1944, on Lone Tree Island in lower Green Bay (Barger 1941, Erdman 1976a,b). Colonies were located on Chambers Island in Green Bay, but no dates were provided with this record (Erdman 1978). An exception is a record of terns nesting on Lac Vieux Desert in Vilas County about 1918 (Jackson 1923). There are gaps in the nesting records between 1946-1960. Terns nested on Lone Tree Island, Green Bay (Barger 1946), the western shore and islands of Lake Winnebago (1947-1949), Green Lake (1949) and unidentified locations in Oconto County (Matteson 1988). There are only 3 records of terns nesting in Wisconsin during the 1950s. Matteson also reported colonies on Strawberry and Sister Islands, Lake Michigan in the early 50s**,** one colony in 1956 on Lake Winnebago, and a colony on a sand spit (probably Barker's Island) in the Duluth/Superior Harbor in 1957.

In the early 1960s, birds nested on Lake Poygan, McKay Island, and Butte des Morts Island, Winnebago County (Matteson 1988). Terns utilized Strawberry Island, Pirate Island and reefs off Jack and Spider islands, Lake Michigan, in the mid- I 960s (Matteson 1988). After 1970, terns have used 4 general regions for nest sites: Duluth-Superior Harbor, Lake Superior; Chequamegon Bay, Lake Superior; Green Bay, Lake Michigan; and lakes Winnebago and Butte des Morts in east-central Wisconsin. Since 1989, Interstate Island has been the primary colony site in Duluth-Superior Harbor (Strand, pers. comm., Matteson, pers. comm.). Between 1973 and 1987, terns nested every year at the Ashland Pier in Chequamegon Bay, and intermittently at the Washburn Dock and Ashland Breakwater. From 1986 through 1996, all nesting in Chequamegon Bay was at the Ashland Pier (Strand, pers. comm.). In 1987-1988, the only tern colony in the St. Louis River Estuary occurred at Wisconsin Point, Wisconsin (Penning and Cuthbert 1993). During the 1970s, terns nested on Lone Tree Island, Grassy Island, or Peshtigo Point, Green Bay, Lake Michigan. Green Bay terns moved to the newly created Kidney Island, (an active dredge disposal site) and to Long Tail Point in the 1980s. A tern colony was discovered in 1983 at Willow Tree Island, Lake Winnebago; terns have nested at this island every year through 1995 (Matteson 1988, Matteson, pers. comm.).

Survey data show that tern numbers fluctuate annually in Wisconsin. Tern populations, as measured by number of nesting pairs, decreased 17% between 1979 and 1980, but over the next 6 years, the number of nesting pairs increased 702% (from 92 to 738) due primarily to a large influx of nesting birds on Renard Isle in 1985 and 1986 (427 and 577 nesting pairs, respectively). Number of nesting pairs decreased to 376 in 1988 and ranged between 308 and 470 pairs through 1994 (Matteson 1988, Scharf and Shugart 1998, Matteson, pers. comm.). In 1995, the number of breeding terns was reported as 558 pairs (Matteson, pers. comm.). Of these, 388 pairs nested on Lake Superior and 70 pairs nested on inland bodies of water. The 1997 breeding pair estimate was 183 pairs (Matteson pers. comm., Cuthbert et al. 2003); an additional 20-30 pairs were probably nesting inland in the Lake Winnebago region at this time.

Limiting Factors

Habitat loss/deterioration, displacement by Ring-billed Gulls, predation by mammals and Great Horned Owls, storm washout, and human disturbance are considered to be the major factors influencing tern population numbers in Wisconsin (Matteson 1988, Matteson, pers. comm., Robbins 1991).

Habitat loss/deterioration along Wisconsin shorelines occurs in 2 ways: rising lake waters periodically cover or erode a substantial amount of suitable habitat (Matteson**,** pers. comm.), and storm generated wave-action has washed out colonies resulting in zero or low reproductive success (Penning and Cuthbert 1993, Matteson 1988). Second, vegetation growth can cause terns to abandon nests or reduce reproductive success (Matteson 1988).

At colony sites in Chequamegon Bay and Green Bay, Ring-billed Gulls displace terns from optimum habitat when they arrive 2-4 weeks before the terns and establish nesting territories earlier (Matteson 1988).

Great Homed Owls probably resulted in nest failure at the Interstate Island and the Wisconsin Point colonies in 1995 (Penning and Cuthbert 1993).

At the Wisconsin Point colony, storm-generated waves swept over the entire sand spit and washed away the colony in 1989 (Penning and Cuthbert 1990a,b, Penning and Cuthbert 1993). Human disturbance was thought to be the main reason for nesting failure at the Washburn boat landing in 1974. The colony, located on a small artificial island near a launch site, was constantly exposed to boat traffic and recreationists (Harris and Matteson 1975c).

Research/Monitoring

Known colony sites are monitored annually for number of nesting pairs and reproductive success (Matteson, pers. comm.).

Management

In 1981, habitat management for the Common Tern was initiated at an active and historical colony site on Chequamegon Bay. Woody and herbaceous vegetation was physically or chemically removed annually between 1981-1985. During the winter of 1985-86, the Ashland Pier, deteriorating from long-term wave and ice action, was rebuilt to resemble its condition in the early 1970s. Management efforts appeared to be successful as nesting pair numbers increased 181% from 58 in 1981 to 163 in 1985 at the Ashland Pier colony (Matteson 1988). The number of nesting pairs peaked at 176 in 1989 (Matteson et al. 1990).

In an attempt to attract nesting pairs to Superior Harbor and Chequamegon Bay, life-sized Common Tern decoys were placed at Barker's Island (Superior Harbor) and Washburn Dock islet (Chequamegon Bay) in 1982 and 1983. In 1984, a sound system with continuous loops of taped tern vocalizations was added to both sites. Both decoys and sound systems were used again in 1985. No terns nested at Barker's Island, but at Washburn Dock in 1984 and 1985, 6 and 3 pairs nested each year, respectively, including 5 pairs that nested within I in of the decoys in 1984 (Matteson 1988). In 1987 and 1988, tern decoys and a sound system were placed at a newly created artificial island site approximately 2 km west of the Ashland Pier in Chequamegon Bay, but no terns nested (Strand, pers. comm.).

In 1983, 14 acres on Barker's Island were designated a sanctuary, fenced and managed for waterbirds. Despite this effort, terns did not nest in 1984 or 1985. The Barker's Island sanctuary was traded for 4 acres on Wisconsin Point in 1987. The newly acquired area was fenced and both a sound system with non-aggressive tern calls and tern decoys were used to attract nesting pairs. Fifty seven pairs nested in 1987 (Matteson 1988). Throughout the mid to late 1980s and into the early 1990s, habitat management was practiced on Renard Isle, Green Bay. Chemical treatment of herbaceous vegetation and a fence to segregate terns from gulls were used on portions of the island (Matteson, pers. comm.). The presence of a large population of Ring-billed gulls (2,000+ pairs) and annual dredge disposal led to the decision to abandon Renard Isle as an actively managed tern breeding site (Matteson, pers. comm,).

To attract both Common and Forster's terns (Sterna forsteri) experimental floating island platforms and life-size tern decoys were installed at several colony sites in lower Green Bay in 1994 (Matteson, pers. comm., Mella, pers. comm.).

In 1984, limited chemical treatment was used on Willow Tree Island, Lake Winnebago. A gravel substrate was installed at Bare Island, Lake Butte des Morts in 1985 (Matteson, pers. comm.).

A Common Tern recovery plan for Wisconsin was developed in 1988 (Matteson 1988). The minimum nesting population goal is 1,000 nesting pairs at 7 or more colony sites by the year 2,000. Reproductive success must be about 1.1 young fledged/ nesting pair to maintain population stability (DiConstanzo 1980, Nisbet 1973). According to Matteson (1988) there is sufficient habitat to support 1,000 nesting pairs in Wisconsin.

ONTARIO

<u>Protective Status:</u> Listed as species not at risk by Committee on Status of Endangered Wildlife in Canada (COSEWIC).

Summary

In the Canadian Great Lakes, Common Terns nest on the upper St. Lawrence River, Lake Ontario, Lake Erie, Lake Huron (primarily in the North Channel and Georgian Bay), and connecting waters. Occasionally, terns nest on Canadian Lake Superior waters (Blokpoel and Tessier 1996). Data for the Canadian Great Lakes are not available prior to the mid-1970s. Courtney and Blokpoel (1983) summarized breeding data for colonies located in both the Canadian and U.S. lower Great Lakes regions (upper St. Lawrence River, Lake Ontario and Lake Erie) for the period 1900-1980. The number of terns nesting in the lower Great Lakes was estimated at 4,000-7,000 pairs between 1900-1920, 7,000-12,000 pairs between 1920-1940, 8,000-15,000 pairs between 1940-1960, and 5,000-16,000 pairs between 1960-1980. In 1980, the number of Common Tern pairs was estimated at 7,366 in all Canadian Great Lakes excluding Lake Superior (Courtney and Blokpoel 1983, Weseloh et al. 1986, Blokpoel and Tessier 1991). Blokpoel (1977) suggested a decline in Common Terns nesting on the upper St. Lawrence River and Canadian Lake Ontario was already occurring in the late 1960s through the mid-1970s. The number of nests recorded in the St. Lawrence River dropped 84% from 1,200+ in 1972 to only 188 in the same area in 1976. The number of tern nests continued to decrease and in 1990, only 64 were recorded on the St. Lawrence River (Blokpoel and Tessier 1991). Following census efforts in 1989-90, numbers of breeding pairs were estimated to be: Lake Superior (25) (Blokpoel and Tessier 1992); Lake Huron (4,242) (Blokpoel and Tessier 1996) and the lower Great Lakes (2,359) (Blokpoel and Tessier 1997) for a total of 6,626 pairs.

Toronto and Hamilton Harbors are the primary nesting sites in Lake Ontario. The number of nests in the Toronto Harbor colonies declined from about 2,200 in 1966 to 1,200 in 1976 (Blokpoel 1977). By 1990, 120 nests were reported in the Toronto Harbor (Blokpoel and Tessier 1991). In the mid 1990s, installation of 5 nesting platforms along the Toronto waterfront resulted in a nesting population of > 200 pairs (Blokpoel, pers. comm.) In the early 1970's 24-150 adults nested on 2 artificial islands north of the Burlington Canal in Hamilton Harbor, western Lake Ontario. Between 1975 and 1981, nesting activity was not observed in Hamilton Harbor (Gilbertson 1975, Morris and Hunter 1976a, Blokpoel 1977, Dobos et al. 1988). Birds returned to the harbor in 1982, but a census was not taken that year. In 1985, the nesting population was 553 breeding pairs and by 1990, numbers peaked at 1,028 pairs (Dobos et al. 1988, Moore et al 1995). The following year the population declined to 585 pairs, but by 1994 tern numbers recovered to 868 pairs (Moore et al. 1995).

The number of terns nesting at Gull Island, Presqui'lle Provincial Park, peaked in the early 1950s at about 7,000 nests (Morris et al. 1980). The colony declined to <1,000 nests in 1972 (Blokpoel 1977). In 1977, only 3 nests were recorded (Morris et al. 1980). Between 1980 and 1994, the number of nests ranged from one in 1986 to 225 in 1985; 96 nests were recorded in 1995 (LaForest pers. comm.).

Terns nested at Port Colborne as early as the 1940s (Beardslee and Mitchell 1965). By the mid 1970s, this was the primary nesting colony in Lake Erie. In 1977, approximately 1,400 of 1,424 Common Tern pairs nested at 2 colony sites at Port Colborne. This number was more than 88% of the tern breeding population on Lake Eric that year

(Blokpoel and McKeating 1978). At the Breakwater colony (Port Colborne), the total number of nests increased slightly from 562 in 1977 to 676 in 1990 (Morris et al. 1992). By 1990, the number increased to 1135 in response to management strategies initiated in 1981 (Blokpoel and Tessier 1991). In recent years, the number of Common Terns nests at Port Colborne colonies has ranged from a low of 705 in 1993 to 863 in 1995 (Morris, pers. comm.).

In 1960-1962, Ludwig (1962) conducted a census of breeding terns in the North Channel, Lake Huron and reported 220, 270, and 750 pairs, respectively. A 1980 survey estimated 5,347 nests in Lake Huron, including the North Channel and Georgian Bay (Weseloh et al. 1986). In 1984, the eastern North Channel of Lake Huron was surveyed and estimates were compared to population estimates obtained from the same sub-area of the 1980 survey. The results were similar (1,322, 1,293, respectively), but the number of colonies increased from 19 colonies in 1980 to 34 colonies in 1984 (Blokpoel and Harfenist 1986). In 1989, the number of tern nests was estimated at 3,299, a decline of 38% from the 1980 estimates (Blokpoel and Tessier unpubl. data).

