

ISLAND-NESTING TERNS ASSESSMENT

September 20, 2006

FINAL VERSION:

Prepared by Mark McCollough

Updated by Lindsay Tudor

MAINE DEPARTMENT OF INLAND FISHERIES AND WILDLIFE
WILDLIFE DIVISION
RESOURCE ASSESSMENT SECTION

TABLE OF CONTENTS

	Page
INTRODUCTION.....	4
NATURAL HISTORY.....	5
Description.....	5
Distribution.....	5
Wintering	7
Habitat	8
Diet	10
Reproduction	11
Survival, Longevity, and Recruitment	13
MANAGEMENT.....	14
Regulations.....	14
Past Goals and Objectives	16
Past and Current management.....	17
HABITAT ASSESSMENT.....	21
Historic Trends	21
Current Assessment	21
Projections.....	23
POPULATION ASSESSMENT.....	26
Past Population Trends	26
Current Population Assessment	27
Limiting Factors	28
USE AND DEMAND ASSESSMENT	32
Historic Trends	32
Current Trends	32
SUMMARY AND CONCLUSIONS	34
LITERATURE CITED	37

LIST OF FIGURES

Figure 1. Maine islands with the nesting terns in 2004..... 19

LIST OF TABLES

Table 1. Summary of survey data for nesting pairs of Common Terns (COTE), Arctic Terns (ARTE), and Roseate Terns (RSTE) by Coastal Region in 2004 (Hall 2004)..... 22

Table 2. Estimates of numbers of pairs and colonies of island nesting terns in Maine, 1885-2004. Numbers of colonies are in parentheses 25

LIST OF APPENDICES

Appendix I Summary of inland Common Tern nesting colonies.....40

INTRODUCTION

Of the 5 species of terns that nest in Maine, 3 species nest primarily on coastal islands: the Common Tern (*Sterna hirundo*), the Arctic Tern (*S. paradisaea*), and the Roseate Tern (*S. dougallii*). A fourth species, the Least Tern (*S. antillarum*) nests on sandy beaches along Maine's southern coast, is state listed as Endangered, and has a separate Assessment and management goals and objectives. The fifth species, the Black Tern (*Chlidonias niger*), is also state listed as Endangered with 82 pairs nesting on 10 inland freshwater sites in Maine, this species warrants its own Assessment, goals and objectives. Small numbers of Common Terns nest on rocky islands located in a few freshwater lakes in northern and eastern Maine, however, this assessment deals only with the three species of coastal island nesting terns, because of their common distribution, habitat use, and management needs.

NATURAL HISTORY

Description

Common Terns, Arctic Terns, and Roseate Terns are all graceful seabirds; smaller and more slender than gulls, with long pointed wings, forked tails, webbed feet, black caps (during the breeding season) and long slender bills. All three species are similar in appearance, and thus difficult to distinguish in the field. All measure about 38-40 cm (15-16 in) in length, with a wingspan of 79 cm (31 in). Common Terns are white with pale gray wings and back, black cap, and red-orange bill with black tip. Arctic Terns are the grayest of the three species, with a bill that is red to the tip and short legs. Roseate Terns are the palest of the three species, and have a black bill and longer tail points (Harrison 1983).

Distribution

In North America, Common Terns breed in coastal areas and on large inland lakes from the Northwest Territories east to Labrador and south along the Atlantic coast to South Carolina and the gulf coast of Louisiana. Small numbers also nest in the Caribbean. Elsewhere, Common Terns breed along the coasts of Europe and North Africa. Common Terns that nest in North America migrate south along both Atlantic and Pacific coasts, and winter from Florida and southern California south to Peru and Argentina (Nisbet 2002).

Arctic Terns have a circumpolar breeding distribution, and nest in arctic and subarctic regions around the world. Arctic Terns nesting in North America migrate south

along the west coasts of Europe and Africa in fall, and winter in the extreme Southern Hemisphere south to Antarctica.

Roseate Terns nest widely around the world; in North America, the northeastern population breeds at relatively few, strictly coastal locations, from Nova Scotia south to Massachusetts and New York, with a few isolated records from New Jersey. The Caribbean population breeds from the Florida Keys south to islands off Central and South America. Roseates also nest in coastal regions of Europe, Africa, and the Indian and Pacific Oceans. Roseate Terns that nest in North America winter along the northeast coast of South America (Gochfeld et al. 1998).

Maine's population of Common Terns is located between larger Common Tern populations to the north and south. South of Maine, over 38,000 pairs nest from Massachusetts to New York (Kress and Hall 2002). To the north, over 26,000 pairs of Common Terns nest in the Canadian Maritime provinces and over 15,000 pairs in the Gulf of Saint Lawrence (Kress and Hall 2002). Maine's population of Common Terns is of special interest because it occurs predominantly in colonies on rocky islands, whereas colonies to the north and south tend to occur on sandy beaches. As previously mentioned, small numbers of Common Terns nest on rocky islands located in a few large, freshwater lakes, in northern and mid-coast Maine, but their distribution and status are poorly monitored (Appendix 1).

Maine's Arctic Tern population is at the southern edge of the western Atlantic population. To the north, an estimated 11,000 pairs nest in the Canadian Maritimes, Newfoundland, and Labrador (Kress and Hall 2002). In Maine, Arctic Terns tend to nest in larger tern colonies than occur in Canada (S. Kress, pers. comm.).

Roseate Terns in Maine occur at the northern edge of their breeding range. Less than 100 pairs nest in Canada, primarily Nova Scotia (PMNWR 2003), while south of Maine over 3,200 pairs nest from Massachusetts to Long Island (PMNWR 2003).

Machias Seal Island, located 10 miles off the coast of eastern Maine, on the U.S. – Canada border in the Bay of Fundy, supports one of the largest colonies of terns in the Gulf of Maine: 2,158 pairs of Arctic Terns and 1,064 pairs of Common Terns (Hall 2004). Machias Seal Island is claimed by Canada, but Canada's claim is disputed by the U.S. Although terns nesting on Machias Seal Island undoubtedly constitute part of the Gulf of Maine tern populations, this colony is not dealt with specifically in this assessment because by verbal agreement with the United States Fish and Wildlife Service (USFWS) tern management on Machias Seal Island is a responsibility of the Canadian Wildlife Service (CWS).

Wintering

By mid to late August, both adults and young begin the migration south. The major wintering areas of Roseate and Common Terns in the Western Hemisphere is poorly known. Roseate Terns are thought to winter along the north coast of South America from Colombia to Brazil, but are seldom observed. Prior to 1995, there are no data in the literature that show where Roseate Terns spend the period January – March. In March 1995, researchers surveying coastal and offshore areas in Argentina, Brazil, and Uruguay, observed Roseates at a site off the Brazilian coast near Bahia. Researchers also recovered a Roseate band in January 1995, from the same area. This is the southernmost record for this species (Hays et al. 1997). In some areas of the

wintering grounds, particularly Guyana, Roseates are trapped by local residents for food (Trull 1988). Occasional band recoveries from fishing boats suggest wintering Roseates may spend part of the winter offshore, returning to beaches after dark to roost (Gochfeld et al. 1998).

