

ISLAND-NESTING TERNS ASSESSMENT

September 1991

Prepared by:

Maine Department of Inland Fisheries and Wildlife
Wildlife Division
Wildlife Resource Assessment Section
Endangered and Nongame Wildlife Project

TABLE OF CONTENTS

	Page
INTRODUCTION.....	3
NATURAL HISTORY.....	4
Description.....	4
Distribution.....	4
Life History.....	6
Reproduction	6
Wintering.....	8
Survival	8
HISTORY	10
Habitat Trends	10
Population Trends	12
USE AND DEMAND TRENDS	16
REGULATIONS.....	17
PAST AND CURRENT MANAGEMENT	19
HABITAT ASSESSMENT.....	21
POPULATION ASSESSMENT.....	24
Limiting Factors	24
Carrying Capacity	24
Estimated Population.....	25
USE AND DEMAND ASSESSMENT	27
CRITERIA FOR DOWN-LISTING.....	28
SUMMARY AND CONCLUSIONS	29
LITERATURE CITED	30
APPENDIX I	32

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. dougalli*). A fourth species, the Least Tern (*S. antillarum*) nests on sandy beaches along Maine's southern coast. The fifth species, the Black Tern (*Chlidonias niger*), nests on 4-5 inland freshwater lakes and marshes in the state. This assessment deals only with 3 species of 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 breeding season) and long slender bills. All three species are very 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.

Distribution

In North America, Common Terns breed in coastal areas and on large inland lake from Hudson Bay south to the Carribean. Elsewhere, Common Terns breeding along the coasts of Europe and North Africa. Common Terns that nest in North America migrate south along both Atlantic and Pacific coast and winter from Florida and southern California south to Peru and Argentina.

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 from Nova Scotia south discontinuously to the Caribbean, and in coastal regions of Europe, Africa, and the Indian and Pacific Oceans (Harrison 1983). Roseate Terns that nest in North America winter along the northeast coast of South America.

Maine's population of Common Tern is located between larger populations to the north and south. South of Maine, over 36,000 pairs nest on Long Island and in Massachusetts (MacLean et al. 1988; B. Blodget, Mass. Div. Fish and Wildlife, unpubl. data). To the north, over 22,000 pairs of Common Terns nest in the Gulf of Saint Lawrence and the Canadian Maritime provinces (Kress et al. 1983). Maine's population of Common Tern 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. A few pairs of Common Tern have nested on islands in large, inland lakes in northern and mid-coast Maine, but their distribution and status are poorly known.

Maine's Arctic Tern population is at the southern edge of the western Atlantic population. To the north, another 3,700-4,700 pairs nest in the Canadian Maritimes (Kress et al. 1983) and an estimated 10,000 pairs occur in Newfoundland and Labrador (W. Drury, pers. comm.). Maine's Arctic Tern tend to nest in larger colonies than occur in Canada (S. Kress, pers. comm.).

Roseate Tern in Maine occur at the northern edge of their breeding range. Only about 100 pairs nest in Canada, primarily Nova Scotia (Kirkham and Nettleship 1987), while south of Maine over 3,000 pairs nest in Massachusetts, Connecticut, and Long Island (Andrews et al. 1989).

Machias Seal Island, located in the Bay of Fundy off the coast of eastern Washington County, Maine, supports the largest colony of terns in the Gulf of Maine: 1,804 pairs of Arctic Tern, 107 pairs of Common Tern, and 1 pair of Roseate Tern (Kress and Borzik 1988). Machias Seal Island is claimed by Canada and is managed by the Canadian Wildlife Service. 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 it lies outside the jurisdiction of both MDIFW and the U.S. Fish and Wildlife Service.

Life History

Reproduction

In Maine, Common Tern, Arctic Tern, and Roseate Tern nest primarily on coastal islands. All three species nest colonially, and often in association with each other. Common Tern prefer to nest nearer the mainland, while Arctic Tern nest most frequently on outer islands. Roseate Tern occur in small numbers only within colonies of the other two species.