As part of a multi-year international inventory of, the Canadian portion of Lake Superior was surveyed in 1978. Common Tern colonies were not found during this survey (Blokpoel et al. 1980). When the area was re-surveyed in 1989, only one colony (25 nests) was recorded. The authors suggest these birds originated from colonies in the U.S. portion of eastern Lake Superior, the St. Marys River or the North Channel. By 1993, terns were not nesting at this site (Blokpoel and Tessier 1993).

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 this species in Ontario (Neuman and Blokpoel 1997). However, the demographics of Common Terns in the lower Great Lakes are cause for concern, as >80 % of the population in 1990 nested in only two colonies, Hamilton Harbour and Port Colborne. In the Canadian Great Lakes, Common Tern numbers have changed more dramatically in Lake Erie and Lake Ontario than in Lake Huron. 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 abundant suitable habitat.

Limiting Factors

Factors that limit Common Tern reproductive success in the Canadian Great Lakes include: competition with Ring-billed Gulls (and in some cases Herring Gulls) for nest habitat, vegetation encroachment, predation, human disturbance, and high lake levels and associated storm damage (Blokpoel and McKeating 1978, Blokpoel et al. 1980, Courtney and Blokpoel 1983, Moore et al. 1995).

Throughout the Great Lakes region, early nesting Ring-billed Gulls frequently encroach upon or completely displace terns from their traditional colony sites (Dobos et al. 1988, Courtney and Blokpoel 1983, Dunlop et al. 1991). On Muggs Island, Lake Ontario, the breeding Ring-billed Gull population increased from about 4,500 adults in 1972 to >7,000 adults in 1974. Concurrently tern numbers declined in 1973 and the colony was abandoned in 1974 (Morris and Hunter 1976a). A similar pattern occurred at the North Limestone Island colony in Lake Huron. Over a period of 2 breeding seasons gull numbers increased dramatically (25,000 to 35,000), but tern numbers remained about the same (1500). The increasing numbers of breeding gulls effectively precluded terns from traditional nesting sites and the colony was abandoned in the third year (Morris and Hunter 1976a). Displacement of terns by gulls was suggested as a primary factor in the North Limestone Island colony abandonment and at least one of the factors in the abandonment of Muggs Island (Morris and Hunter 1976a). In western Lake Ontario, Ring-billed Gulls were the primary factor in colony abandonment at several sites in Hamilton Harbor (Moore et al. 1995).

Inundation of colonies due to high lake levels or storm-wash over has been documented by several authors. Morris et al. (1976) reported 10- 18 % of Common Tern eggs were lost to flooding at 2 small, low-lying Hamilton Harbor colonies in 1972. Terns often nest on shoals and sand spits susceptible to flooding when lake levels rise (Ludwig 1962). A number of colonies active in 1980 were on low-lying ground and vulnerable to wash over during storms (Weseloh et al. 1986).

Ground and aerial predators adversely affect reproductive success by feeding on eggs and chicks. In 1981, mink were observed consuming half-grown chicks at the Eastern Headland colony, Lake Ontario (Courtney and Blokpoel 1983); Burness and Morris (1993) reported on the direct and indirect consequences of mink on nesting Common Terns. Striped skunk and red fox may have eaten eggs and chicks at colonies in Lake Ontario (Courtney and Blokpoel 1983). Predation by Black-crowned Night-Herons was reported or suggested at colonies on Lake Erie and Lake Ontario (Hunter and Morris 1976a, Morris et al. 1980). Herring Gulls ate Common Tern chicks at Port Colborne, Ontario, but this behavior is thought to be relatively rare (Courtney and Blokpoel 1983). Great Horned Owls killed >100 chicks at the Eastern Headland colony, Lake Ontario, in 1979 (Courtney and Blokpoel 1983). Eggs in the Eastern Headland colonies were destroyed by Ruddy Turnstones (Farraway et al. 1986, Morris et al. 1992, Dunlop et al. 1991). In 1988 and 1989, the presence of Ring-billed Gulls in the Port Colborne colony elicited panic flights by adults and subsequently, gulls ate unattended eggs (Morris et al. 1992). At the same location, Herring Gulls were observed taking tern chicks and feeding them to their offspring in 1987 (Morris et al. 1992).

Human disturbance (e.g. people and dogs walking through the colony) is believed to be at least a partial reason for the tern population decline between 1982 and 1989 at the Eastern Headland colony (Morris et al 1992).

Common Terns initiate nesting during the early stages of seasonal vegetation succession and are susceptible to vegetation encroachment as the season progresses. Vegetation reduces the number of nesting terns or reproductive success as it can cause nest abandonment (Ludwig 1962, Courtney and Blokpoel 1983). In 1982, vegetation was removed from Little Tern Island, Lake Ontario, and 218 active nests were recorded. In the 4 breeding seasons subsequent to 1982, vegetation was not removed and the number of active nests declined to 4 in 1986 (Morris et al. 1992). Moore et al. (1995) reported that a decline in the nesting tern population at 3 sub-colonies in Hamilton Harbor was caused by vegetation overgrowth.

A combination of limiting factors can cause terns to change nests sites, lower reproductive success, and reduce the number of terns returning to a site each year. For example, Ring-billed Gull presence at traditional nest sites and vegetation encroachment forced terns to move from a sand spit to mainland site at Eastern Headland, Lake Ontario (Blokpoel and Fetterolf 1978). Mainland sites appear more affected by multiple limiting factors because they lack isolation and protection from ground hunting predators and human activities. The Eastern Headland colony is a mainland site that is easily accessible to humans and terrestrial predators.

Research/Monitoring

As part of a multi-year inventory of waterbirds, a systematic survey of the Canadian Great Lakes program was initiated in 1978. Baseline region-wide surveys were conducted in the following time steps: Lake Ontario and the upper St. Lawrence River-1976 (Blokpoel 1977), Lake Erie and the Detroit River-1977 (Blokpoel and McKeating 1978), Lake Superior, 1978 (Blokpoel et al. 1980), and Lake Huron, including the North Channel and Georgian Bay, 1980 (Weseloh et al. 1986). The eastern North Channel was re-surveyed in 1984 (Blokpoel and Harfenist 1986). Lakes Superior and Huron were re-surveyed in 1989 (Blokpoel and Tessier 1993, Blokpoel and Tessier unpubl. data) and the lower Great Lakes in 1990 (Blokpoel and Tessier 1996).

The major colony on Lake Erie, Port Colborne, has been monitored annually since 1977 (Morris et al. 1992, Morris pers. comm.). Hamilton Harbor colonies were monitored intermittently in the 1950's and 1960's. Between 1970-1995, Hamilton Harbor colonies were monitored annually except for 1974, 1979, and 1983 (Dobos et al. 1988, Moore et al. 1995). Between 1970-1995, Toronto Harbor colonies were monitored annually except for 1972-1975 (Morris et al. 1992).

Tern populations on Ice Island, upper St. Lawrence River, were monitored between 1979 and 1995 (Andress, pers. comm.). Research and management of the Ring-billed Gull population were done on Ice Island 1990-1993 (Blokpoel et al. 1997, Blokpoel et al. 1997).

Extensive research has been conducted at the Lake Ontario and Erie colonies and, to a lesser extent, at the St. Lawrence River colonies. Studies investigated the following subjects: nest site selection (Blokpoel et al. 1978), predation pressure (Morris and Hunter 1976a, Courtney and Blokpoel 1980b, Morris and Wiggins 1986, Farraway et al. 1986), parental attentiveness (Morris and Hunter 1976a, Morris et al. 1976, Wiggins and Morris 1987, Moore and Morris 1992), the relationship between early-nesting gulls and tern reproductive success (Courtney and Blokpoel 1980b, Blokpoel and Tessier 1984a, 1984a, 1986, Morris et al. 1992, Moore et al. 1995), migration and wintering sites (Blokpoel et al 1982, 1987, 1989, Blokpoel and Tessier 1984b), effects of toxic chemicals on terns (Gilbertson et al. 1976), artificial nests sites (Dunlop et al. 199 1), and food items and availability (Courtney and Blokpoel 1980a).

Management

In 1976, management efforts at Presqui'lle Provincial Park (Gull Island), Lake Ontario, included weekly cutting of vegetation during the nesting season, gull nest destruction and introduction of eggs from another colony (Morris et al. 1980). The authors proposed that vegetation control and the prevention of gull nesting contributed to extension of the tern nesting season from 34 days in 1975 to 77 days in 1976. The egg replacement effort was not successful (Morris et al. 1980).

Installation of monofilament grids has been used at a number of colony sites to prevent gulls from nesting. The monofilament line is placed in a pattern narrow enough to prevent gulls from entering, but wide enough to allow terns to enter the nesting area. Ice Island, the upper St. Lawrence River, was selected as a suitable site to test the efficacy of the monofilament grid system because the island had traditionally had a Common Tern colony of >100 pairs prior to Ring-billed Gull takeover. Monofilament grids were installed at Ice Island, St. Lawrence River, between 1990-1993. Wooden tern decoys were placed under the monofilament lines to attract birds to the site. Gulls were successfully excluded from the site and 141 tern nests were recorded (Blokpoel et al. 1997). A monofilament grid was used at Presqui'lle Provincial park in 1994 allowing terns to nest in an area previously dominated by nesting Ring-billed Gulls (Teeuw 1994). In 1995 and 1996, 3 artificial islands were constructed in Hamilton Harbor to provide (including the Common Tern) with additional nesting habitat and to reduce the conflict between birds nesting on the mainland and industrial land use (Quinn et al. 1996).

THREATS

Common Terns are affected by a diversity of threats in the Great Lakes region including competition with Ring-billed Gulls (*Larus delawarensis),* predation, human disturbance, habitat loss and/or deterioration, inclement weather, and chemical contaminants (Connors et al. 1975, Courtney and Blokpoel 1983, Shields and Townsend 1985, Niemi et al. 1986, Blokpoel and Harfenist 1986, Matteson 1988, Grim and Benedict 1990, Blokpoel and Scharf 1991, Harper 1993, Stricker 1995, LaBarr 1995). Multiple factors often lower reproductive success at individual colony sites but competition for nest habitat with Ring-billed Gulls and predation appear to be the most important factors affecting breeding success. Limiting factors during migration or at wintering sites are unknown.

In accordance with the Endangered Species Act of 1973, five factors are used to determine whether a species is endangered or threatened:
(1) the present or threatened destruction, modification, or curtailment of its habitat or range;
(2) overutilization for commercial, recreational, scientific, or educational purposes;
(3) disease or predation;

(4) the inadequacy of existing regulatory mechanisms;
(5) other natural or marinade factors affecting its continued existence.

Based on literature available on the species, and input provided by state agencies, known threats to Common Terns are summarized according to these listing factors.

PRESENT OR THREATENED HABITAT LOSS

Ring-billed Gull Impacts

In the Great Lakes region, Common Tern nest site availability has decreased due to the expanded Ring-billed Gull population (Ludwig 1962, Morris and Hunter 1976a, Courtney and Blokpoel 1983, Shugart and Scharf 1983, Miller 1988, Blokpoel and Scharf 1991, Blokpoel et al. 1995). Gulls use the same nesting habitat as Common Terns (Courtney and Blokpoel 1983) and establish nest territories 2-4 weeks earlier than terns (Morris and Hunter 1976a, Courtney and Blokpoel 1983, LaBarr 1995, Blokpoel et al. 1995). At the Port Colborne colony, Lake Ontario, gulls initiated egg-laying on 9 April 1982 while terns began egg-laying on 30 April 1982. The 3- week interval between first gull clutch and first tern clutch is typical for this colony (Morris et al. 1992) and is the probable cause of tern displacement from traditional nesting grounds throughout the Great Lakes (Morris and Hunter 1976a). Ring-billed Gulls displaced terns on Grassy Island, Lake Huron (Ludwig 1962), Thunder Bay Island, Lake Huron (Scharf 1979), and a number of colonies in Lake Ontario (Quilliam 1973, Morris and Hunter 1976a, Courtney and Blokpoel 1983, Blokpoel et al. 1997, Moore et al. 1995). Initiation of Ring-billed Gull nesting at the Leech Lake, Minnesota, colony coincided with the beginning of the tern population decline (Miller 1988, Mortensen 1993).