Common Terns winter from the southern coast of the United States (Root 1999) south to Argentina (Nisbet 2002). Large winter concentrations occur in Suriname, Trinidad, Brazil, and Argentina. Hays et al. (1997) found 20,000 – 30,000 Common Terns wintering at Punta Rasa, Argentina in February suggesting this location may be the most significant wintering area in South America for Common Terns from North America.

Arctic Terns from the northwest Atlantic migrate east to Europe or the west coast of Africa and continue south to winter in the extreme southern regions of the Southern Hemisphere (Cramp 1985). As with Roseate Terns, most first-year and many second-year Common Terns and Arctic Terns remain all year on the wintering grounds (Gochfeld et al. 1998, Nisbet 2002).

Habitat

Roseate Terns are exclusively marine, nesting on rocky or sandy islands, barrier beaches, or salt marsh islands. In the northeast, Roseates generally nest under dense vegetation, rocks or driftwood. They will also use artificial cover provided on managed islands such as half-buried tires or nest boxes (Gochfeld et al. 1998). Roseate colonies are usually barrier beaches that have good cover, are predator-free and are close to an abundant supply of available prey. All recent records of Roseates nesting in the

northeast are within Common Tern colonies (USFWS 1998). Roseates are reported to use isolated coastal areas during winter, especially dynamic sites such as river mouth bars, peninsulas, etc., for roosting and preening (Hays et al. 1997).

Similar to Roseates, Common Tern nest sites include rocky islands, barrier islands, and salt marshes that are close to an abundant supply of available prey with a minimum risk from predators (Burger and Gochfeld 1991). Common Terns, however, also nest in freshwater environments and readily use dredge spoil and other artificial islands. Common Terns usually nest in colonies, often with other species. They nest in predominantly open habitats with an average vegetative cover of 10 to 25%, preferring to nest at the interface of vegetation and open sand or rock (Burger and Gochfeld 1991). Little winter habitat information is available. They prefer to roost in isolated coastal areas and have been reported to roost on oil platforms, boats, and other man made structures. Individuals presumably forage offshore returning to roosts after dark (Hays et al. 1997).

Arctic Terns nest in a variety of marine and freshwater environments from temperate regions to the high arctic. Nesting sites include rocky islands, sand, or gravel beaches, dunes, tundra, river bars, and marshes. Lower latitude birds tend to nest in dense colonies, but boreal breeders often nest either in small groups or alone. Arctic Terns show the least variation in nest sites, preferring to nest in more open habitat (i.e. rocky ledges and open beach), presumably because their shorter legs preclude movement through tall, dense vegetation. Little winter habitat information is available (Cramp 1985).

Diet

All three species of terns feed primarily on small marine fish (up to 150 mm long), diving from heights of 1-6 meters and reaching depths ranging from 0.3 – 0.5 meters. Terns are able to remain underwater for 0.8 – 1.6 seconds (Nisbet 2002). Foraging success depends on size, abundance, and depth of prey, as well as foraging flock size, tidal height, and sea conditions. Average length of fish prey delivered to chicks ranges from 2.5 – 9.0 cm. There is considerable variation in diet between years and colonies. Foraging range is variable and may depend on prey availability; generally Common Terns forage 100 meters to 35 km from the breeding colony. Common Terns are described as dietary generalist switching between prey types and foraging strategies. In Maine, Common Terns feed mainly on White Hake (*Urophycis tenuis*), Atlantic Herring (*Clupea harengus*), Sand Lance (*Ammodytes americanus*), Butterfish (*Poronotus triacanthus*), American Pollock (*Pollachius virens*), amphipods (*Gammarus* spp.), and insects (Hall 1999).

Arctic Terns, like Common Terns, are able to switch between different food types and foraging strategies. They feed on fish, crustaceans, and insects using similar foraging strategies as Common Terns. In Maine, Arctic Terns feed on white hake, four-bearded rockling (*Enchelyopus cimbrius*), Atlantic herring, three-spined stickleback (*Gasterosteus aculeatus*), sand lance, butterfish, amphipods, skeleton shrimp (*Meganyctiphanes norvegica*), and insects (Hall 1999).

Roseate Terns feed primarily on marine fish and rarely use invertebrates (Gochfeld et al. 1998). In Maine, Roseates feed on Sand Lance, White Hake, Four-Bearded Rockling, Atlantic Herring, Butterfish, and American Pollock. Roseates in the

northeast tend to feed over shallower water, in smaller groups, and less frequently over predatory fish than Common Terns. They are capable of diving from heights of up to 12 m. and are able to remain underwater for 1.5 – 2.5 seconds, capturing one or more fish per successful plunge (Gochfeld et al. 1998).

In some years, at some colonies, all three tern species may be food limited thus affecting production and fledgling success.

Reproduction

In Maine, Common Terns, Arctic Terns, and Roseate Terns nest primarily on coastal islands. All three species nest colonially, and often in association with each other. Common Terns prefer to nest near to the mainland, while Arctic Terns nest most frequently on outer islands. Currently in Maine, Roseate Terns only nest within colonies of the other two species and only on sites that are intensely managed and gull numbers are actively reduced.

All three species show considerable site fidelity to breeding islands, and may return to the same site to nest year after year. They will abandon a colony site, however, if habitat characteristics change unfavorably or if the colony is subjected to severe, repeated predation or disturbance. Even when a productive colony is below carrying capacity, a number of birds produced by that colony will prospect for new colony sites, although the majority will likely be recruited to their natal colony.

Common, Arctic, and Roseate Terns arrive at their breeding islands in Maine during the second or third week in May. After elaborate courtship rituals, birds pair and select nest sites. Eggs are laid in a simple scrape or nest bowl, often lined with pebbles,

shells, or vegetation. Arctic and Roseate Terns usually lay 1-2 eggs, and Common Terns 2-3 eggs. Egg-laying is often synchronous for each species within the colony, unless predation or disturbance leads to renesting (Gochfeld et al 1998, Nisbet 2002). The incubation period is about 23 days, and both adults alternate incubation bouts. After hatching, tern chicks are fluffy balls of grayish-brown down. They leave the nest within days, but continue to be fed and brooded by the adults. Young fledge after 22-30 days, but may remain in the general vicinity of the nesting island for several more weeks and continue to be fed by the adults until able to fish efficiently for themselves (Nisbet and Drury 1972).

Productivity of nesting terns, measured as mean number of chicks fledged per pair, is highly variable among colonies and years. The ability of adult terns to provision young largely determines how many young will fledge. Adult terns may fly up to 20 miles round-trip to capture fish to feed young (Gochfeld et al. 1998). Generally, larger, managed colonies tend to be more successful than small, unmanaged colonies, although productivity can vary among years at large managed colonies. For example, relatively high productivity was reported from Petit Manan in 2002 (1.57 chicks fledged per pair for Common Terns, and 1.41 chicks fledged per pair for Arctic Terns) and in 2003 (1.84 for Common Terns and 1.21 for Arctic Terns). In contrast, Stratton Island productivity suffered a severe decline from a high fledgling rate of 1.2 chicks per pair for Common Terns and 1.4 chicks per pair for Roseate Terns in 2001, to 0.1 chicks per pair of Common Terns and 0.6 chicks per pair of Roseate Terns in 2002. A combination of nocturnal predation and disease lead to this sharp decline and was repeated in 2003 and 2004 (Diamond et al. 2001, Allen 2002, PMNWR 2003, Hall 2004). However, estimates

of productivity by managers on seabird nesting islands, are not always directly comparable between years or colonies because of a lack of standardization (Kress and Hall 2002).