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 Tern, Arctic Tern, and Roseate Tern 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. Common Tern in Maine usually nest on bare rocks immediately adjacent to tall vegetation, but will sometimes nest on sandy or rocky beaches on seaweed, or in short vegetation. Roseate Tern prefer to nest in thick vegetation, under driftwood, or in rock crevice, but will sometimes nest in the open. Arctic Tern show the least variation in nest sites. They prefer to nest on bare rocks or beaches, presumably because their short legs preclude movement through tall, dense vegetation.

Arctic Tern and Roseate Tern usually lay 1-2 eggs, Common Tern 2-3 eggs. Egg-laying is often relatively synchronous for each species within the colony, unless predation or disturbance leads to relaying. 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 22-29 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.

Common Tern, Arctic Tern, and Roseate Tern feed on small schooling fish and crustaceans which they catch by plunging vertically into the water and seizing prey in their bill. Primary prey species in Maine include white hake, Atlantic herring, and sand lance. Adult terns may fly up to 20 miles round-trip to capture fish to feed young. The ability of adult terns to provision young largely determines how many young will fledge.

Productivity of nesting terns, measured as mean number of chicks fledged per pair, is highly variable between colonies and years. Relatively high productivity was reported from Petit Manan in 1988: 1.74 chicks fledged per pair for Common Tern, and 1.19 chicks fledged per pair for Arctic Tern (Kress and Borzik 1988). In contrast, many of the small, unmanaged colonies fledge no chicks in a given year. Because of a lack of standardization, estimates of productivity have sometimes not been directly comparable between years or colonies.

Wintering

By mid to late August, both adults and young begin the migration south. Most information on winter distribution of Roseate Tern is summarized by Nisbet (1984). Roseate Tern are thought to winter along the north coast of South America from Colombia to Brazil, but are seldom observed. In some areas of the wintering grounds, particularly Guyana, they are trapped by a few local residents for food (Trull 1988). First and some second-year birds remain on the wintering grounds year-round.

Common Tern winter from the southern coast of the United States south to Peru, Brazil, and Argentina. Arctic Tern winter in the extreme southern regions of the Southern Hemisphere. As with Roseate Tern, most first-year and many second-year Common Tern and Arctic Tern remain all year on the wintering grounds.

Survival

Limited information on survival rates is available for these 3 tern species. DiCostanzo (1980) estimated an annual adult survival rate of 0.92 for Common Tern at

Great Gull Island in New York. Coulson and Horobin (1976) estimated annual adult survival rates of 0.87-0.88 for Arctic Tern in northern Europe. Recently Spendelow and Nichols (1989) estimated annual adult survival rates of only 0.74-0.75 for Roseate Tern nesting at Faulkner Island in Connecticut. They also noted that the methods used by DiCostonzo (1980) and Coulson and Horobin (1976) may have overestimated survival rates for Common Tern and Arctic Tern.

HISTORY

Habitat 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, Maine Dept. of Inland Fish and Wildl., 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, firewood cutting, granite quarrying, and harvest of seabirds and eggs for food or feathers for the millinery trade led to declines in tern populations and availability of nesting habitat. 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. Most islands that supported tern colonies at some time during the past 100 years no longer have terns.

Trends in food resources are less certain; forage fish may have declined in abundance because of overfishing or pollution in nursery areas. At Matinicus Rock, (Figure 1) for example, Arctic Tern productivity in the last 3 years has averaged less than 1 chick fledged per nest (Arctic Tern usually lay 2 eggs/clutch; S. Kress, unpubl. data). Detailed studies of feeding behavior indicated that the larger (first hatched) chick in each brood received the most meals and was the only bird to fledge from the brood.

Figure 1. Locations of major tern nesting islands and geographic locations mentioned in text.

Some Arctic Tern 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, unpubl. data).