In addition to physical displacement of traditional tern colony sites, the biotic integrity of the colony can be changed due to the presence of nesting gulls. Vegetation at natural colony sites may be damaged by acidic gull fecal material and pulling and/or trampling of plants within the colony (McBrayer et al. 1995). Gull nesting activities also can alter soil chemistry and prevent the normal regeneration of vegetation (Blokpoel et al. 1995, Cuthbert, unpubl. data).

Competition with Ring-billed Gulls for nest sites often forces terns to use marginal nesting habitat (Ludwig 1962, Morris and Hunter 1976a). Blokpoel and Scharf (1991) described terns being forced to use nest sites closer to the waterline. These sites were more vulnerable to washouts during storms. Another response to displacement by gulls is movement to new colony sites. During the 1960s, terns colonized Rock, Hen and Grammas islands, Lake Champlain, Vermont. Investigators suggested that these new colonies formed when Common Tern habitat on Popasquash Island was occupied by earlier nesting Ring-billed Gulls (Spear 1966, LaBarr 1995). At the Gull Island colony, Leech Lake, Minnesota, the breeding terns declined between 1976-1986 as the number of gulls nesting in the same area increased rapidly. By 1989, the Gull Island colony was abandoned and a new colony on Little Pelican Island was established (Mortensen 1993).

Impacts from other Colonial Waterbirds

The activities of other colonial waterbird species have been suggested to have detrimental effects on tern colonies but evidence for impact is very limited. Double-crested Cormorants loafing on superstructures deposit large amounts of excrement. If the loafing structures (such as lighthouses) are located over a tern colony, colony abandonment may occur (McBrayer et al. 1995, Horning pers. comm.). In 1995 there was concern about increasing numbers of American White Pelicans *(Pelecanus erythrorhynchos)* and cormorants that loaf on Gull Island, Leech Lake, Minnesota. Mortensen (1993) suggested their presence may interfere with tern nesting. In 2003, Mortensen reported that cormorants are now nesting on Little Pelican Island, Minnesota, and, in combination with Ring-billed Gull, appear to threaten future habitat availability to Common Terns. Monofilament grids were constructed at sites in Oneida Lake. New York, and Lake Mille Lacs, Minnesota to prevent nesting by gulls and cormorants (Adams and Richmond, pers. comm.). In general, impacts from Double-crested Cormorants will likely be minimal and site specific because Common Terns rarely nest at the same location as cormorants (Cuthbert et al. 2003).

Water Level and Climate Impacts

Water levels fluctuate in the Great Lakes within and between breeding seasons. Fluctuations are caused by natural variation in annual precipitation and by human activities (e.g. management for shipping; shoreline erosion control; climate change). Natural island nesting habitat has been eroded or inundated by high water levels at Ontario colonies (Morris and Hunter 1976a, Dunlop et al. 1991), Michigan colonies (Winterstein and Millenbah 1995, Scharf and Shugart 1998) and Minnesota (Lapp 1994, 1995, Cuthbert, unpubl. data.). Sandy and/or gravelly substrate, a frequent tern nest site component, is susceptible to storm generated wave washout (Dunlop et al. 1991, Penning and Cuthbert 1993). As a result, nesting habitat can be completely lost or significantly altered so that it is unsuitable as nesting substrate close to the waterline. Common Terns are most affected during years of above average lake levels because nests are more likely to be placed closer to the waterline and colony sites are more exposed during storms that generate large waves that may inundate small islands (Blokpoel and Scharf 1991). During the past several decades this situation has been exacerbated by the large Ring-billed Gull population that has forced Common Terns to use marginal habitat close to the water line (Blokpoel and Scharf 1991). An additional significant concern has emerged with recent studies on the impact of global climate change Great Lakes ecosystems (Kling et al. 2003). Climate change scenarios predict shorter winters, lower water levels, higher than average mean temperatures, shorter duration of ice cover and more frequent heavy rain in the Great Lakes region. Because Common Terns are one of the highest risk species in the Great Lakes, they are likely to be one of the first colonial waterbird species impacted by climate change. It is important for regional biologists to consider climate change and how it may affect Common Terns in the future. For example, a recent study (Becker et al. 1997) documented starvation of Common Tern fledglings during heat waves along the German North Sea coast.

Vegetation Encroachment

Terns establish nest sites during the early stages of succession (Palmer 1941), which may occur within a season or over several years. As plant growth progresses, terns may be forced to abandon nests (Harris and Matteson 1975a, Courtney and Blokpoel 1983, Matteson 1988, Shields and Townsend 1985). At colonies located on dredge sites in the Saint Mary's River, Michigan, plant succession may discourage terns from selecting these sites (Scharf 1981). Matteson (1988) reported that vegetation caused lower reproductive success and/or nest abandonment on Renard Isle in Green Bay, Wisconsin. At the Maumee River colony, Ohio, terns were physically unable to reach their nests as a result of seasonal grass growth in 1980 (Shields and Townsend 1985). Growth of sandbar willow forced terns to abandon nests at a Minnesota colony (McKearnan and Cuthbert 1989).

OVERUTILIZATION

No evidence exists to suggest there is any commercial harvest, recreational egging or similar direct removal of individuals or eggs from the Great Lakes Common Tern population during the breeding season. However, several investigators (Blokpoel et al 1982, van Halewyn and Norton 1984) reported semi-commercial netting of Common Terns at least along the coasts of Trinidad and Guyana during the winter. Periodically USFWS grants permits for collection of small numbers of eggs for contaminant studies. Occasional removal of small numbers of eggs should not affect the status of this population in any measurable way.

DISEASE OR PREDATION

A number of authors list predation as the primary limiting factor of tern reproductive success. Avian and mammalian predators are described most often, but depredation by invertebrates and reptiles has been documented (Palmer 1941, Nisbet and Welton 1984, Stricker 1995). Predators directly affect reproductive success by taking eggs and chicks and thereby reducing hatching and fledging success. In response to some predators (owls, herons, mink, *Mustela vison)* adult terns temporarily abandon the nest, leaving the eggs and chicks vulnerable to predation, temperature extremes, and starvation (Nisbet and Welton 1984, Shealer and Kress 1991, Burness and Morris 1993).

Avian predators include Great Horned Owls *(Bubo virginianus),* Black-crowned Night-Herons *(Nycticorax nycticorax),* and Ruddy Turnstones *(Areneria interpres).* Predation of 195 Common Tern chicks was attributed to at least one Great Homed Owl at a colony in Lake Superior, Wisconsin (Penning, pers. comm.). In Massachusetts, the deaths of 20 adults and 40 large chicks were attributed to Great Horned Owls (Nisbet and Welton 1984). Courtney and Blokpoel (1983) reported owls taking more than 100 chicks at a Lake Ontario colony in 1979. Evidence of owl predation was reported at the Port Terminal colony, Minnesota (McKearnan and Cuthbert 1989) and at colonies in the Saint Lawrence River (Karwowski et al. 1995). Nocturnal abandonment by nesting terns in response to Great Homed Owl flyovers is considered to be the primary reason for most nest failure in all years terns have been monitored (LaBarr 1995, LaBarr and Rimmer 1994, LaBarr, pers. comm.). Nocturnal foraging flights by Great Homed Owls over colonies in Lake Champlain, Vermont, often cause adult terns to desert the colony, leaving the nests unprotected overnight (Nisbet and Welton 1984, LaBarr 1995). Predation by Black-crowned Night-Herons has been reported or suggested at colonies in Lake Erie, Ontario (Hunter and Morris 1976), Lake Eric, Ohio (Shields and Townsend 1985), Lake Champlain (LaBarr, pers. comm.), and Presqu'ille Park, Ontario (Morris et al. 1980). Evidence of egg predation by Black-crowned Night-Herons was observed at a colony in Massachusetts (Nisbet and Welton 1984).

Other opportunistic avian predators include migrating Ruddy Turnstones. Parkes et al. (1971) first documented turnstones eating Common Tern eggs at Great Gull Island, New York. Eggs at Eastern Headland colonies, Lake Ontario, also have been destroyed by Ruddy Turnstones (Farraway et al. 1986, Dunlop et al. 1991, Morris et al. 1992). Stricker (1995) recorded egg depredation patterns that suggested turnstones (e.g., a jagged hole on the side of the egg about 1.5 cm in diameter). At the Leech Lake colony, Minnesota, at least 18 nests were destroyed by turnstones (Mortensen 1994). Turnstones have been recorded on Popasquash Island, Lake Champlain, and are suspected of taking eggs in some years (LaBarr, pers. comm.).

Palmer (194 1) reported that several species of gulls eat tern eggs and chicks. Courtney and Blokpoel (1983) observed Herring Gull *(Larus argentatus)* predation on Common Tern chicks at Port Colborne, Ontario. Gull predation on eggs and chicks was suggested as a major factor in the lowered reproductive success at a colony in Maine (Hatch 1970). Herring Gulls were observed taking tern chicks during the 1987 and 1988 breeding season (Morris et al. 1991), and Shields and Townsend (1985) reported aggressive behavior between juvenile Ring-billed Gulls and tern chicks. In 1988 and 1989, the presence of Ring-billed Gulls in the Port Colborne colony elicited panic flights by adults; subsequently, gulls fed on unattended eggs (Morris ct al. 1992). Other potential avian predators of tern eggs and chicks include American Crows *(Corvus brachyrhychos)* and Canada Geese *(Branta canadensis).* Crows have been observed at Lake Champlain tern colonies, but predation on eggs and chicks has not been confirmed (LaBarr 1995). Canada Geese ate tern eggs at a Lake Ontario colony (Courtney and Blokpoel 1980c, 1983). The authors suggest that egg depredation by geese is not uncommon at that colony.

Mammalian predation is also a significant factor limiting Common Tern reproductive success. At colonies on the Atlantic coast, Norway rats *(Rattus norvegicus)* ate eggs, chicks and adults (Palmer 1941). In 1977, Shugart and Scharf (1983) recorded a decline in nesting pairs after rats killed tern eggs and chicks in 2 Lake Michigan colonies in the previous year. At a Lake Erie tern colony in 1980, an almost 70% hatching failure was attributed to repeated visitations by a feral cat *(Felis catus)* during incubation (Shields and Townsend 1985). Mink were observed eating half-grown chicks (Courtney and Blokpoel 1983) at a Lake Ontario colony in 1981. A mink ate 20 eggs before it was destroyed at the Wisconsin Point colony in 1988 (Penning and Cuthbert 1990a). Based on track sign, Stricker (1995) suggested raccoon *(Procyon lotor)* predation as a major limiting factor on tern reproductive success at the Pipe Creek Wildlife Area colony, Ohio, in 1993 and 1994. At the Tower Island colony, Niagara River, Courtney and Blokpoel (1983) observed a number of dead half-grown chicks and suggested raccoons as the predator. Striped skunk *(Mephitis mephitis)* and red fox *(Vulpes vulpes)* are suspected of taking eggs and chicks at colonies in Lake Ontario, (Courtney and Blokpoel 1983), Lake Michigan (Shugart and Scharf 1983), Minnesota (McKearnan and Cuthbert 1989), and the Atlantic Coast (Palmer 1941).

Predation on terns by garter snakes *(Thamnophis sirtalis)* has been recorded at New England colonies (Lyon 1927, Floyd 1929, Lazell and Nisbet 1972) and in northern Lake Michigan (Cuthbert, unpubl. data). In 1993 and 1994, Stricker (1995) found evidence of fox snake *(Elaphe vulpina)* predation on tern eggs at Pipe Creek Wildlife Area, Ohio.

Ants have been reported to enter pipping eggs or predate upon newly hatched chicks in unprotected nests (Austin, Jr. 1932). Both pipping eggs and chicks have been killed by tiny thief ants (Solenopsis molesta) at Vermont's Popasquash Island colony (LaBarr 1995). Newly hatched chicks in unattended nests were killed and/or blinded by ants *(Lasius neoniger)* at a Massachusetts tern colony (Nisbet and Townsend 1985). In 1980, pipping eggs and newly hatched chicks were killed by ants at the High Island colony, Lake Michigan (Cuthbert, unpubl. data). Many ant predation reports coincide with predation by owls and the subsequent nocturnal desertion (Austin, Jr. 1932, Nisbet 1972). Nisbet and Welton (1984) suggest that brooding adults are generally able to keep ants out of their pipping eggs, but nocturnal desertion allows ants access to eggs for enough time to kill or blind chicks.