Survival, longevity, and recruitment

All three species are relatively long-lived. The oldest recorded Roseate Tern was 25.6 years and a 26 year old Common Tern was documented as successfully breeding on Bird Island, Ma.: median age of breeders on Bird Island was determined to be 9-10 years old (Gochfeld et al 1998, Nisbet 2002). Information on adult survival rates for all three tern species is limited. On Bird Island and Ram Island, MA, Nisbet and Cam (2002), estimated annual adult survival of Common Terns to be $.88 \pm 0.04$ or 0.91 ± 0.05 depending on selection of sample size ($n=2,367$ or $n=1,599$ respectively) (Nisbet 2002). DiCostanzo (1980) estimated an annual adult survival rate of 0.92 for Common Terns at Great Gull Island in New York. Coulson and Horobin (1976) estimated annual adult survival rates of 0.87-0.88 for Arctic Terns in northern Europe. Recently Spendelov and Nichols (1989) estimated annual adult survival rates of only 0.74-0.75 for Roseate Terns nesting at Faulkner Island in Connecticut. They also noted that the methods used by DiCostanzo (1980) and Coulson and Horobin (1976) may have overestimated survival rates for Common Terns and Arctic Terns. Estimates of survival to first breeding are also limited and vary widely in scope and methodology among studies.

MANAGEMENT

Regulations

All three species of island-nesting terns are protected by both federal and state legislation. The U.S. Migratory Bird Treaty Act of 1918 protects all three species from take. The Roseate Tern is federally listed as "Endangered" by the USFWS and thus protected from take and harassment by the U.S. Endangered Species Act of 1973. The Endangered Species Act also prohibits activities of federal agencies, or activities funded or permitted by federal agencies, from adversely impacting Roseate Terns or their habitats. Authorization for capture, banding, or other activities directed at Roseate Terns, are controlled by the U.S. Endangered Species Act and must be granted by the Regional Director of the USFWS. Any banding, research, or management activities directed at federally endangered or threatened birds in Maine must also be authorized by MDIFW.

The Roseate Tern is also classified as state Endangered and the Arctic Tern is classified as state Threatened by MDIFW under provisions of the Maine Endangered Species Act (ESA) of 1975. This Act protects state-listed species from take and harassment. It also authorizes MDIFW to designate Essential Habitat that is critical to the conservation of Endangered and Threatened species, and to promulgate and enforce guidelines for the protection of Essential Habitat. State agencies and municipal governments may not permit, license, fund, or carry out projects that significantly alter habitats identified as essential, or that violate protection guidelines. Finally, the Act requires that a permit be obtained from MDIFW in order to use bait, decoys, or

recordings to attract, move, or otherwise manipulate populations of Roseate Terns or other state listed species. Presently, 22 Roseate Tern nesting areas are mapped and designated as Essential Habitat. These areas are located on coastal islands between Kennebunkport and Addison.

Common Terns are classified as "Species of Special Concern", the third category after "Endangered" and "Threatened" on MDIFW's administrative list of rare and endangered wildlife. Species of Special Concern are at the next level of management priority below species classified as "Endangered" or "Threatened", but are not recognized by the Maine ESA and therefore do not receive the legal protection afforded to Endangered and Threatened species.

Habitats of Endangered and Threatened species, including nesting islands used by Roseate Terns and Arctic Terns receive regulatory oversight by the Maine Department of Environmental Protection (DEP) under provisions of the Natural Resources Protection Act of 1988 (NRPA). Maine's Natural Resources Protection Act also identified seabird nesting islands as "Significant Wildlife Habitat". MDIFW is responsible for defining and mapping Significant Wildlife Habitats and DEP must adopt them via rulemaking before NRPA takes effect. To date, MDIFW has identified and mapped, and DEP has adopted, 234 seabird nesting islands (including 18 islands with nesting terns), as Significant Wildlife Habitat.

Maine's Comprehensive Growth Management Act mandates MDIFW to provide information on rare species habitats, including tern nesting islands, to the Department of Economic and Community Development for use by towns for comprehensive planning purposes.

MDIFW's Coast of Maine Wildlife Management Area comprises more than 200 islands, including several tern nesting islands. Human entry to these islands is prohibited between April 6 and August 31. A letter of permission from MDIFW is required to land during the nesting season on these islands; owned or managed by MDIFW.

A banding permit from MDIFW is required before terns or other birds can be banded or marked. A scientific collecting permit from MDIFW is required before terns or other birds can be captured or handled.

Past Goals and Objectives

The Island Nesting Tern Management goal is from the 1990 Species Assessment and was derived by a public working group. The goal defines a long-term outlook for the recovery of these species to historic levels. It is the basis for the Department's Management System completed in January, 1993.

Management objectives, set in 1990, were also formulated by the public working group. Management objectives are interim in nature and express population and distribution objectives to be achieved by 2000. All 3 management objectives have not yet been met, and long-term recovery objectives have not been established.

PAST GOAL (1990)

Increase the abundance and expand the distribution of all three island-nesting tern species (Common Terns, Arctic Terns, and Roseate Terns).

PAST OBJECTIVES (1990)

- 1.** Increase the number of productive Roseate Tern colonies (>1 fledged chick/pair) to at least 3 with 50 or more pairs of terns per colony by the year 2000.
- 2.** Increase the populations of all 3 tern species to 1930's levels (estimated at 6,000 pairs of Common Terns, 6,000 pairs of Arctic Terns, and 276 pairs of Roseate Terns) by the year 2000.
- 3.** Maintain the current productive colonies (> 1 fledged chick/pair) with at least 200 pairs while increasing the number and distribution of productive colonies with at least 200 pairs to at least 1 in each of the 7 coastal regions by the year 2000.

Past and Current Management

Monitoring and management of terns in Maine during the past 25 years has been carried out by several organizations and agencies collectively referred to as the Gulf of Maine Seabird Working Group (GOMSWG). Recent state-wide censuses of island-nesting terns in Maine were conducted in 1977 by Korschgen (1979) and in 1984, 1987, and 1988 by members of the Gulf of Maine Tern Working Group (Kress and Weinstein, 1987; Kress and Borzik 1988).

In 1974, National Audubon Society(NAS) began a successful program of gull management and efforts to reestablish a tern nesting colony at Eastern Egg Rock (Figure 1) in Muscongus Bay (Kress 1983). These efforts by NAS have since been expanded to Matinicus Rock, Seal Island, Stratton Island, Outer Green Island, Jenny Island, and Pond Island. The tern colonies that NAS manages at Eastern Egg Rock, Matinicus Rock, and Seal Island, are the largest and most productive colonies on the Maine coast.