Population Trends

Estimates of total numbers and colonies of terns along the coast of Maine, exclusive of Machias Seal Island, from 1885 to 1989, are summarized in Table 1. Estimates for Machias Seal Island are given separately in Table 2. Although Machias Seal Island is claimed by the Canadian Province of New Brunswick, its nesting terns are clearly part of the Gulf of Maine system.

Estimates of Common Tern, Arctic Tern, and Roseate Tern populations along the coast of Maine have all declined by over 50% since the 1930s (Table 1). Counts between 1977 and 1989 suggest populations of all 3 species are stable or slowly increasing, but imprecision of counts during this period, as in the past, permit only crude trend analyses. 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. There remains uncertainty whether numbers reported between 1911 and 1945 represent pairs or individuals (W. H. Drury, person. comm.).

The number of large colonies (>100 pairs) of Common Tern and Arctic Tern has declined from 16 in 1931 to 6 in 1989 (Palmer 1937, Kress and Borzik 1989). Number of large productive colonies is a better measure of the status of the population than is total number of colonies, e.g. a few large, productive, relatively stable colonies likely

Table 1. Estimates of numbers of pairs and colonies of 3 species of island-nesting terns in Maine, 1885-1989. Numbers of colonies are in parentheses. Data do not include estimates for Machias Seal Island.

Year	Species						Source
	COTE		ARTE		RSTE		
1989	2,635	(18)	2363	(9)	80	(5)	a
1988	2,848	(18)	2020	(9)	68	(7)	b
1987	2,073	(19)	1902	(8)	52	(6)	c
1984	2,543	(28)	1720	(17)	76	(8)	c
1982	nd		1300	(5)	140	(3)	d
1977	2,095	(24)	1640	(8)	80	(3)	e
1972	2,600	(18)	2900	(11)	75-150	(2)	d
1945	7,900		5000		nd		d, g
1940	8,000	(25)	4500		nd		d, f, g
1931-36	6,000	(25)	6100	(9)	276	(4)	d, f, g
1911	4,000	(19)	4400		nd		d, g
1902-05	4,800	(19)	4400		nd		d, g
1885	Present		Present		Present		d

Nd = no data available.

^aKress, S. W. and R. V. Borzik. 1989. Minutes of the Gulf of Maine Tern Working Group, unpubl. report. 14pp.

^bKress, S. W. and R. V. Borzik. 1988. Minutes of the Gulf of Maine Tern Working Group, unpubl. report. 13pp.

^cKress, S. W. and E. H. Weinstein. 1987. Minutes of the Gulf of Maine Tern Working Group, unpubl. report. 7pp.

^dKress, 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.

^eKorschgen, C. E. 1979. Coastal waterbird colonies: Maine. U. S. Fish and Wildlife Service, Biological Services, FWS/OBS – 79/09. 83pp.

^fPalmer, R. S. 1949. Maine birds. *Bull. Mus. Comp. Zool., Harvard College*, Vol. 102. Cambridge, MA. 656pp.

^gDrury, W. H. 1973-74. Population changes in New England seabirds. *Bird-Banding* 44:267-313; 45:1-15.

Table 2. Estimates of numbers of pairs of Arctic (ARTE) and Common Terns (COTE) on Machias Seal Island, New Brunswick, 1901-1988.

Year	Species		Source
	ARTE	COTE	
1988	1,804	107	b
1987	1,200	100	c
1984	1,450	nd ^a	c
1977	1,506	nd ^a	e
1931-36	1,900	100	d, f
1911	1,100	nd ^a	g
1901	1,100	nd ^a	h

^and = No data available.

^bKress, S. W. and R. V. Borzik. 1988. Minutes of the Gulf of Maine Tern Working Group, unpubl. report. 13pp.

^cKress, S. W. and E. H. Weinstein. 1987. Minutes of the Gulf of Maine Tern Working Group, unpubl. report. 7pp.

^dKress, 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.