INADEQUACY OF EXISTING REGULATORY MECHANISMS

Common Terns appear to be adequately protected from direct human kill or injury under existing regulatory mechanisms. These are as follows: Common Terns are Federally protected in the United States under the Migratory Bird Treaty Act, and in Canada, under the Migratory Bird Convention Act (Blokpoel and Scharf 1991). In the Great Lakes region, 4 states (Ohio, Illinois, Wisconsin and Vermont) designate the Common Tern as endangered, 3 states (Michigan, Minnesota, New York) assign the species to threatened status, Pennsylvania lists the tern as extirpated, and Indiana does not designate any protective status other than that provided by federal law. The Committee on Status of Endangered Wildlife in Canada (COSEWIC) has designated the Common Tern as a species “not at risk.”

Habitat loss and degradation are less effectively prevented by existing state and Federal regulations. State and Federal resources for habitat acquisition, easement or other direct protection are very limited. High quality undisturbed breeding, roosting, feeding, migration and wintering habitats are all diminishing.

In 1995, the U.S. Fish and Wildlife Service identified the Great Lakes population of the Common Tern as one of approximately 120 migratory nongame bird species of management concern in the U.S. (USFWS 1995). As such, it receives priority conservation attention by the agency. This species/population was a Category 2 candidate for review for possible proposed addition to the Federal endangered or threatened species list (USFWS 1991) until use of the Category 2 list was discontinued in 1996 (USFWS 1996).

OTHER NATURAL OR HUMAN INFLUENCED FACTORS

Human Disturbance

Human disturbance may adversely affect Common Tern nesting success (Palmer 1941, Spear 1970, Harris and Matteson 1975a, LaBarr 1995). Activities that may disturb terns include recreation in or near colonies, site development, and vandalism. Birders and photographers also are potentially damaging to tern reproductive success. Their presence may keep brooding adults off nests, exposing the eggs or chicks to thermal stress and/or opportunistic predators (Courtney and Blokpoel 1983, Burger and Gochfeld 1991). Any human disturbance in Common Tern colonies when Ruddy Turnstones are present is likely to cause egg loss because turnstones will eat eggs when adults are flushed from the nest (Cuthbert unpubl. data). Matteson and Strand reported that recreation occurring near or on nesting areas reduces tern reproductive success (Matteson 1988). Chronic human disturbance (people and dogs walking through colony) at the Eastern Headland colony, Lake Ontario, is believed to be at least a partial reason for the declining tern population at that site (Morris et al. 1992). More than 500 nesting pairs used the Cedar Beach colony, New Jersey, in 1977. Later in the breeding season, a sewer pipeline was put through the center of the colony. No birds returned to the site in 1978 (Burger and Gochfeld 1991). A breeding site was abandoned for 4 years after vandals set fire to grasslands within a colony at Breezy Point, New York (Burger and Gochfeld 1991). Harassment of nesting terns and vandalism of colonies terminated management efforts in the colony on Hearding Island, Minnesota, in 1989 (Penning 1993, Penning, pers. comm.)

Contaminants

Contaminants, such as organochlorines, heavy metals, and other chemical compounds, have been implicated as factors reducing reproductive success of Common Terns (Faber and Hickey 1973, Cooke 1973, Connors et al. 1975, Fox 1976, Matteson 1988, Harris et al. 1985, Tillitt et al. 1991, Best et al. 1992, 1995, Burger and Gochfeld 2003). Contaminants can effect avian reproduction in a number of ways: reduced hatching success (due to infertility, embryonic defects, embryonic failure, change in egg-shell chemistry and structure) and higher chick mortality due to physical deformities and biochemical anomalies and lowered parental attentiveness (Fox 1976, Tillitt et al. 1992).

High concentrations of DDE and PCBs were reported in eggs from the Great Lakes during the 1970s (Gilbertson and Reynolds 1972, Fox 1976, Morris et al. 1976). Fox (1976) found that dented tern eggs had higher mean PCB levels (6.77 ppm) than non-dented eggs (3.42 ppm). He suggested organochlorines produce egg shell thinning and structural abnormalities that ultimately result in reduced hatching success. Gilbertson et al. (1976) reported that Common Tern eggs had the lowest recorded PCB residue levels of 5 species surveyed from the Lower Great Lakes, but the highest rate of chick deformities. Common Tern eggs obtained from colonies in the Canadian Great Lakes showed relatively high levels of organochlorines that coincided with a high incidence of chick mortality and lower reproductive success (Weseloh and Braune 1989).

Common Terns may be exposed to various chemical contaminants on their wintering grounds, migration routes, or breeding sites. Based on birds banded on the Ontario Great Lakes, terns winter in South America, Central America, and southern Florida (Haymes and Blokpoel 1978a, Blokpoel et al. 1987). Weseloh et al. (1989) suggested that the Peruvian wintering grounds are probably not a major source of contaminants because this country is not a major user of organochlorine pesticides. In contrast, Brazil, Argentina, Colombia, and Mexico apply large amounts of pesticides (these countries account for 90% of all pesticide use in Central and South America) and Common Terns may be exposed to contaminants if they winter in these areas (Weseloh et al. 1989). Fox (1976) reported a low concentration of mean DDE (0.02 ppm) in Common Tern food fish during the summer and assumed the bioaccumulation of DDE occurred on the wintering grounds.

Common Terns appear to migrate along the Atlantic coast and acquisition of organochlorine chemicals in eggs of Atlantic coast waterbirds has been related to local contamination, not to contamination occurring in the migration routes or wintering grounds (Nisbet and Welton 1984). A significant increase in chemical contaminants (dieldrin, HCB, PCB, and DDE) correlated with length of time spent on the Great Lakes after arrival from the wintering grounds (Gilbertson 1974), thereby lending support to the concept of local contamination occurring in the breeding area (Weseloh et al. 1989).

In the Great Lakes region, several investigators (Gilbertson and Fox 1977, Kurita et al. 1987, Kubiak et al. 1989) suggested that local sources of chemical contaminants have contributed to reproductive problems in fish-eating waterbirds. Many tern colonies can be found on confined disposal facilities (Scharf 1981, Matteson 1988, Penning and Cuthbert 1993, Winterstein and Millenbah 1995, Moore et al. 1995), that are receptacles for polluted dredge sediments from lakes and rivers (Best et al. 1992, Moore et al. 1995). Terns also select colony sites in highly industrialized areas and on human structures (Scharf 1981, Moore et al. 1995). These areas are susceptible to environmental contamination from industry and development. Tern colonies in Canada's Hamilton Harbor are near the country's largest steel industries (Weseloh et al. 1995). Heavy metals, polychlorinated biphenyls, phenolics, and nutrients are found in the harbor sediments (Weseloh et al. 1995). Using a H411E bioassay, Tillett et al. (1991) reported that the highest concentrations of tetrochlorodibenzo-p-dioxin equivalents (TCDD-EQ) were found in Double-crested Cormorant and Caspian Tern eggs from several Great Lake colonies associated with urban or industrialized areas and that these colonies had a significant amount of reproductive impairment. While TCDD-EQ levels in waterbird eggs from more remote, non-urban areas in the Great Lakes were less than levels in eggs from the industrialized areas, they were still higher than normal background levels. Based on these results, the authors suggest that organic chemicals continue to enter the

Great Lakes system via atmospheric deposition (Eisenreich and Looney 1981, Tillett et al. 1991).

In summary, numerous studies reported high levels of toxic chemicals in the late 1960's and early 1970's (e.g. Gilbertson and Reynolds 1972, Fox 1976). To determine if contaminant residues had declined, increased, or stabilized in Great Lakes Common Terns, a collaborative study was carried out in 1981 (Weseloh et al. 1989). Analysis of tern eggs showed contaminant levels declined 80-90% between the early 1970's and 1981. This decline occurred following legislative action to control specific contaminant levels. It is not clear how much of a factor toxic chemicals now play in the population dynamics of this species. Common Terns are declining in the 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 (Neuman and Blokpoel 1997). See Nisbet 2002 for a more recent and extensive review of Common Terns and contaminants.

MANAGEMENT

Considering the size of the Great Lakes region, the number of jurisdictional units, and the number and remoteness of colony sites, the knowledge of Common Tern biology, population threats and status at many colonies is extensive. Dozens of dedicated biologists have spent decades studying terns in this region. They have also developed creative and successful methodology for enhancing and protecting selected colony sites and state/provincial populations. Despite documented declines in many states and in Ontario, the most recent coordinated binational efforts indicate approximately 8,500-11,000 breeding pairs nested in the Great Lakes region during the last decade of the 1900s. Without the efforts of many people working independently or in small groups at many locations, this number would likely be significantly below the recent estimate. The knowledge and technology is available to successfully manage most declining colonies although staff time and funding are increasingly limited throughout the region.

Common threats impacting terns in most of the states and Ontario have resulted in extensive knowledge and tested methodology to enhance colony productivity and protection in the Great Lakes. These include: habitat management (including habitat restoration, enhancement, or creation), predator control, eliminating or minimizing competition for nest sites, and prevention of human disturbance.

HABITAT IMPROVEMENT

<u>Shelters</u>

Terns tend to select nest sites with some topographical relief such as vegetation, sticks, small logs, or rocks (Blokpoel et al. 1978). These features probably provide chicks with shade and refuge from predators. In nesting areas with little or no topographical relief, human constructed shelters provide protection from predators. At the Lake Champlain, Vermont, colonies, the use of wood and rock chick shelters were very successful in increasing Common Tern productivity (LaBarr 1995, LaBarr, pers. comm.). Shelters were placed on a nesting raft near an Eastern Headland colony, Lake Ontario; one pair nested and raised two chicks at this site (Burness and Morris 1992).

Reconstruction of Nesting Substrate

High lake levels and storm wash over can remove suitable nesting substrate (Dunlop et al. 199 1, Morris et al. 1992) Nest sites can be rehabilitated by restructuring the substrate with gravel, sand blankets, small rocks, logs, driftwood, and low growing plants. In 1987 and 1988, original substrate was removed from the Port Colborne colony, Lake Erie, by flooding, wind and rain. After the 1988 breeding season, the substrate was replaced with a mix of large rocks, small rocks, gravel, and natural debris. Mossy stonecrop *(Sedum acre)* was replanted at random intervals. The following breeding season, Morris et al. (1992) reported terns nesting at this site in numbers similar to years prior to habitat destruction and rehabilitation. Prior to the 1995 breeding season at the Leech Lake colony, Minnesota, fiber matting and pea gravel nesting substrate were installed to reduce colony site maintenance (in the form of vegetation removal) and to provide the terns with a more open nesting area (Mortensen 1995). At the Mille Lacs Lake, Minnesota, colony, gravel was used to fill in crevices among large boulders that had caused tern chick mortality.

Vegetation Encroachment

Vegetation encroachment on nest sites can be prevented by physical or chemical removal of vegetation to maintain open conditions suitable for Common Terns (ODNR 1992, Matteson 1988, Parnell et al. 1988, Morris et al. 1992, Penning 1993). In 1982, all vegetation was removed from the Little Tern Island colony, Ontario, and 218 pairs nested at this site. In subsequent years no vegetation removal efforts occurred and the number of nests declined to four in 1986 (Morris et al. 1992). Between 1980 and 1989, both hand tools and herbicide applications were used to remove vegetation at the Ashland Pier colony, Wisconsin. In response to vegetation removal, terns nested in all of the newly available habitat and the number of nesting pairs increased from 52 in 1980 to 176 in 1989 (Matteson et al. 1990). Until fiber matting was installed at the Little Pelican Island colony, Minnesota, management efforts included cutting, burning, and tilling vegetation at the colony site to maintain open habitat for breeding terns (Mortensen 1994). Cook-Haley and Millenbah (2002) studied the impacts of vegetation manipulations on Common Tern nest success on Lime Island, St. Marys River, Michigan. Their work indicates that although terns appear to select sites with 10-30% standing cover and > 65% litter, nests at these sites had lower success than those in about 40% vegetation cover and 50% litter cover. Cook-Haley and Millenbah suggest that investigators should not disregard the importance of areas that typically support fewer nests in greater amounts of standing vegetation when evaluating nest success of Common Terns.

Artificial Nest Sites

Gull competition for nest sites, predator accessibility and vegetation succession reduce the quality and amount of Common Tern breeding habitat (Stricker 1995, Dunlop et al. 1991, McKearnan and Cuthbert 1989, Matteson 1988). These losses have been mitigated by creating new sites (Parnell et al. 1988, Matteson 1988, Dunlop et al. 1991, Karwowski et al. 1995, Quinn et al. 1996).