The USFWS began an aggressive program to reduce gull populations at Petit Manan Island (Figure 1) in 1984 that has resulted in re-establishment of a major colony of Arctic and Common Terns. Maine Coastal Island National Wildlife Refuge (formerly Petit Manan National Wildlife Refuge) continues to actively manage for nesting terns on Petit Manan and Metinic islands. Maine Audubon Society has monitored several current and former nesting islands in southern Maine since 1981.

MDIFW manages 301 state-owned coastal islands and ledges, including 70 former or current tern nesting islands, within its Coast of Maine Wildlife Management Area. MDIFW maintains a data base on seabird nesting islands that includes information on ownership and current and historical counts of nesting seabirds. The Department has participated in statewide counts of nesting terns since 1977. MDIFW plays a major role in protecting habitat for terns and other coastal wildlife by consulting with and making management recommendations to DEP and the Land Use Regulation Commission (LURC) through various environmental review and permitting processes.

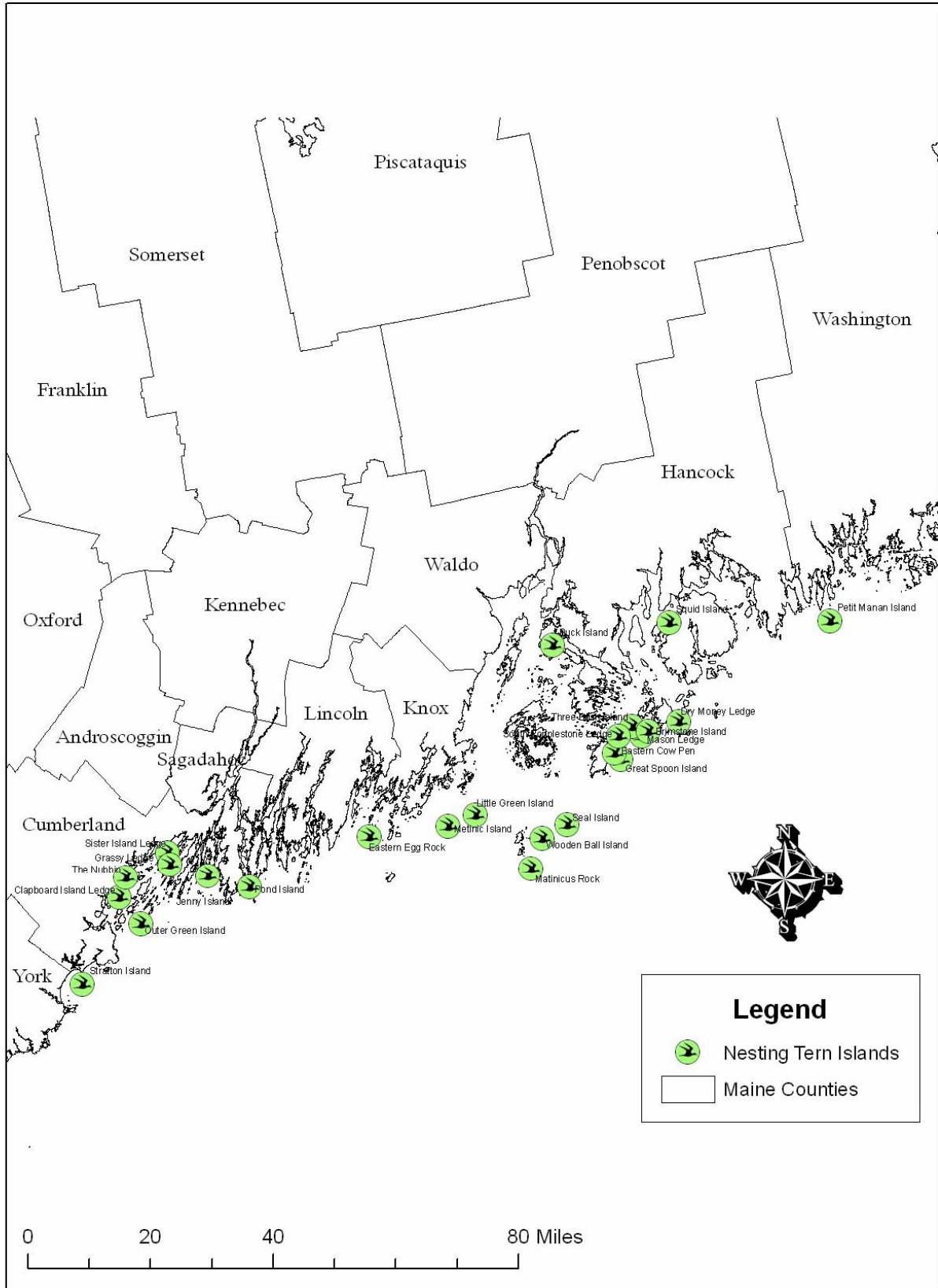


Figure 1. Maine islands with nesting terns in 2004.

Presence of nesting Herring and Great Black-backed gulls often makes an island or a portion of an island unsuitable for terns. These large gulls nest earlier and tend to utilize suitable nesting habitat thus excluding terns from preferred nesting sites. Great Black-backed and Herring gulls are also active predators of tern eggs and tern chicks.

Gull control programs carried out by the USFWS and NAS have demonstrated that an intensive program of poisoning, shooting, and nest destruction, continued over several successive years, can effectively discourage nesting and roosting gulls. This, in turn, can allow former tern colonies to become re-established and existing tern colonies to maintain or increase their size and productivity. The handful of relatively large, productive colonies that remain along the Maine coast are all maintained, in large part, through continuing gull and predator control. Other predators include: Black-crowned Night Herons, Great Horned Owls, and mink. Without this intensive management, these colonies would probably decline or disappear.

Since 1990, MDIFW and GOMSWG have worked together to develop strategies to achieve the established goal and objectives. Recovery of tern populations has required continued intensive management on nesting islands. Ten Maine nesting islands are currently managed for terns by removing and controlling gulls, using decoys and sound recordings of colonies to attract nesting terns, and having managers live on the islands during the nesting season to deter predators and control human disturbance. Substantial population gains have resulted from intensive management on those few coastal islands; however, all 3 tern species now have most of their “eggs in a few baskets”.

HABITAT ASSESSMENT

Historic Trends

Of the approximately 3,000 islands that occur along the Maine coast, at least 150 have been used by nesting terns at various times during the past 100 years (Lovett 1984, Kress and Borzik 1989, MDIFW unpubl. data). The amount and quality of nesting habitat available to terns has fluctuated during that period. Human use of Maine's coastal islands peaked during the late 1800's. Use of islands for livestock grazing, fishing communities, logging, and granite quarrying, coupled with an increased propensity for the harvest of seabirds and eggs for food, led to declines in available nesting habitat and to declines in tern populations. As human use of offshore islands declined during the early 1900's, and as laws and regulations governing the harvest of seabirds were implemented, terns began recolonizing coastal islands (Hutchinson 1982). Over the past 50 years, many islands in the Gulf of Maine that remain physically suitable for nesting, and were used historically, have become sub-optimal or unavailable for nesting terns because of the presence of nesting gulls.