^eKorschgen, C. E. 1979. Coastal waterbird colonies: Maine. U. S. Fish and Wildlife Service, Biological Services, FWS/OBS – 79/09. 83pp.

^fPalmer, R. S. 1949. Maine birds. *Bull. Mus. Comp. Zool., Harvard College*, Vol. 102. Cambridge, MA. 656pp.

^gDrury, W. H. 1973-74. Population changes in New England seabirds. *Bird-Banding* 44:267-313; 45:1-15.

contribute more to the growth and security of the regional population than do many small, unproductive, unstable colonies. The apparent increase in total number of sites where Roseate Tern occur (Table 1) may be the result of more accurate censusing in recent years, which recorded occasional pairs of Roseate Tern within colonies of the other two species.

USE AND DEMAND 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 hunting and egg collecting, and since that time use has been primarily nonconsumptive, i.e. birdwatching and photography.

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 U.S. Fish and Wildlife Service and thus is also 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 that are directed at Roseate Terns and are controlled by the U.S. Endangered Species Act must be granted by the Regional Director of the U.S. Fish and Wildlife Service. Any banding or other research or management activities directed at federally endangered or threatened birds must also be authorized by the MDIFW.

The Roseate Tern is also classified as endangered by the Maine Department of Inland Fisheries and Wildlife (MDIFW) under provisions of the Maine Endangered Species Act of 1975. The Act protects state-listed species, such as the Roseate Tern, 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 Tern or other state-listed species.

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 or the eggs or young handled.

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 1 and August 15. A letter of permission from MDIFW is required to land during the nesting season on these islands, owned or managed by MDIFW.

Common Terns and Arctic Terns are classified as "Species of Special Concern", the third category after "Endangered" and "Threatened" on MDIFW's official 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 do not receive the legal protection afforded to Endangered and Threatened Species by Maine's Endangered Species Act.

Habitats of endangered and threatened species, including the Roseate Tern, and nesting islands used by Common Tern and Arctic Tern, receive regulatory oversight by the Maine Department of Environmental Protection (DEP) under provisions of the Natural Resources Protection Act of 1988. Also, 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.

PAST AND CURRENT MANAGEMENT

Monitoring and management of terns in Maine during the past 10 years has been carried out by several organizations and agencies. Recent statewide 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). National Audubon Society began a successful program of gull management and efforts to reestablish a tern nesting colony at Eastern Egg Rock (Figure 1) in Muscongus Bay in 1974 (Kress 1983). These efforts have since been expanded to Matinicus Rock, Seal Island, and Stratton Island. The tern colonies that National Audubon Society manages at Eastern Egg Rock and Matinicus Rock are two of the largest and most productive colonies on the Maine coast. The U.S. Fish and Wildlife Service, cooperating with researchers from the College of the Atlantic, began an aggressive program to reduce gull populations at Petit Manan National Wildlife Refuge (Figure 1) in 1984 that has resulted in reestablishment of a major colony of Arctic Terns and Common Terns and over 60% of the Roseate Terns that nest in Maine. Maine Audubon Society has monitored several current and former nesting islands in southern Maine since 1981.

The Maine Department of Inland Fisheries and Wildlife owns and manages 282 coastal islands and ledges, including 70 former or current tern nesting islands, within its Coast of Maine Wildlife Management Area. MDIFW maintains a database 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 the Department of Environmental Protection and the Land Use Regulation Commission through various environmental review and permitting processes.

Gull control programs carried out by the U.S. Fish and Wildlife Service and National Audubon Society have demonstrated that an intensive program of poisoning, shooting, and nest destruction continued over several successive years can effectively remove and discourage nesting gulls. This, in turn, can allow former tern colonies to become reestablished 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 control. Without this intensive management, these colonies would probably decline or disappear.