Dredged-material islands created from shipping channel and harbor maintenance provide suitable nesting sites (Parnell et al. 1988, ODNR 1991). The presence of dredge-spoil islands contributed to a stable population of terns in the 1970s in Lake Michigan (Shugart and Scharf 1983). Dredge islands in western Lake Erie provided colony sites in 1937, 1939 and in the 1960s (ODNR 1991). Termination of dredge-spoil deposition usually leads to vegetation succession and a lower number of nesting birds (Scharf 1981). Most dredge-spoil islands must be managed for vegetation succession. All vegetation was removed from Interstate Island, St. Louis River estuary early in 1989; terns nested on the island in 1989 and 1990 (Penning and Cuthbert 1993). Many dredge sites are located in harbors adjacent to the mainland. Birds using these sites may be vulnerable to contaminant exposure either through direct contact with substrate dredged from harbors containing high levels of toxic waste or indirectly through their prey.

Other artificial structures that provide alternatives to natural breeding sites are navigational aids located in the U.S. waters of the St. Lawrence River (Smith et al. 1984, Karwowski et al. 1995). Egg predation, nest abandonment, flooding, and chick mortality were all lower on the navigational aids relative to natural breeding sites (Karwowski et al. 1995). In 1984, productivity on artificial sites was at least 1.69 chicks fledged per nest with eggs. In contrast, productivity on the natural sites in the same year was 0. 11 or fewer chicks fledged per nest with eggs (Karwowski et al. 1995).

Nesting boxes, nest rafts and nesting platforms have been placed on or near traditional tern colony sites (Dunlop et al. 199 1, Morris et al. 1992, Penning and Cuthbert 1993, Winterstein and Millenbah 1995, Stricker 1995, Quinn et al. 1996) to expand nest site options for breeding terns. In 1989, nest boxes were placed in the Wisconsin Point colony, St. Louis River estuary to raise nest sites above the storm wave wash over zone. Boxes and the nests they contained were destroyed during storms, demonstrating that this management strategy is not effective at sites exposed to severe wave action (Penning and Cuthbert 1990a,b, Penning and Cuthbert 1993). In 1990, nest rafts containing a sand, gravel, and driftwood substrate were placed at the Eastern Headland, Lake Ontario. Chick shelters, tern decoys, and ramps were also installed. Rafts were installed after Ring-billed Gulls initiated nesting and during the arrival of Common Terns into the area. Some nests were destroyed by storm wash over, but fledging success on four rafts was 1.3 per nest (Dunlop et al. 1991). Winterstein and Millenbah (1995) installed two nesting platforms near Duck Island, Saginaw Bay, Michigan, in 1995. Platforms were not used as nest sites because they were beached after severe storms (Winterstein and Millenbah 1995). Floating island platforms were installed in lower Green Bay in 1994-1996, but terns did not successfully nest on these platforms (Matteson, pers. comm.).

<u>Colony Site Attraction</u>

In the 1980s, tern decoys and taped tern vocalizations were used to attract Common Terns to new colony sites at Barker's, Interstate, and Hearding islands, to the Washburn Dock islet, a new artificial island site in Chequamegan Bay, and to Wisconsin Point in Allouez Bay (Matteson 1988, Penning and Cuthbert 1993, Strand, pers, comm.). Terns appeared to select nest sites near the tern decoys at Presqu'ille Provincial Park, Ontario, in 1994 (Teeuw 1994).

Habitat Protection

Preservation of breeding habitat has been achieved through land protection by state and Federal governments and nongovernmental organizations (Appendix 2). A recent study (Wires and Cuthbert 2001) evaluated historic and current Common Tern colony sites in the Great Lakes region for protection. Additionally, 6 categories of land ownership were identified for 45 sites prioritized for conservation. These categories include: federal, state, municipal, non-governmental organizations, private and unknown. Of these sites, 29% are located on private land. About 25% of sites are under federal ownership; most federal sites were on national wildlife refuges. Another 25% of high priority Common Tern colony sites are on lands owned by NGOs. Approximately 16% are on state lands and 2% occur on municipal lands. Unknown ownership was reported for 4% of the sites. Several examples in Minnesota include the purchase of Pine and Curry islands (Lake of the Woods) by the Minnesota Chapter of the Nature Conservancy and MN DNR to protect nesting Piping Plovers *(Charadrius melodus)* and Common Terns. The land, formerly under private ownership, is managed by MN DNR's Scientific and Natural Areas Program. The only productive colony in the Duluth Harbor, Interstate Island, was held in divided ownership until 1983. Following lengthy negotiations easements were obtained from the corporations and the island is now cooperatively managed by Wisconsin and Minnesota (Penning and Cuthbert 1993). This agreement has been essential for effective management of this important site.

PREDATOR CONTROL

Removal

Elimination of predators has been carried out at a number of Common Tern colonies to increase productivity. All of the removal programs have been conducted under appropriate state and federal permits. Most of these efforts are site- and predator-specific. For example, at a Lake Superior colony, leg-hold traps were used to remove mink before they could destroy tern nests (Penning and Cuthbert 1993). Great Homed Owls and Ruddy Turnstones have been removed from sites when predation was documented. Research by Guillemette and Brousseau (2001) recently studied if culling predatory gulls enhanced productivity of breeding common terns in Carleton, Quebec, Canada. They tested the effectiveness of removing individual predatory gulls (Herring Gulls, Great Black-backed Gulls (*Larus marinus*)) as a management technique. They found that only a few individuals specialized on Common Terns and removal of these birds significantly reduced or eliminated loss of tern eggs and chicks.

Barriers

Electric fences can be used to discourage mammalian predators from entering colonies (Penning and Cuthbert 1993, Herkert pers. comm.). Fences were placed around the Wisconsin Point colony, Lake Superior in 1988. The fence prevented domestic dogs from entering the colony but a mink was able to gain access because the fence did not extend over water (Penning and Cuthbert 1993).

EXCLUSION OF RING-BILLED GULLS

Nest site encroachment by gulls reduces the availability of optimal breeding habitat for Common Terns (Blokpoel and Scharf 1991, Maxson et al. 1996). Several management strategies can be employed to reduce the number of nesting Ring-billed Gulls including: 1) active disturbance 2) structures that physically exclude gulls, 3) destruction of nests or eggs (Blokpoel and Tessier 1986, 1987, Matteson 1988, Moore et al. 1995, Maxson et al. 1996) and 4) direct killing of adult gulls. Research by Blokpoel et al. (1997) on restoration of the Ice Island, Ontario, colony suggests on-going gull control is required to maintain Common Tent colonies once they are occupied by nesting Ring-billed Gulls.

Shell crackers, propane-fired cannons, human disturbance (by entering gull colony), bird-scaring reflective tape, playback of loud noises, Great Homed Owl decoys, and tethered birds of prey have been used as deterrents to nesting Ring-billed Gulls (Blokpoel and Tessier 1987, Parnell et al. 1988, Penning 1990, Matteson 1988, ODNR 1989-1992**,** 1995**,** Andress, pers. comm.). Physical exclusion of gulls has been accomplished by using monofilament lines attached to metal wires supported by T bars and spaced 60 cm apart at Lake Ontario colonies (Blokpoel and Tessier 1987, Moore et al. 1995). String deterrents have also been used successfully at Lake of the Woods, (Maxson and Haws 1995) and Mille Lacs Lake (Lapp 1994,1995), Minnesota. Maxson et al. (1996) found success of gull physical exclusion deterrents (bright-colored nylon string, wire, monofilament) was related to gull colony size and nest density, available nesting space, gull breeding history and colony species composition. The authors reported that elevated bright colored nylon string, arranged in a linear pattern with a spacing of up to 2 in, was effective only at new or small colonies with no prior history of successful breeding. At large gull colonies with a history of successful breeding the string was effective only if it was installed in a grid pattern and some gulls were removed (Maxson et al. 1996).

The destruction of eggs and nests requires federal and state permits. It has been used as a gull control strategy at Oneida Lake (Adams, pers. comm.), lakes Ontario and Lake Eric (Blokpoel and Tessier 1987, Morris et al. 1980, ODNR 1989, Morris et al. 1992, Moore et al. 1995), Lake Michigan (Cuthbert, unpubl. data, St. Louis Rivet Estuary (Goodermote 1994), Lake Champlain (LaBarr 1995, LaBarr and Rimmer 1995), Lake Superior (Penning and Cuthbert 1993), and LOTW (Maxson and Haws 1994, 1995).

CONTROL OF HUMAN DISTURBANCE

Human activities carried out in or near nesting habitat at the onset of the breeding season (May - June) may cause terns to avoid the site, effectively displacing them from prime nesting sites and potentially forcing them to select less suitable sites. After the nesting cycle has started, human disturbance may cause adults to temporarily abandon the nest, leaving the eggs or chicks exposed to temperature extremes and/or opportunistic predators (Courtney and Blokpoel 1983, Matteson 1988). Additionally, nests can be physically destroyed if stepped on or driven over by off-road vehicles in the nesting area. Management strategies to control human activities within tern colonies include: 1) closing the area to recreation 2) posting signs to discourage people from entering the colony, and 3) educating the public on Common Tern natural history and habitat requirements (ODNR 1989-1992, Morris et al. 1992, LaBarr 1995). The Gull Point Natural Area, Pennsylvania, was closed to the public in 1994 and the first Common Tern nest in 30 years was observed at Presque Isle State Park in 1995 (Gormley, pers. comm.; Stull, pers. comm.). Signs were installed at the Eastern Headland colony, Lake Ontario, in 1980, 1983, and 1985, and at the Ashland Pier colony, Lake Superior (Morris et al. 1992, Strand, pers. comm.). Vandalism and continued disturbance by people and dogs indicate that signs are not extremely effective (Morris et al. 1992). Signs stating "Do Not Enter", "Closed Area" or "Unlawful to Enter" appear more effective than those that asked for cooperation (e.g. "Please Do Not Disturb Birds) (Cuthbert, unpubl. data). Public education concerning the Lake Champlain tern population in Vermont is conveyed through conversations with recreationists, media articles, informational posters and slide lectures (LaBarr and Rimmer 1995). The educational effort is considered to be a significant contribution in the recent increase in Common Tern productivity (LaBarr and Rimmer 1995). An educational pamphlet stressing the detrimental effects of colony disturbance is available from the Minnesota Department of Natural Resources.

RESEARCH AND MONITORING NEEDS

Long-term survival of the Common Tern in the Great Lakes region requires monitoring, intensive management, communication and conservation. The following information and programs are recommended to facilitate this effort. Note: these recommendations were presented in the initial draft of this status assessment. Much progress has been made towards addressing these needs and updates are provided.

1. A reliable, frequent, coordinated international census of Common Terns is needed for major breeding sites (at a minimum) in the Great Lakes region. To reduce cost and time invested, this can be done in conjunction with the decadal multispecies surveys conducted by USFWS and CWS but one survey/decade will not provide accurate population trends (Steinkamp et al. 2002) Because many states monitor breeding activities of Common Terns annually (due to their special status) it is a reasonable goal to increase frequency of breeding pair estimates for the region. An initial effort to address this issue is described in a recent report by Cuthbert and Wires (2003) summarizing a workshop held in 2002 to develop a long-term binational monitoring plan for colonial waterbirds in the Great Lakes.

2. Identification of a network of important breeding sites (see Blokpoel and Scharf 1991, p. 32) in the Great Lakes region is an important step in establishing an annual monitoring effort at a scale that is economically feasible and biologically meaningful. Under this plan, only large, traditional (or otherwise important) colonies would be censused each year. As part of this evaluation, more complete information is needed on ownership and management plans associated with important sites used by Common Terns. Initial work on prioritizing additional sites and obtaining information on land ownership was completed by Wires and Cuthbert (2001). See http://www.waterbirds.umn.edu.

3. Information is needed on important colonies in need of special attention. Special needs may include land protection, serious problems with low productivity, and human disturbance. Vulnerable colony sites or regions should be identified for intensive management. Initial work was conducted by Wires and Cuthbert (2001). See http://www.waterbirds.umn.edu.