Current Assessment

Terns nested on 24 islands along the Maine coast in 2004. Only 12 islands supported colonies with more than 50 pairs of terns and 10 islands supported colonies with more than 100 pairs (Table 1). Of the 20 islands that Palmer (1937) reported as

Table 1. Summary of survey data for nesting pairs of Common Terns(COTE), Arctic Terns (ARTE), and Roseate Terns (RSTE) by Coastal Region in 2004 (Hall 2004).

Island	Township	COTE	ARTE	RSTE	Ownership
<i>The Downeast Coast (Winter Harbor to Cutler)</i>					
Petit Manan	Milbridge	1,312	911	29	USFWS
<i>Blue Hill Bay (Brooklin to Southwest Harbor)</i>					
Dry Money Ledge	Frenchboro	78			MDIFW
Mason Ledge	Swans Island	1			MDIFW
Three Bush Island	Swans Island	2			Private
Brimstone	Swans Island	60			MDIFW
Squid Island Ldg	Bar Harbor	43			Private
<i>Inner Penobscot Bay (Camden to Deer Isle)</i>					
Buck Island	Brooksville	109			MDIFW
Eastern Cowpen	Isle au Haut	36			MDIFW
South Popplestone	Isle au Haut	4			MDIFW
Great Spoon	Isle au Haut	7	1		MDIFW
<i>SW Penobscot Bay (Port Clyde to Criehaven)</i>					
Seal Island	Criehaven Twp	1,167	1,172		USFWS
Wooden Ball Island	Criehaven Twp		12		Private
Matinicus Rock	Criehaven Twp	116	830		USFWS
Little Green Island	Matinicus Isle		1		Private
Metinic Island	Matinicus Isle	342	426	1	USFWS/Private
<i>Muscongus Bay (Bristol to Port Clyde)</i>					
Eastern Egg Rock	St George	873	84	110	MDIFW
<i>Kennebec River (Cundy's Harbor to Georgetown)</i>					
Pond Island	Phippsburg	429		9	USFWS
<i>Casco Bay (Cape Elizabeth to Cundy's Harbor)</i>					
Jenny Island	Harpwell	210	1	2	MDIFW
Clapboard Island Ldg	Falmouth	1			MDIFW
The Nubbin	Yarmouth	1			MDIFW
Sister I. Ldg	Freeport	13			MDIFW
Grassy Ldg	Harpwell	1			MDIFW
Outer Green Island	Portland	510		8	MDIFW
<i>Saco Bay (Kittery to Cape Elizabeth)</i>					
Stratton Island	Saco	323	7	11	NAS
Maine Coast Total		5,547	3,445	170	

having tern colonies of 50 or more pairs in 1931, 13 are no longer used by nesting terns, primarily because of encroachment by nesting gulls. Habitat on many islands that were used historically by nesting terns has become unsuitable or marginal for various reasons including presence of nesting gulls, human habitation, or vegetation succession.

Long term trends in food resources are less certain and undocumented, forage fish may have declined in abundance since 1930's and 40's levels because of overfishing or pollution in nursery areas. Feeding and productivity studies conducted by staff on managed nesting islands in the Gulf of Maine often document years where favored prey items change dramatically. Variability in provisions and productivity may be related to prey abundance suggesting years with low reproductive success may be due to limited food availability. For example, in certain years, Arctic Terns have been observed feeding their young largely on insects and crustaceans, suggesting that more nutritious food, such as small fish, may be scarce (S. Kress, unpub. data).

Of the 150 islands in Maine that have been used by nesting terns at various times since the late 1800's, 92 (61%) are in conservation or public ownership. Of the 24 Maine islands used for nesting in 2004, 20 are in public or conservation ownership (Table 1)(MDIFW, unpubl. data; W. H. Drury, personal communication).

Projections

There currently exist in Maine sufficient nesting islands to support populations of island-nesting terns equal to or greater than the estimated 1931 levels (6,000 pairs of Common Terns, 6,000 pairs of Arctic Terns, and 275 pairs of Roseate Terns (Table 2)).

However, many of these islands are functionally unavailable to nesting terns because of the presence of gulls.

Competition and predation by gulls are the factors most responsible for limiting the carrying capacity of Maine's coastal habitat to support tern populations. Availability of food resources to support population growth are unknown. However, food resources have been sufficient to allow relatively successful reproduction at several of the larger colonies (Petit Manan, Matinicus, and Eastern Egg Rock, Figure 1) during the past 3-5 years.

During the next 15 years, if current levels of management are maintained, populations of Common Terns, Arctic Terns, and Roseate Terns can be expected to remain at or near the current level. If existing management programs are reduced or eliminated, tern populations can be expected to decline. Conversely, expanded management efforts can be expected to increase functional carrying capacity and result in expanded distribution of tern populations.

Table 2. Estimates of numbers of pairs and colonies of island nesting terns in Maine, 1885-2004. Numbers of colonies are in parentheses.

Year	COTE	ARTE	RSTE	Source
2004	5547 (22)	3445 (9)	170 (7)	Hall 2004
2003	5632 (21)	3225 (8)	239 (5)	PMNWWR 2003
2002	5936 (22)	2975 (9)	285 (3)	Allen 2002
2001	6806 (26)	2771 (10)	289 (4)	Diamond et al. 2001
2000	6759 (21)	2619 (9)	285 (4)	Kress and Hall 2002
1999	6506 (21)	2854 (9)	288 (5)	“
1998	6496 (21)	2405 (7)	257 (4)	“
1997	6563 (20)	2270 (10)	237 (6)	“
1996	5308 (22)	2695 (7)	161 (4)	“
1995	4872 (21)	2490 (9)	151 (5)	“
1994	4222 (21)	2381 (9)	142 (5)	“
1993	4065 (15)	2250 (9)	141 (6)	“
1992	3468 (23)	2128 (8)	121 (4)	“
1991	3925 (22)	2094 (10)	127 (6)	“
1990	2703 (18)	2175 (10)	107 (4)	“
1989	2634 (19)	2347 (8)	80 (5)	“
1988	2848 (18)	2020 (9)	68 (7)	“
1987	2173 (19)	1720 (7)	52 (6)	“
1984	2543 (28)	1720 (7)	76 (10)	“
1977	2095 (24)	1640 (8)	80 (3)	“
1972	2600 (18)	2900 (11)	75-150 (2)	“
1945	7900	5000		“
1940	8000 (25)	4500		“
1931-36	4900-6500 (19)	5000-6100 (9)	275 (3)	“
1911	4000 (19)	4400		“
1902-05	4800 (16)	4400		“

POPULATION ASSESSMENT

Past Population Trends

Vast tern populations nesting in the northeastern U. S. plummeted in the 19th century when hunting for local use expanded to widespread hunting and egging for commercial markets. In the late 19th century, when it became fashionable to decorate women's hats with tern feathers, the final onslaught began. By 1890, tern populations in the Northeast were reduced dramatically because of over harvest for the millinery trade. In response to a public outcry, protective legislation was passed to regulate the widespread harvest of migratory birds in the early 1900's. With the passage of migratory bird laws tern numbers rebounded.