HABITAT ASSESSMENT

Island-nesting terns nested on 21 islands along the Coast of Maine in 1989. Only 10 islands supported colonies with more than 50 pairs of terns, however, and only 6 islands supported colonies with more than 100 pairs (Table 3). Of the 20 islands that Palmer (1937) reported as 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 because of the presence of nesting gulls or human habitation, or because of vegetation succession. The abundance of forage fish for terns in the Gulf of Maine is uncertain at present, but may be reduced below levels of the 1930s and 40s.

At least 151 different islands in the Gulf of Maine have been used by nesting terns at various times from the late 1800's to the present (Maine Dept. Inland Fish and Wildl., unpubl. data; W. H. Drury, pers. comm.). Of these 151 islands, 92 (61%) are in conservation or public ownership, and 61 of 151 (40%) are owned or managed by MDIFW (Table 4). Of the total of 27 islands used for nesting in 1988 or 1989, 15 (56%) are in public or conservation ownership (Table 4).

Table 3. Summary of census data for Common Terns (COTE), Arctic Terns (ARTE), and Roseate Terns (RSTE) in Maine in 1989 (Kress and Borzik 1989).

Island	Species			Productivity ^b
	COTE ^a	ARTE ^a	RSTE ^a	
Petit Manan	856 ^c	856 ^c	48 ^c	0.7 COTE 0.9 ARTE
Brimstone	0	0	0	-
Mason Ledge	0	0	0	-
Indian Point	67	0	0	nd
Little Spoon	7	0	0	nd
Great Spoon	0	6	0	nd
Cowpens	0	0	0	-
Three Bush	56	0	0	nd
Two Bush	0	0	0	-
Gooseberry	35	0	0	nd
Saddleback	0	0	0	-
Green Ledge	0	0	0	-
White Ledge	0	0	0	-
Seal Is.	1	16	0	0.9 COTE
Matinicus Rock	53 ^c	1,166 ^c	0	0.8 ARTE
Wooden Ball	0	0	0	-
Little Green	2	61	0	nd
Large Green	85 ^c	215 ^c	0	0
Metinic	0	7	0	nd
Killick Stone	49	0	0	0
Crotch Is.	0	0	0	-
Eastern Egg Rock	883 ^c	36 ^c	17 ^c	0.8 COTE
Stratton Is.	122	0	2	0.1 COTE
Hen Is.	16	0	0	0
Turnip	0	0	0	-
Pond	48	0	0	0.1 COTE
Sister Is. Ledge	0	0	0	-
North Sugarloaf	0	0	0	-
Outer Head	2	0	0	0
Beach Is.	7	0	1	0
The Nubbin	70	0	0	0
West Goose Rocks	237	0	12	0
Clapboard Is. Ledge	39	0	0	0
Grassy Ledge	0	0	0	-
French Is. Ledge	0	0	0	-
Total Pairs	2,635	2,363	80	

^aData are expressed as numbers of pairs.

^bProductivity data are expressed as mean number of young fledged per pair.

^cEstimate based on nest count adjusted by Lincoln index.

Table 4. Ownership of islands used historically and currently (1988 or 1989) by nesting terns in the Gulf of Maine.

Ownership	No. of Islands	
	Historical	Current
State		
Dept. Inland Fish. and Wildlife ^a	61	9
Bureau Public Lands	8	0
Bureau Parks and Recreation	1	1
Federal		
Fish and Wildlife Service	4	2
National Park Service	1	0
Coast Guard	2	1
Canadian Wildlife Service	1	1
Private, Non-profit Conservation		
The Nature Conservancy	10	0
National Audubon Society	4	1
Private, Individual or Family	59	12
Totals	151	27

^aIncludes islands owned by Bureau of Public Lands with management authority transferred to Inland Fisheries and Wildlife.

POPULATION ASSESSMENT

Limiting Factors

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. Increasing populations of Herring and Great Black-backed Gulls during this century are believed to have caused substantial declines in Maine's populations of Common Tern, Arctic Tern, and Roseate Tern during the past 40 years, primarily through competition for nest sites and predation on eggs, chicks, and, occasionally, adults (Hatch 1970, Drury 1973-74, Kress et al. 1983).