4. State and provincial governments need to be advised of the importance of consistent monitoring, protection and management of Common Tern colonies on an international scale. This will be especially effective if done in a multispecies or ecosystem context. There is much evidence that Common Terns respond well to a diversity of management strategies. Efforts by multiple individuals throughout the Great Lakes basin and connecting waters have in many cases protected local populations from even more serious declines than those already documented. Currently, the Waterbird Monitoring Partnership of the North American Waterbird Conservation Plan (NAWCP) is undertaking a large scale, inclusive effort to coordinate waterbird monitoring activities throughout North America (Kushlan et al. 2002). This effort involves Federal, state and provincial agencies and provides an important communication route and endorsement for continued conservation efforts on Common Terns. Additionally, USFWS has contracted with the University of Minnesota to prepare a plan for conservation of waterbirds in the Upper Mississippi Valley/Great Lakes Region. This regional report will include Common Terns.

5. Uniform methods for collecting and reporting data on population numbers and reproductive success are needed to make inter-state/province comparisons more useful (e.g. Erwin and Custer 1982). A draft document describing breeding season census techniques for seabirds and colonial waterbirds throughout North America has recently been prepared (Steinkamp et al. 2002).

6. Extensive information on methodology for enhancing Common Tern survival and reproductive success is available in the published literature and in unpublished reports. Collation of this material into a field manual of Common Tern management guidelines is desirable. Investigators need to continue to fine tune management strategies, especially Ring-billed Gull management and rapid detection and response to predators in breeding colonies. Reference national

effort. A recent tern management plan for northeastern U.S. and Atlantic Canada was prepared by Kress and Hall (2000) and this document provides extensive information on methods for Common Tern management and conservation that are applicable to the Great Lakes population.

7. This report has identified lack of clarity in the boundaries of the Great Lakes population. Surveys have traditionally included colonies within 1 km of Great Lakes and connecting waters shoreline. Banding data indicate the biological population is larger than the Great Lakes. Important questions to answer include: what are the biological boundaries? This is best answered through analysis of band recovery data. This analysis will help answer the following questions: Does management need to follow these boundaries? Is the Great Lakes population biologically separate from other Common Terns in North America? What is important from a conservation and management perspective? This study was recently completed by Cuthbert and Wires (2002) and can be obtained at http://www.waterbirds.umn.edu.

8. Since the original draft report was prepared for this status assessment, global climate change has emerged as an important potential influence on Great Lakes ecosystems. Many predictions for the Great Lakes region have potentially significant consequences for Common Terns (e.g. lower water, less ice cover, higher temperatures). The potential impact of climate change needs to be examined and incorporated into regional plans for this species.

9. Contaminants are important in specific regions of the Great Lakes. Common Tern biologists and contaminant scientists often work independently. Field workers need to recognize the potentially important role contaminants may play in survival and reproductive success at individual colonies and include an evaluation of this threat in any conservation plan.

10. As with most migratory species, very little information is available on migration or winter ecology and conservation needs. To develop a comprehensive conservation plan for the Great Lakes population of Common Terns, more information is needed on where and how they spend 75% of their year and the status of wintering habitat.

11. A recent publication (Becker and Wendeln 1997) describes the uses of transponders to study the population ecology of Common Terns in Europe. Transponders were injected subcutaneously to mark single Common Tern adults and all chicks at a colony site in Germany with the goal of completely marking an entire colony of terns for long-term research. This method microtags terns for life and birds can be located at their nest and also at resting placed using a fixed antenna system. This approach appears useful for region wide studies on Common Terns in the Great Lakes and warrants further investigation.

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Table 1. Common Tern Breeding Pair Estimates in the Great Lakes (U.S. and Canada) by State/Province (1977-1998). Estimates from Cuthbert et al. 2003 and Pekarik (1998).

UNIT	1977 PAIRS	1977 COLONIES	1989/90 PAIRS	1989/90 COLONIES	1997 PAIRS	1997/98 COLONIES
Illinois	0	0	46	1	13	2
Indiana	0	0	0	0	0	0
Michigan	1390	26	1577	20	1221	7
Minnesota[a]	191	2	81	1	208	1
New York[b]	523	4	1409	25	1577	38
NewYork[c]+	NC	NC	NC	NC	346	3
Ohio	263	1	63	2	119	2
Pennsylvania	0	0	0	0	0	0
Vermont[d]	NC		NC		166	2
Wisconsin[e]	130	4	263	2	183	3
Ontario	NC	NC	6626	73	4038	41
TOTAL[f]			10,065	124	7359	94

NC: Not Censused

[a] Does not include inland Minnesota colonies at Leech Lake, Lake of the Woods, Mille Lacs Lake.

[b] Estimate for New York includes terns nesting on St. Lawrence River.

[c] These estimates include interior colonies on Oneida Lake; these estimates are not included in the Great Lakes total.

[d] Estimates for VT are for 2 colonies in Lake Champlain. These terms are not included in the Great Lakes total.

[e] Estimates for WI do not include terns nesting at interior sites in the Lake Winnebago region.

[f] Total estimate is for the Great Lakes (within 1 km of shoreline) and does not include interior colony sites.

Table 2. Common Tern Breeding Pair Estimates in the Great Lakes (U.S. and Canada) by Water Body (1977-1998). Estimates from Cuthbert et al. (2003) and Pekarik (1998).

WATER BODY	1977 PAIRS	1977 COLONIES	1989/90 PAIRS	1989/90 COLONIES	1997/98 PAIRS	1997/98 COLONIES
Lake Superior	328	5	282	3	316	2
St. Marys River	246	5	344	9	628	1
Lake Michigan	753	13	1054	9	437	8
Lake Huron	364	8	4499	60	2577	20
Lake St. Clair	0	0	55	1	0	0
Detroit River	20	1	0	0	4	1
Lake Erie	263	1	1779	7	1436	5
Niagara River	518	3	160	3	126	5
Lake Ontario	5	1	1226	8	1056	18
St. Lawrence River	NC	NC	666	24	779	34
Oneida Lake[a]	NC	NC	NC	NC	346	3
Lake Champlain[b]	NC	NC	NC	NC	166	2
TOTAL[c]			10,065	124	7359	94

NC: Not Censused

[a] Estimate for Oneida Lake not included in Great Lakes total.

[b] Estimate for Lake Champlain not included in Great Lakes total

[c] Does not include estimates from Oneida Lake or Lake Champlain

Table 3. Comparison of First and Current (1997/98) Estimates of State/Provincial and Regional Population Sizes of Common Terns in the Great Lakes Region (US & Canada).

	First Estimate			Current Estimate			Trend
	Pairs	Year	Source	Pairs	Year	Source	
Great Lakes Population	10,065	1989/90	Pekarik 1998; Cuthbert et al. 2003	7,359[a] 8,196[b]	1997/98	Pekarik 1998; Cuthbert et al. 2003	Decline
U.S. Great Lakes	> 6000	1930-40	Ludwig 1962	3321	1997	Cuthbert et al. 2003	Decline
Ontario	7366	1980	Courtney & Blokpoel 1983	4038	1998	Pekarik 1998	Decline
Illinois	“small:	1934	Bohlen 1989	13	1997	Cuthbert et al. 2003	No Change
Indiana	1	1935	Mumford & Keller 1984	0	1997	Cuthbert et al. 2003	No Change
Michigan	2092	1976	Shugart & Scharf 1983	1221	1997	Cuthbert et al. 2003	Decline
Minnesota	2600	1930s	McKearnan & Cuthbert 1989	503[c]	1997	Cuthbert et al. 2003	Decline
New York	3200	1960s	Bull 1974;Smith et al. 1984	1923[d]	1997	Cuthbert et al. 2003	Decline
Ohio	2000-7000	1939	Peterjohn 1989	119	1997	Cuthbert et al. 2003	Decline
Pennsylvania	25	1927	Todd 1940	0	1997	Cuthbert et al. 2003	Decline
Vermont	15-20	1953	LaBarr 1995	166	1997	Cuthbert et al. 2003	Increase
Wisconsin	1000	1960s	Matteson 1988	208[e]	1997	Cuthbert et al. 2003	Decline

[a] Estimate includes Common Tern pair < 1 km Great Lakes shoreline.
[b] Estimate includes Great Lakes terns plus estimates for interior MN, WI, VT, and NY.
[c] Estimate includes Lake Superior terns plus interior lake birds.
[d] Estimate includes Great Lakes, St. Lawrence River plus Oneida Lake terns.
[e] Estimate includes Great Lakes terns plus interior birds.

Figure 1. Common Tern Subpopulation Estimates for the Great Lakes Region (US & Canada)1997/98. PE = population estimates/number of colonies. Sources are Pekarik (1998); Cuthbert et al. (2003).

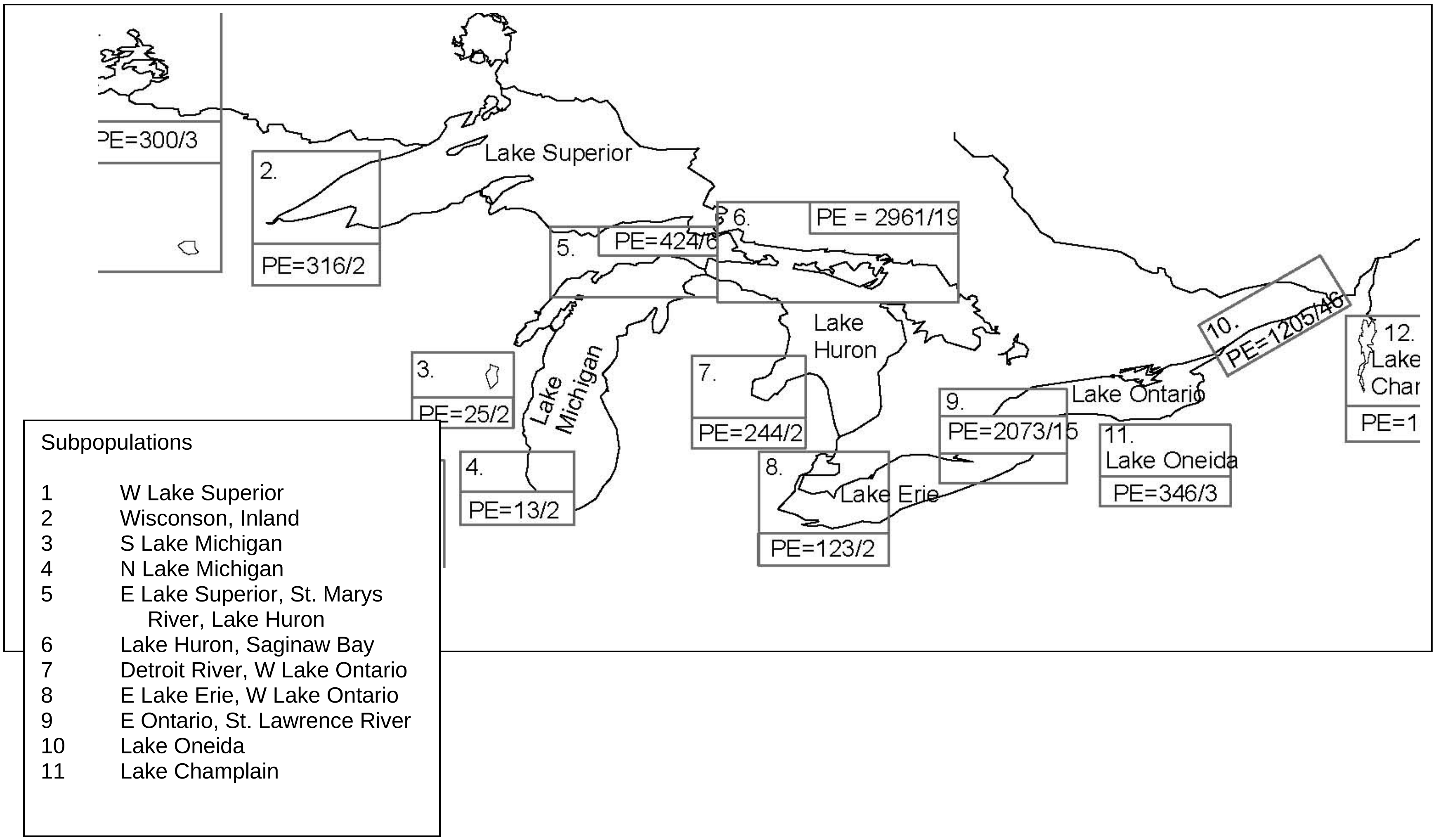


Figure 2. Distribution of Common Tern Colony Sites in the U.S. Eastern Great Lakes, 1977-2001.