Populations peaked in the 1930's. Unfortunately, beginning in the 1940's tern numbers once again began to plummet because of predation and competition by increasing gull populations. By the late 1970's tern populations in Maine had diminished to less than half of 1930's levels (Table 2).

Maine tern surveys conducted between 1977 and 1989 suggested populations of all 3 species were stable or slowly increasing. Counts in 1977 (Korschgen 1979) were believed to be underestimates, whereas 1988 and 1989 counts (Kress and Borzik 1988, 1989) were derived in part from mark-recapture techniques, which generally yield higher counts than other methods.

Current Population Assessment

Today tern numbers in the Gulf of Maine (including Machias Seal Island) remain stable or increasing. According to surveys conducted in 2004, the Gulf of Maine currently supports 20,829 pairs of Common Terns (up 3% from 2003), 5,694 pairs of Arctic Terns (up 8% from 2003) and 379 pairs of Roseate Terns (stable from 2002) (Hall 2004).

In Maine (not including Machias Seal Island), estimated populations of island nesting terns in 2004 were as follows: 5,547 pairs of Common Terns, 3,445 pairs of Arctic Terns, and 170 pairs of Roseate Terns. The number of large colonies (> 100 pairs) of nesting terns in Maine, has declined from 16 in 1931 to 10 in 2004 (Palmer 1937, Hall 2004). The number of large productive colonies is a better measure of the status of the population than is total number of colonies (eg., a few large, productive, relatively stable colonies likely contribute more to the growth and security of the regional population than do many small, unproductive, unstable colonies). Conversely, there can be a greater risk of catastrophic declines by having a large percentage of a population restricted to a few sites. In 2004, Common Terns nested on 22 islands along the coast of Maine, but 84% of the population occurred on only 6 islands. Arctic Terns nested on 10 islands in 2004, with 98% of the population nesting on 5 islands, Roseate Terns nested on 7 islands with only Eastern Egg Rock supporting more than 100 pairs. Productivity has recently declined on some of the larger tern colonies in the Gulf of Maine, due to an increase in disease and predation (Hall 2004), perhaps indicating some colonies may be approaching carrying capacity.

Areas of coastal Maine where terns formerly nested in abundance and are now largely absent or shifting from island to island seeking a secure colony site include: 1) the downeast coast between Machias Seal Island and Petit Manan, 2) Blue Hill Bay, and 3) inner Penobscot Bay. Although terns have nested in small numbers in these areas recently, no productive colonies exist, and these subpopulations may be lost without active management.

Limiting Factors

Predation

Competition and predation by Herring and Great Black-backed Gulls are the primary factors limiting the abundance and distribution of island-nesting terns in Maine. Recent increasing populations of gulls are believed to have caused substantial declines in Maine's populations of terns, primarily through competition for nest sites and predation on eggs, chicks, and, occasionally, adults (Hatch 1970, Drury 1973-74, Kress et al. 1983).

At the turn of the century, Herring Gulls shared the same severe population declines experienced by terns and other seabird populations. Hunting, eggging, and harvesting for the millinery industry decimated Herring Gull populations. By 1901, there were only 11,000 pairs in the U.S. all nesting in Maine (Drury 1973). With the passage of the Migratory Bird Treaty Act and consequent protection, by 1931, the New England and Long Island population had rebounded to 41,000 pairs. Numbers continued to increase with expanding human development along coastal areas and subsequent increases in open landfills and waste areas. By 1972, there were 90,000 pairs nesting

at 305 sites from Grand Manan to New York City. However, Herring gull populations may be declining from the 1970's and 1980's throughout their Northeastern North American range (Schauffler 1998).

Nesting Black-backed Gulls were absent in the U.S. until the late 1920s or early 1930s (Drury 1973). In 1931, 25-35 pairs nested at 12 sites in New England. As with Herring Gulls, Black-backed Gull numbers continued to increase and by 1972 there were 12,400 pairs nesting at 177 sites from Grand Manan to Long island (Drury). Unlike the Herring Gull population, the Black-backed Gull population continued to expand and by 1995 there were approximately 15,500 pairs at 231 sites in Maine (Kress and Hall 2002).

Other predators that limit abundance and productivity at some nesting islands include: Great-horned Owls, Black-crowned Night Herons, Peregrine Falcons, rats and mink.

Weather

Weather may also be a limiting factor. Eggs and chicks are sometimes lost to storms and high tide washovers. Prolonged periods of inclement weather can also reduce breeding succes. Inclement conditions such as heavy rains, wind, temperature and periods of fog can result in lower breeding success due to mortality of chicks and eggs and/or a reduction in foraging efficiency by parents (Kress and Hall 2002).

Food

The extent to which tern populations in the Gulf of Maine may be limited by reduced food supplies is uncertain. The availability of productive feeding areas within foraging range can be an important factor in determining the suitability of island nesting sites. Changes in food availability and/or prey composition can affect the success of nesting terns (Kress and Hall 2002). For example: in 2000, on Machias Seal Island, Arctic Tern chick diets consisted of less than 50% herring and more than 35% euphausiid shrimp. Euphausiids are considered to be a poor food item and this may account for the poor Arctic Tern chick survival and growth observed that year (Charette et al. 2004).

Disease

With relatively large numbers of nesting terns concentrated on only a few islands tern colonies are especially vulnerable to disease outbreaks which may limit numbers and breeding success. For example: in 2002 and 2003, 20 – 30% of the tern colony on Stratton Island was affected by a disease that has yet to be identified. All three tern species suffered chick mortalities (Allen 2002, PMNWR 2003).

Human Disturbance

Disturbance by individuals in colonies do result in adverse effects such as reduced egg or chick survival because these eggs and chicks may be exposed to extended temperature extremes, inclement weather, and predation if parents do not quickly return to their nests (Kress and Hall 2002).

Winter Mortality

Regional declines in numbers of Roseate Terns may be due, in part, to mortality on the wintering grounds (Andrews et al. 1989). Winter mortality may also be a significant limiting factor for both subadult and adult Common Terns (Blokpoel et al. 1982).

USE AND DEMAND ASSESSMENT

Historic trends

Prior to 1918, all three species of island-nesting terns were subjected to uncontrolled shooting, primarily to obtain feathers for the millinery trade, and egg collecting. Changes in women's fashions and passage of the Migratory Bird Treaty Act in 1918 helped protect these species from harvesting and egg collecting. Since then, use has become primarily nonconsumptive.

Current Trends

Current use of all 3 species of island-nesting terns is nonconsumptive use by birdwatchers, photographers, and the general public. The total number of individuals that gain enjoyment from actively seeking or opportunistically observing terns in Maine is unknown. However, we do know approximately 25,000 people visit Petit Manan Island via tour boat each year, and commercial tour boats are also visiting Eastern Egg Rock and Matinicus Rock (Linda Welch pers. comm.).