Human disturbance, and predation by Great-horned Owls, Black-crowned Night Herons, rats and mink are factors limiting abundance and productivity at some nesting islands. Eggs and chicks are sometimes lost to storms and high tide washovers. The extent to which tern populations in the Gulf of Maine may be limited by reduced food supplies is uncertain. Regional declines in numbers of Roseate Tern 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 Tern (Blokpoel et al. 1982).

Carrying Capacity

There currently exist in Maine sufficient nesting islands to support populations of island-nesting terns equal to or greater than the estimated 1931 levels, i.e. 8,000 pairs of Common Tern, 8,000 pairs of Arctic Tern, and 275 pairs of Roseate Tern (Table 1).

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 Tern, Arctic Tern, and Roseate Tern can be expected to remain at or near the current level. If existing management programs are reduced or eliminated, tern populations can also be expected to decline. Conversely, expanded management efforts can be expected to increase functional carrying capacity and result in expanded tern populations.

Estimated Population

Estimated populations of island-nesting terns in Maine in 1989, exclusive of Machias Seal Island, were as follows: 2,635 pairs of Common Tern, 2,363 pairs of Arctic Tern, and 80 pairs of Roseate Tern (Table 1, 3). Common Tern nested on 19 islands along the coast of Maine in 1989, but 80% of the population occurred on 4 islands with ≥ 100 pairs. Excluding Machias Seal Island, Arctic Tern nested on 8 islands in 1989, but 86% of the population nested on 2 islands, Matinicus Rock and Petit Manan.

At present there are only 4 large, relatively stable and productive colonies of island-nesting terns in the Gulf of Maine: Machias Seal Island, Petit Manan, Matinicus Rock, and Eastern Egg Rock (Figure 1). The latter 3 colonies have all shown large and rapid increases in numbers and productivity of nesting terns in response to intensive gull management through poisoning and shooting.

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, 3) inner Penobscot Bay, 4) the southwest approaches to Penobscot Bay, 5) mouth of the Kennebec River, 6) Casco Bay, and 7) Saco Bay. Although terns have nested in small numbers in these areas recently, no secure colonies exist, and these sub-populations may be lost without active management.

USE AND DEMAND ASSESSMENT

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 or regionally is unknown. However, we do know that about 2,000 people visited Eastern Egg Rock in 1989 on 3 commercial tour boats, and 2 other boats conducted tours to visit the nesting colony at Matinicus Rock.

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 (U.S. Fish and Wildlife Service 1982). Annual contributions to Maine's Endangered and Nongame Wildlife Fund also demonstrate public interest and support.

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 grow. Unfortunately, human presence at tern nesting colonies during breeding season (May-August) jeopardizes nest success, and 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.

CRITERIA FOR DOWN-LISTING

Specific criteria for down-listing populations of Common Tern, Arctic Tern, and Roseate Tern in Maine should be determined in consultation with members of the Gulf of Maine Tern Working Group, and in the case of the Roseate Tern, with the federal Roseate Tern Recovery Team. These individuals are actively involved in the management of terns in Maine, and are the most knowledgeable group available to determine population levels necessary to insure the long-term security of Common Tern, Arctic Tern, and Roseate Tern in Maine. Factors to consider when determining criteria for down-listing include: 1) abundance, 2) distribution, 3) productivity, 4) number of protected colonies, and 5) regional status.

The federal Roseate Tern Recovery Team has recommended a level of 5,000 breeding pairs nesting at a minimum of six large productive colonies as the criteria for down-listing the Northeast Atlantic population of the Roseate Tern from “Endangered” to “Threatened” status (Andrews et al. 1989). Removal from federal endangered or threatened status has been recommended if the population reaches the historic 1930’s level of 8,500 pairs.