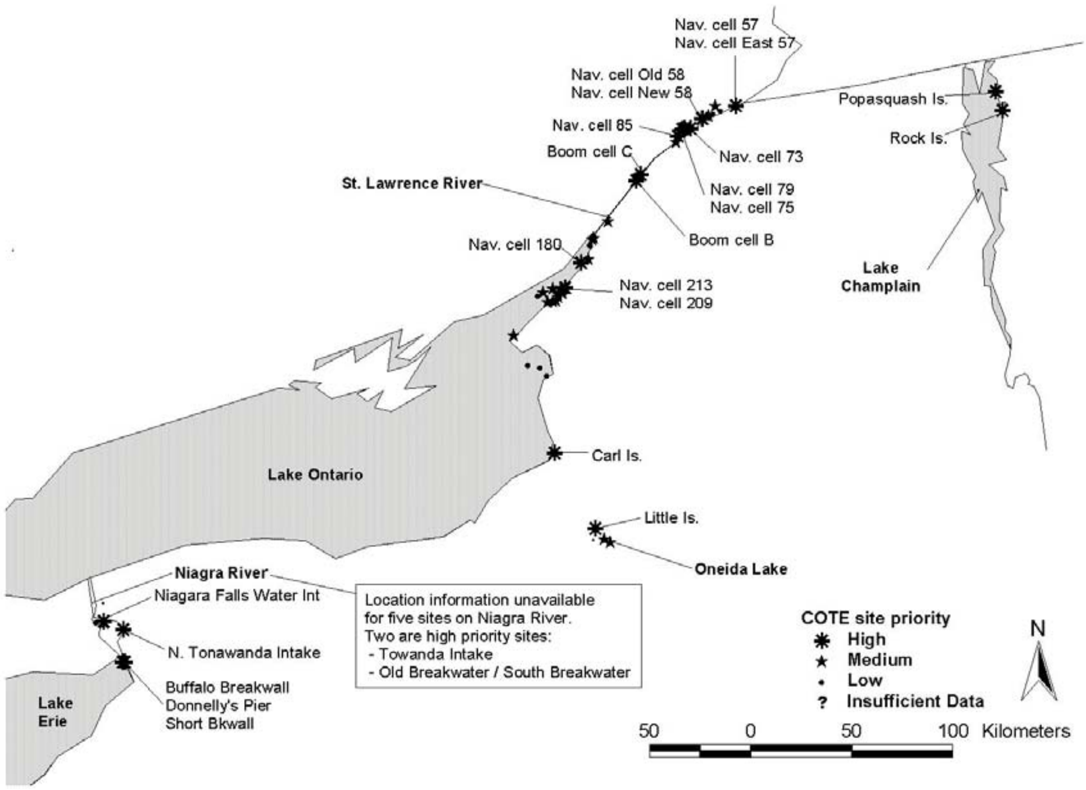
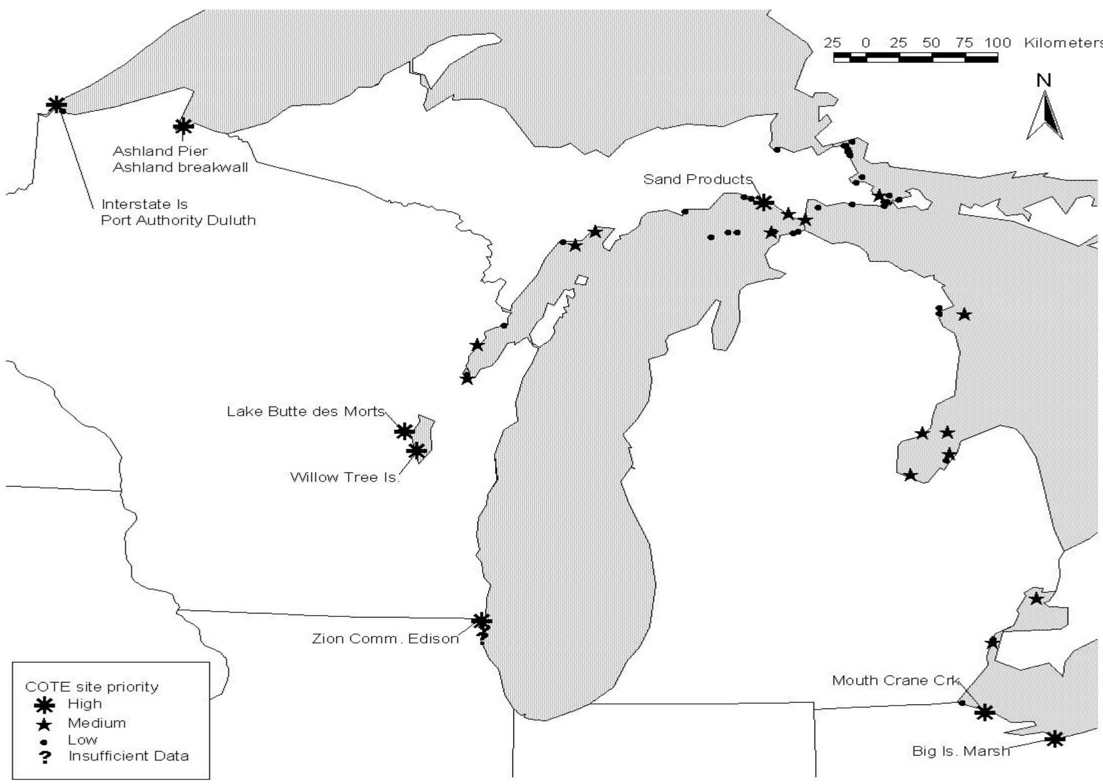


Figure 3. Distribution of Common Tern Colony Sites in the U.S. Western Great Lakes, 1977-2001.



Appendix 1. Known Common Tern Colony Sites in the U.S. Great Lakes 1977-1997.

Site name	Lake	State	Lat	Long	1977 nests	1989/90 nests	1997 nests
Zion Comm. Edison	LM	IL	4228	8750		46	10
Johns Mansville	LM	IL	422315	874856			3
Grassy Is	DR	MI	4215	8307	20		
Bush Bay Rocks	LH	MI	4559	8415	8		
St Martin Is	LH	MI	4558	8435	54		
Carlton Bay rk	LH	MI	4558	8356	13		
Thunder Bay Is	LH	MI	4501	8313	138	7	
Bare PT Harbor	LH	MI	4502	8327	50		
Abitibi Waste Is	LH	MI	4505	8327	12		
AuGres S. Breakwater	LH	MI	440126	834041			10
Lone Tree Is Sag Bay	LH	MI	4347	8328	25		
Duck Is.	LH	MI	4350	8326		132	
Saginaw CDF (includes Shelter &Channel)	LH	MI	4340	8349	64	118	234
Little Hog Is sh UP	LM	MI	4604	8518		36	
Epoufette Is sh	LM	MI	4603	8514	14		
Sand Products	LM	MI	4601	8507	95	325	155
St Vitals Is	LM	MI	4547	8646	191	194	
West of Peninsula Pt	LM	MI	4540	8658	4		100
Portage Point	LM	MI	4542	8705	34		
St Vitals Is sh	LM	MI	4547	8646		2	
High Is	LM	MI	4544	8538	87		
East Grape Is	LM	MI	4546	8523	11		
Waugoshance Point 2	LM	MI	4546	8501	18		
Cecil Bay Island	LM	MI	4545	8450		50	
Cecil Bay Bkwl	LM	MI	4546	8447	80		
Pt AuChenes Bay Is	LM	MI	4555	8453	26		44
Snake Is Beaver	LM	MI	4546	8528	80	311	
Port Inland	LM	MI	4557	8553		3	
Rk. E of Waugoshance Is.	LM	MI	454540	850320			50
Naomiking Is	LS	MI	4628	8458	120		
Goose Bay Is	LSC	MI	4235	8242		55	
NW Sugar Is	SM	MI	4627	8416	21		
West Sugar I	SM	MI	4626	8415	116		
SE Neebish Is	SM	MI	4613	8408	45		
West Sugar II	SM	MI	4626	8416	44		
Sugar5 n Is	SM	MI	4631	8413		11	
Boundary Is	SM	MI	4629	8418		6	
Boundary e Is	SM	MI	4629	8417		9	
MIddle Island off 7 Mile Rd	SM	MI	4624	8415		22	
South Island off 7 Mile Rd	SM	MI	4624	8415		50	
Roach Pt sh	SM	MI	4610	8412		74	
Little Cass Is	SM	MI	4603	8353		45	
Watson Reef Ruins	SM	MI	4600	8354	20		

Harbor Is rf	SM	MI	4601	8347		105	
North Sweets Is	SM	MI	4600	8356		22	
Lime Island	SMR	MI	460317	835843			628
Port Authority Duluth	LS	MN	4645	9206	185		
Sky Harbor Airport	LS	MN	4642	9203	6		
Interstate Is	LS	MN	4645	9207		81	208
Donnelly's Pier	LE	NY	4253	7854		376	483
Reef Lighthouse	LE	NY	4253	7854		71	
Short Bkwall	LE	NY	4253	7854		134	294
Sandy Pond Is	LO	NY	4335	7611	5		
Point Peninsula Is	LO	NY	4358	7612		13	5
Carl Island (aka Sandy Pond)	LO	NY	4335	7611		54	6
Buckhorn Wier	NR	NY	4304	7900	41		
Tower Is NR	NR	NY	4304	7903	356		
Buckhorn Far Crib	NR	NY	4304	7900		69	32
Buckhorn Near Crib	NR	NY	4304	7900		36	14
Niagara Falls Water Intake	NR	NY	430413	790013			14
Buffalo Breakwall	NR	NY	4253	7855	121	55	13
No Tonawanda Intake	NR	NY	430133	785328			53
Little Is. - Oneida	OL	NY	4314	7600			339
Damon Island	OL	NY	4311	7557			5
Grass Is. - Oneida	OL	NY	4310	7555			2
Eagle Wing Group	SL	NY	4415	7606		67	83
Gull Island SLR	SL	NY	4415	7604		37	2
Perch Rock - NE Marker 216	SL	NY	4416	7602		2	4
Foxy's Shoals	SL	NY	4415	7603		6	3
Tidd Island	SL	NY	4416	7602		53	5
Big Gull Island	SL	NY	441816	760328			9
North Grindstone Rock	SL	NY	441737	760720			1
Navigation cell 213	SL	NY	441700	760059			9
Twin Island	SL	NY	441645	760146			8
Cape Vincent Breakwall	SL	NY	440730	762000			1
Navigation cell 180	SL	NY	4424	7552		6	14
Navigation cell 156	SL	NY	4430	7546		108	29
Whaleback Island	SL	NY	4430	7445		10	
Old Man Island	SL	NY	4434	7540		1	23
Navigation cell 91	SL	NY	4452	7511		1	2
Navigation cell 79	SL	NY	4455	7508		37	71
Navigation cell 75	SL	NY	4415	7507		38	57
Navigation cell 73	SL	NY	4455	7505		59	55
Navigation cell Old 58	SL	NY	4457	7500		138	124
Navigation cell 57	SL	NY	4459	7447		5	6
Navigation cell East 57	SL	NY	4459	7447		2	29
Northeast Long Sault Island	SL	NY	4449	7454		31	
No Name Island	SL	NY	445753	745546			1
Navigation cell 51	SL	NY	445737	745734			3
Navigation cell New 58	SL	NY	445704	750023			25
Navigation cell 85	SL	NY	445333	750958			41

Murphy Island	SL	NY	445322	750958			2
Boom cell C	SL	NY	444453	752540			18
Boom cell B	SL	NY	444321	752752			22
Halfway Island Rock	SL	NY	442450	754912			15
Navigation cell 209	SL	NY	441755	755911			1
Toledo Dike	LE	OH	4143	8326	263		
Mouth Crane Crk	LE	OH	4138	8314		13	34
Big Island Marsh	LE	OH	4123	8237		50	85
Popasquash Is.	LC	VT	445144	731122			154
Rock Is. LC - Franklin Co.	LC	VT	444630	731000			12
Peshtigo Point	LM	WI	4459	8739	5		
Lone Tree Is GB	LM	WI	4434	8800	108		
Kidney Is	LM	WI	4432	8800		87	1
Pensaukee Is.	LM	WI	444903	875419			74
Ashland breakwall	LS	WI	4637	9051	9		
Ashland Pier	LS	WI	4637	9051	8	176	108
Willow Tree Island	LW	WI	NA	NA			12
Lake Butte des Morts	LW	WI	NA	NA			13

Appendix 2. Ownership and Monitoring at all known Common Tern Sites in the U.S. Great Lakes (2001)