Few statistics are available to assess the use and demand relative to species of endangered and nongame wildlife such as terns. An estimated 818,000 nonconsumptive users of fish and wildlife (approximately 73% of the state's population) reside in Maine (USFWS 1996). Nonconsumptive use of wildlife generated \$220 million in Maine in 1996. In 1991, bird watching alone generated \$64.8 million in retail revenues in Maine. Annual contributions to Maine's Endangered and Nongame Wildlife Fund also demonstrate public interest and support. In 2003, the Conservation

Registration Plate (Loon plate) raised \$425,147 for nongame and endangered wildlife programs (MDIFW 2004).

As the popularity of birding, wildlife photography, and nature study grows, and as the awareness of the diversity of Maine's wildlife resources grows, the demand for observation and photographic opportunities relative to rare species such as island-nesting terns may increase. Unfortunately, human presence at tern nesting colonies during breeding season (May-August) jeopardizes nest success, but current management seeks to reduce human disturbance during this period. Increases in abundance of terns nesting and feeding near the mainland will increase opportunities for observation, and perhaps decrease the demand for visits to nesting islands.

SUMMARY AND CONCLUSIONS

Current populations of Common Terns, Arctic Terns, and Roseate Terns in the Gulf of Maine appear to be stable or slowly increasing, but are at levels less than 50% of populations reported in the 1930s. Recent declines in tern populations resulted primarily from increases in regional populations of Great Black-backed and Herring Gulls, which compete with terns for nesting islands and prey on tern eggs and chicks. For several decades, monitoring and management of tern species in Maine have been conducted by several private organizations and government agencies. State-wide censuses of island nesting terns in Maine were conducted by Dr. William Drury and other individuals starting in the 1960's. The USFWS (Korschgen 1979) and the Gulf of Maine Tern Working Group (GOMTWG) censused terns in the 1970's and 1980's. Management activities began in the 1980's when the USFWS and NAS controlled gulls to reestablish Arctic, Common, and Roseate Tern colonies at Petit Manan, Eastern Egg Rock, Matinicus Rock, Seal Island, and Stratton Island.

In 1990, MDIFW developed the island nesting tern assessment for Maine and in conjunction with a public working group, established an island nesting tern management goal and management objectives that were approved by the Commissioner and the Commissioner's Advisory Council. The goal defines a long-term outlook for the recovery of these species. It is the basis for the Department's Management System completed in January, 1993.

Management objectives are interim in nature and express population and distribution objectives that were to be achieved by 2000. Long-term recovery objectives

have not been established. All 3 management objectives have not yet been met, but significant progress is being made as outlined below.

The first Maine objective addresses the State and Federally listed Endangered Roseate Tern. This objective is to establish at least 3 productive colonies with 50 or more pairs of Roseates by 2000. In 2000, 285 pairs of roseates were nesting on four islands but only two, Eastern Egg Rock (165 pairs) and Stratton Island (104 pairs) had exceeded the 50 pair objective. Roseate tern numbers have grown from 108 pairs in 1990 to a high of 289 pairs in 2001, but have since declined to 170 pairs in 2004. Greater Roseate numbers must be encouraged on currently-occupied islands or newly established tern restoration islands to meet this objective. Essential Habitat sites for Roseate Tern nesting areas were first adopted in 1992 with annual updates continuing. There are currently 22 nesting sites designated as Essential Habitat under Maine's Endangered Species Act.

The second MDIFW management objective identified by MDIFW's strategic planning process is to increase all 3 species of island nesting terns to 1930's levels in Maine (6,000 pairs of Common Terns, 6,000 pairs of Arctic Terns, and 276 pairs of Roseates). All three species are responding to intensive management, and numbers of breeding pairs have increased since the mid 1980's. Between 1984 and 2000, the Common Tern population increased from 2,543 to 6,759 pairs, Arctic Terns increased from 1,720 to 2,619 pairs, and Roseate Terns increased from 76 to 285 pairs. Population objectives for Common Tern and Roseate Tern were met in 2000, unfortunately since then, both populations have suffered declines and are currently below the 2000 population target (Table 1).

The final objective is to maintain a distribution of at least one colony with at least 200 pairs in each of 7 coastal regions. Between 1984 and 2000, the number of Common Tern colonies decreased from 30 to 23; Arctic Terns decreased from 18 to 10, and Roseate colonies decreased from 8 to 4. In 2004, 84% of the Common Terns were nesting on just 6 islands, 98% of the Arctic Terns on 5 islands, and 100% of the Roseate Terns were nesting on 6 islands. These, for the most part, are actively-managed islands. Currently, colonies exceeding 200 nesting pairs occur on 9 islands, but only 5 of the 7 coastal regions enumerated in the Management System have sites with 200 or more nesting pairs (Table 1). Efforts to establish successful tern colonies in the two remaining coastal colonies are underway.

Substantial population gains have resulted from intensive management at a few coastal islands. However, all 3 tern species now "have most of their eggs in a few baskets". At present, over 80% of Maine's island nesting terns occur on 7 intensively managed island colonies: Stratton Island, Seal Island, Metinic Island, Eastern Egg Rock, Outer Green Island, Matinicus Rock, and Petit Manan Island. Such a concentrated population is especially vulnerable to local catastrophic losses due to predation, disease, inclement weather, washovers, oil spills, or failure of food supplies. Small, unmanaged colonies in the state are generally unstable, and exhibit poor reproductive success because of interference from gulls and other predators, human disturbance, suboptimal nesting habitat, and possibly poor food supply. Nesting terns have already disappeared from much of coastal Maine. Without continued intensive management, island nesting terns are likely to decline.

LITERATURE CITED

- Andrews, R., G. Atwell, B. G. Blodget, I. C. T. Nisbet, and M. Scheibel. 1989. Roseate tern recovery plan. Northeastern population. U.S. Fish and Wildlife Service, Newton Corner, MA. 86pp.
- Allen, R. B. (ed.) 2002. Minutes of the Gulf of Maine Seabird Working Group. Unpubl. Rep. Maine Department Inland Fisheries and Wildlife. 32pp.
- Blokpoel, H., R. D. Morris, and P. Trull. 1982. Winter observations of Common Terns in Trinidad, Guyana, and Suriname. *Colonial Waterbirds* 5:144-147.
- Burger, J. and M. Gochfeld. 1991. *The Common Tern: Its Breeding Biology and Social Behavior*. Columbia University Press, New York. 413pp.
- Charette, M. R., A. L. Black, C. M. Devlin, A. W. Diamond, and L.I. Minich 2004. Machias Seal Island 1995 – 2003 Progress Rep. Univ. of New Brunswick 67 pp.
- Cramp, S. (ed.) 1985. *The Birds of the Western Palearctic*. Vol. IV Terns to woodpeckers. Oxford University Press, Oxford. (Handbook of the birds of Europe, the middle east and North Africa).
- Coulson, J. C. and J. Horobin. 1976. The influence of age on the breeding biology and survival of the Arctic Tern *Sterna paradisaea*. *J. Zool.* London 178: 247-260.
- Diamond, A. W., C. S. Hall and S. W. Kress (eds). 2001. Minutes of the Gulf of Maine Seabird Working Group. Unpubl rep. National Audubon Society, Ithaca, N.Y. 40pp.
- DiCostanzo, J. 1980. Population dynamics of a Common Tern colony. *J. Field Ornithol.* 51: 229-243.
- Drury, W. H. 1973-74. Population changes in New England seabirds. *Bird-Banding* 44:267-313; 45:1-15.
- Gochfeld, M. , J. Burger and I.C.T. Nisbet. 1998. Roseate Tern (*Sterna dougallii*). In *the Birds of North America*, No. 370 (A. Poole and F. Gill, eds.). The Birds of North America Inc. Philadelphia, PA.
- Hall, C. S. 2004. Minutes from the Gulf of Maine Seabird Working Group, 18th annual summer meeting. Unpubl. rep. 36 pp.
- Hall, C. S. 1999. The diet, reproductive performance and management of Common and Arctic Terns in the Gulf of Maine. M. Sc. Thesis, University of Massachusetts, Amherst, Ma.