SUMMARY AND CONCLUSIONS

Population of Common Tern, Arctic Tern, and Roseate Tern in the Gulf of Maine appear to be stable or slowly increasing, but at levels that are less than 50% of populations reported in the 1930s. 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. At present, over 60% of Maine's island nesting terns occur in 3 intensively managed island colonies: Eastern Egg Rock, Matinicus Rock, and Petit Manan. 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. Other colonies in the state are generally smaller, 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, the remaining colonies can be expected to decline or disappear.

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.
- Blokpoel, H., R. D. Morris, and P. Trull. 1982. Winter observations of common terns in Trinidad, Guyana, and Suriname. *Colonial Waterbirds* 5:144-147.
- 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*: 178:247-243.
- 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.
- 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.
- Hutchinson, A. E. 1982. Wildlife management areas. Coast of Maine. *Maine Fish and Wildlife (summer)*. Pg. 9-14.
- 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.
- _____, 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.
- _____ and E. H. Weinstein (comp.). 1987. Minutes of the Gulf of Maine Tern Working Group. Unpubl. report. 7pp.
- _____ and R. V. Borzik. 1988. Minutes of the Gulf of Maine Tern Working Group. Unpubl. report. 12pp.

- _____ and R. V. Borzik. 1989. Minutes of the Gulf of Maine Tern Working Group. Unpubl. report. 14pp.
- Lovett, S. 1984. A list of common, arctic, and roseate tern nesting sites along the Maine coast. Unpubl. report. Maine Dept. of Inland Fish and Wildl.
- MacLean, D. C., T. S. Litwin, A. Ducey-Ortiz, and R. A. Lent (eds.). 1988. 1987 Long Island colonial waterbird and piping plover survey. Seatuck Research Program, Islip, N.Y. 174pp.
- Nisbet, I. C. T. 1984. Migration and winter quarters of North American roseate terns as shown by banding recoveries. *J. Field Ornithol.* 55:1-17.
- Palmer, R. S. 1937. Notes on Maine tern colonies, 1937. Unpubl. report. 15pp.
- _____. 1949. Maine birds. *Bull. Museum Comparative Zoology, Harvard College*, Vol. 102. Cambridge, MA. 656pp.
- Spendelov, J. A. and J. D. Nichols. 1989. Annual survival rates of breeding adult roseate terns. *Auk* 106:367-374.
- Trull, P. 1988. The roseate tern in Massachusetts. *Mass. Wildl.* 38(3):22-31.

Appendix I. Summary of tern colonies along the Maine coast, 1931-36. Estimates are from 1931 as reported by Allen and Norten (1931), unless otherwise noted as 1936 estimates from Palmer (1937, 1949). Estimates are believed to be of individual birds, rather than pairs.

Island	Species			
	Common	Arctic	Roseate	
Machias Seal Is.	200	3,800	1	
Gull Rock	100	500	0	
Fosters Is.	200	1,000	0	
Egg Rock (Jonesport)	500	100	0	
Petit Manan-Green Is.	600	200	0	
Trumpet Is.	1,000	0	0	
West Barge Is.	50	0	0	
Ship Is.	600	0	0	
Brimstone	300	0	0	
Halibut Rock	12	0	0	
Two Bush Isl. (E. Penobscot Bay)	200	0	0	
Little Green Isl (1936)	“few pairs”	“several pairs”	0	
Matinicus Rock	0	6,000	0	
Garden Is. (1936)	2,000	0	0	
Metinic Is.	300	0	0	
Upper Sugarloaf	450	0	50	
Lower Sugarloaf	500	0	100	
Thrumcap (1936)	“quite a few”	“several”	0	
Goose Rock (1936)	275	0	0	
Pond Is.	200	0	0	
Little Mark Is.	50	0	0	
Haddock Rock	50	0	0	
Stepping Stones	12	0	0	
Princes Point Ledge	20	0	0	
Stratton Is.	1,200	0	400	
Ross Is. (Muscongus Bay, 1936)	0	“several pairs”	0	
	Total Terns	8,899	11,940	553
	Total Colonies	10	25	4