Site	Lake	State	rank	Owner-ship category	Owner	Efforts to monitor
Zion Comm. Edison	LM	IL	1	P	Mission Energy-Waukegan Power Plant	?
Sand Products	LM	MI	1	P	Sand Products-Industry	annual monitoring by Seney NWR biologists (Tansy; Corace); no land owner agreement
Interstate Is	LS	MN	1	S	Minnesota Dept. Nat Res. - Burlington	annual monitoring by F. Strand
Navigation cell 213	SL	NY	1	F	USDOT, St. Lawr Seaway Dev Corp	annual monitoring by L. Harper
Navigation cell 180	SL	NY	1	F	USDOT, St. Lawr Seaway Dev Corp	annual monitoring by L. Harper
Navigation cell 79	SL	NY	1	F	USDOT, St. Lawr Seaway Dev Corp	annual monitoring by L. Harper
Navigation cell 75	SL	NY	1	F	USDOT, St. Lawr Seaway Dev Corp	annual monitoring by L. Harper
Navigation cell 73	SL	NY	1	F	USDOT, St. Lawr Seaway Dev Corp	annual monitoring by L. Harper
Navigation cell Old 58	SL	NY	1	F	USDOT, St. Lawr Seaway Dev Corp	annual monitoring by L. Harper
Navigation cell 57	SL	NY	1	F	USDOT, St. Lawr Seaway Dev Corp	annual monitoring by L. Harper
Navigation cell East 57	SL	NY	1	F	USDOT, St. Lawr Seaway Dev Corp	annual monitoring by L. Harper
Navigation cell New 58	SL	NY	1	F	USDOT, St. Lawr Seaway Dev Corp	annual monitoring by L. Harper
Navigation cell 85	SL	NY	1	F	USDOT, St. Lawr Seaway Dev Corp	annual monitoring by L. Harper
Navigation cell 209	SL	NY	1	F	USDOT, St. Lawr Seaway Dev Corp	annual monitoring by L. Harper
Buffalo Breakwall	LE	NY	1	F	US Army Corps of Engineers	annual monitoring by NYSDEC & SUNY Univ
Donnelly's Pier	LE	NY	1	F	US Army Corps of Engineers	annual monitoring by NYSDEC & SUNY Univ
Short Breakwall	LE	NY	1	F	US Army Corps of Engineers	annual monitoring by NYSDEC & SUNY Univ
Old Breakwater/South Breakwater	NR	NY	1	F	US Army Corps of Engineers	annual monitoring by NYSDEC & SUNY Univ
Niagara Falls Water Intake	NR	NY	1	M	City of Niagara Falls	annual monitoring
North Tonawanda Intake	NR	NY	1	M	City of Towanda, Water Authority	annual monitoring by NYSDEC & SUNY Univ

Towanda Intake	NR	NY	1	M	City of Towanda	annual monitoring by NYSDEC & SUNY Univ
Carl Is. (aka Sandy Pond)	LO	NY	1	P	R. Sawyer-Pvt Ind	monitoring by TNC
Boom cell C	SL	NY	1	S	New York Power Authority	annual monitoring by L. Harper
Boom cell B	SL	NY	1	S	New York Power Authority	annual monitoring by L. Harper
Little Is.	OL	NY	1	S	New York State	annual monitoring by NYSDEC & Cornell Univ.
Mouth Crane Creek	LE	OH	1	F	USFWS Ottawa NWR	annual monitoring by OH DNR
Big Is. Marsh	LE	OH	1	S	Pipe Creek Wildlife Area	annual monitoring by OH DNR
Popasquash Is.	LC	VT	1	NGO	Audubon-Green Mtn Aud Society	annual monitoring
Rock Is.	LC	VT	1	NGO	Audubon-Green Mtn Aud Society	annual monitoring
Ashland Pier	LS	WI	1	M	City of Ashland (mgd by WI DNR as WMA)	annual monitoring by S. Matteson
Willow Tree Is.	LW	WI	1	P	LeRoy Patt	annual monitoring by WI DNR
Lake Butte des Morts	LBdM	WI	1	P	Don Wolf/WI DNR manages	annual monitoring
St. Ignace Coast Guard Station	LM	MI	2	F	U.S. Coast Guard	annual monitoring by Seney NWR
Thunder Bay Is.	LH	MI	2	F	US Coast Guard/MI Islands NWR	no monitoring
Saginaw CDF	LH	MI	2	F	US Army Corps of Engineers	monitoring by USFWS (D. Best)
AuGres S. Breakwater	LH	MI	2	F	US Army Corps of Engineers	no monitoring
St Vitals Is.	LM	MI	2	O		no monitoring
West of Peninsula Pt.	LM	MI	2	O		no monitoring
Pt AuChenes Bay Is.	LM	MI	2	P		no monitoring
Grosse Ile (N.end bridge)	DR	MI	2	P	Bruno Smoke	no monitoring
Lime Is.	SMR	MI	2	S	Michigan Dept. Natural Resources	no monitoring
Rock East of Waugoshance Is.	LM	MI	2	S		no monitoring
Charity Reef	LH	MI	*2*	S	State of Michigan	monitoring by USFWS (D. Best)
Duck Is.	LH	MI	2	S	Wild Fowl Bay State Game Area	monitoring by USFWS (D. Best)
Goose Bay Is.	LSC	MI	2	S		no monitoring
Cape Vincent Breakwall	SL	NY	2	F	US Army Corps of Engineers	annual monitoring by L. Harper
Navigation cell 156	SL	NY	2	F	USDOT, St. Lawr Seaway Dev Corp	annual monitoring by L. Harper
Navigation cell 91	SL	NY	2	F	USDOT, St. Lawr Seaway Dev Corp	annual monitoring by L. Harper
Navigation cell 51	SL	NY	2	F	USDOT, St. Lawr Seaway Dev Corp	annual monitoring by L. Harper
Navigation cell 160	SL	NY	2	F	USDOT, St. Lawr. Seaway Dev Corp	annual monitoring by L. Harper

Lockport Water Intake	NR	NY	2	M	City of Lockport	annual monitoring by NYSDEC & SUNY Univ
Eagle Wing Group	SL	NY	2	P	Thousand Island Land Trust	annual monitoring by L. Harper
Gull Is. (SLR)	SL	NY	2	P		annual monitoring by L. Harper
Perch Rock - NE Marker 216	SL	NY	2	P		annual monitoring by L. Harper
Foxy's Shoals	SL	NY	2	P		annual monitoring by L. Harper
Tidd Is.	SL	NY	2	P		annual monitoring by L. Harper
Big Gull Is.	SL	NY	2	P		annual monitoring by L. Harper
North Grindstone Rock	SL	NY	2	P		annual monitoring by L. Harper
Old Man Is.	SL	NY	2	P		annual monitoring by L. Harper
Halfway Is. Rock	SL	NY	2	P		annual monitoring by L. Harper
Damon Island	OL	NY	2	P	Cornell University	annual monitoring by NYSDEC & Cornell Univ.
Grass Is.	OL	NY	2	P	Cornell University	annual monitoring by NYSDEC & Cornell Univ.
Northeast Long Sault Is.	SL	NY	2	S		annual monitoring by L. Harper
Buckhorn Far Crib	NR	NY	2	S	New York Power Authority	annual monitoring by NYSDEC & SUNY Univ
Buckhorn Near Crib	NR	NY	2	S	New York Power Authority	annual monitoring by NYSDEC & SUNY Univ
Kidney Is.	LM	WI	2	F	US Army Corps of Engineers	annual monitoring by T. Erdman
Pensaukee Is.	LM	WI	2	F	US Army Corps of Engineers	?
Grassy Is.	DR	MI	3	F		no monitoring
Northwest Sugar Is.	SM	MI	3	O		no monitoring
West Sugar Is. 1	SM	MI	3	O		no monitoring
Southeast Neebish Is.	SM	MI	3	O		no monitoring
Little Hog Is. Shoal (UP)	LM	MI	3	O		no monitoring
Epoufette Is. Shoal	LM	MI	3	O		no monitoring
West Sugar Is. 2	SM	MI	3	O		no monitoring
Sugar 5 North Is.	SM	MI	3	O		no monitoring
Boundary Is.	SM	MI	3	O		no monitoring
Boundary East Is.	SM	MI	3	O		no monitoring
Naomiking Is.	LS	MI	3	O		no monitoring

MIddle Is. off 7 Mile Rd	SM	MI	3	O		no monitoring
South Is. off 7 Mile Rd	SM	MI	3	O		no monitoring
Roach Pt. Shoal	SM	MI	3	O		no monitoring
Little Cass Is.	SM	MI	3	O		no monitoring
Watson Reef Ruins	SM	MI	3	O		no monitoring
Harbor Is. Reef	SM	MI	3	O		no monitoring
North Sweets Is.	SM	MI	3	O		no monitoring
Portage Point	LM	MI	3	O		no monitoring
St Vitals Is. Shoal	LM	MI	3	O		no monitoring
Bush Bay Rocks	LH	MI	3	O		no monitoring
Cecil Bay Is.	LM	MI	3	O		no monitoring
Cecil Bay Breakwall	LM	MI	3	O		no monitoring
Snake Is. (Beaver)	LM	MI	3	O		no monitoring
Carlton Bay Rock	LH	MI	3	O		no monitoring
Lone Tree Is. (Sag Bay)	LH	MI	3	O		no monitoring
Shoal St. Martin's Bay	LH	MI	3	O		?
St Martin Is.	LH	MI	3	P	J. & S. Azzar and E. Autore Trust	no monitoring
Port Inland	LM	MI	3	P		no monitoring
Bare Pt. Harbor	LH	MI	3	P		no monitoring
Abitibi Waste Is.	LH	MI	3	P		no monitoring
High Is.	LM	MI	3	S	Michigan Dept. Natural Resources	no monitoring
East Grape Is.	LM	MI	3	S	Michigan Dept. Natural Resources	no monitoring
Waugoshance Pt. 2	LM	MI	3	S		no monitoring
Port Authority Duluth	LS	MN	3	P		no monitoring
Sky Harbor Airport	LS	MN	3	P		no monitoring
Reef Lighthouse	LE	NY	3	F	U.S. Coast Guard	some monitoring
Navigation cell 165	SL	NY	3	F	USDOT, St. Lawr Seaway Dev Corp	annual monitoring by L. Harper
Navigation cell 41	SL	NY	3	F	USDOT, St. Lawr Seaway Dev Corp	annual monitoring by L. Harper
Chub Is. Shoal	SL	NY	3	O		annual monitoring by L. Harper
Bass Is.	LO	NY	3	O		annual monitoring by L. Harper
Indian Chief Islands	SL	NY	3	O		annual monitoring by L. Harper
Point Peninsula Shoal	SL	NY	3	O		annual monitoring by L. Harper

Whaleback Is. Rock	SL	NY	3	O		annual monitoring by L. Harper
Twin Is.	SL	NY	3	P		annual monitoring by L. Harper
Whaleback Is.	SL	NY	3	P		annual monitoring by L. Harper
Point Peninsula Is.	LO	NY	3	P		?
No Name Is.	SL	NY	3	S		annual monitoring by L. Harper
Murphy Is.	SL	NY	3	S		annual monitoring by L. Harper
Buckhorn Wier North	NR	NY	3	S	New York State Power Authority	annual monitoring by NYSDEC & SUNY Univ
Tower Is.	NR	NY	3	S	New York State Power Authority	annual monitoring by NYSDEC & SUNY Univ
Buckhorn Wier South	NR	NY	3	S	New York Power Authority	annual monitoring by NYSDEC & SUNY Univ
East Crib	NR	NY	3	S	New York Power Authority	annual monitoring by NYSDEC & SUNY Univ
Toledo Dike	LE	OH	3	F		?
Lone Tree Is. (Green Bay)	LM	WI	3	F		annual monitoring by T. Erdman
Ashland Breakwall	LS	WI	3	M		no monitoring
Peshtigo Pt.	LM	WI	3	S		?
Great Lakes Naval Training Center	LM	IL	NA	F	U.S. Navy	?
Johns Manville	LM	IL	NA	P	Johns Manville	some monitoring
Scarecrow Is.	LH	MI	NA	F	MI Islands National Wildlife Refuge	?
Andrews Is. Reef	SMR	MI	NA	O		?
Tawas Pt.	LH	MI	NA	S	Michigan Dept. Natural Resources	monitored by local birders
South of Strawberry Is.	LSC	MI	NA	S		?

F = Federal
M = Municipal
NGO = Non-governmental Organization
P = Private
S = State
UO = Unknown owner

Appendix 3: Common Tern Contacts in the Great Lakes Region.

Illinois

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