- Harrison, P. 1983. Seabirds. Houghton Mifflin Company, Boston. 448pp.
- Hatch, J. J. 1970. Predation and piracy by gulls at a ternery in Maine. *Auk* 87:244-254.
- Hays, H. , J. DiCostanzo, G. Cormons, P. T. Z. Antas, J. L. X. do Nascimento, et al. 1997. Recoveries of Roseate and Common Terns in South America. *J. Field Ornithol.* 68:79-90.
- Hutchinson, A. E. 1982. Wildlife management areas. Coast of Maine. *Maine Fish and Wildlife (summer)*. Pg. 9-14.
- Kress, S. W. and C. Scott Hall. 2002. The Tern Management Handbook. Unpubl. rep. USFWS, Migratory Bird Division. Hadley, MA. 164pp.
- Kirkham, I. R. and D. N. Nettleship. 1987. Status of the Roseate Tern in Canada. *J. Field Ornithol.* 58:505-515.
- Korschgen, C. E. 1979. Coastal waterbird colonies: Maine. U. S. Fish and Wildlife Service, Biological Services Program. FWS/OBS-79/09. 83pp.
- Kress, S. W. 1983. The use of decoys, sound recordings, and gull control for re-establishing a tern colony in Maine. *Colonial Waterbirds* 6:185-196.
- Kress, S. W. and C. Scott Hall. 2002. The Tern Management Handbook. Unpubl. rep. USFWS, Migratory Bird Division. Hadley, MA. 164pp.
- Kress, S. W., E. H. Weinstein, and I. C. T. Nisbet. 1983. The status of tern populations in northeastern United States and adjacent Canada. *Colonial Waterbirds* 6:84-106.
- Kress, S. W. and E. H. Weinstein (comp.). 1987. Minutes of the Gulf of Maine Tern Working Group. Unpubl. report. 7pp.
- Kress, S. W. and R. V. Borzik. 1988. Minutes of the Gulf of Maine Tern Working Group. Unpubl. rep. 12pp.
- Kress, S. W. and R. V. Borzik. 1989. Minutes of the Gulf of Maine Tern Working Group. Unpubl. rep. 14pp.
- Lovett, S. 1984. A list of Common, Arctic, and Roseate tern nesting sites along the Maine coast. Unpubl. report. Maine Dept. Inland Fisheries and Wildlife.
- MDIFW. 2004. Wildlife Division Research and Management Report – 2004. Maine Dept. Inland Fisheries and Wildlife. Unpubl. Rep.

- Nisbet, I. C. T. 2002. Common Tern (*Sterna hirundo*). In the Birds of North America, No. 618 (A. Poole and F. Gill eds.) The Birds of North America Inc., Philadelphia, PA.
- Nisbet, I. C. T. and E. Cam. 2002. Test for age-specificity in survival of the Common Tern. *J. Appl. Statist.* 29:65-83.
- Nisbet, I. C. T. and W. H. Drury. 1972. Measuring breeding success in Common and Roseate Terns. *Bird Banding* 43:97-106.
- Palmer, R. S. 1937. Notes on Maine tern colonies, 1937. Unpubl. rep. 15pp.
- Petit Manan National Wildlife Refuge. 2003. Minutes of the Gulf of Maine Seabird Working Group, 20th annual meeting. Unpubl. rep. 40 pp.
- Schauffler, R.P. 1998. An estimate of the numbers of breeding Herring and Great Black-backed Gulls on the coast of Maine and a comparison on methods used to count them. M. Sc. Thesis, Univ. of Massachusetts, Amherst. Ma 78 pp.
- Spendelov, J.A. and J.D. Nichols. 1989. Annual survival rates of breeding adult Roseate Terns. *Auk* 106: 367-374.
- Root, T., 1999. Atlas of wintering North American Birds – an analysis of Christmas bird count data. Univ. Chicago press. 312pp.
- Trull, P. 1988. The Roseate Tern in Massachusetts. *Massachusetts Wildlife* 38(3):22-31.
- USFWS. 1996. The 1996 National Survey of Hunting, Fishing, and Wildlife-Associated Recreation. USFWS.
- USFWS. 1998. Roseate Tern Recovery Plan – Northeastern Population. First Update. Hadley Ma 97 pp.

APPENDIX 1

SUMMARY OF INLAND COMMON TERN NESTING COLONIES

Lake	County	Observation	Date
Bog Brook	Washington	2 birds	1990
Graham Lake	Hancock	4 nests	1993
Mountainy Pond	Hancock	8 nests	1992
Big Burnt Pond	Hancock	1 nest	1993
Nicatous Lake	Hancock	2 nests obs.	2005
South Branch	Penobscot	birds obs	1993
Scraggley lake	Penobscot	1 nest obs.	2005
Twin Lake	Penobscot	1 nest	2001
Caucomgomic Lake	Piscataquis	5 nests	2001
Shallow Lake	Piscataquis	100 pair	2001
Poland Lake	Piscataquis	25-50 pair	2001
Allagash Lake	Piscataquis	7 nests	1989
		100 birds obs.	1988
		4 birds obs	1994
		6 nests	2003
Chamberlain Lake	Piscataquis	19 nests	1989
		8 nests	1994
		4 nests	2003
Chesuncook Lake	Piscataquis	11 nests	1986
		2 nests	1989
		11 nests	2003
Ragged Lake	Piscataquis	10 birds obs.	1996
Lobster Lake	Piscataquis	5 nests	1989
		2 nests, 12 adults	1994
		8 nests	2003
Moosehead Lake	Piscataquis	birds obs.	1990
Schoodic Lake	Piscataquis	4 adults obs.	1985
Seboies Lake	Piscataquis	10-15 pairs	1992
Eagle Lake	Piscataquis	2 nests	1980s
East Grand Lake	Aroostook	colony reported	1993
		15 adults	1994
Portage Lake	Aroostook	2 birds obs	1989
		20 birds obs	1993
Long Lake	Aroostook	40 birds obs	1993
		20 pairs	1996

Lake	County	Observation	Date
Christina Reservoir	Aroostook	2-3 pairs	1993-94
Square Lake	Aroostook	birds obs	1993
		3 birds obs.	1997
Mud Lake	Aroostook	birds obs	1993
Cross Lake	Aroostook	20 birds obs.	1997