# LEAST TERN ASSESSMENT

December 20, 1993

MAINE DEPARTMENT OF INLAND FISHERIES AND WILDLIFE

WILDLIFE DIVISION

WILDLIFE RESOURCE ASSESSMENT SECTION

ENDANGERED AND THREATENED SPECIES GROUP

BY

MARK A. McCOLLOUGH

TABLE OF CONTENTS

# INTRODUCTION

Since 1968, the Maine Department of Inland Fisheries and Wildlife (MDIFW) has aggressively pursued development and refinement of wildlife species assessments and implementation of cost-effective comprehensive programs that support selected goals and objectives for the next 15 years. Assessments are based upon available information and the judgments of professional wildlife biologists responsible for individual species or groups of species. Precise data may not always be available or are too limited for meaningful statistical analysis; however, many trends and indications are sometimes clear and deserve management consideration.

The assessment has been organized to group information in a user-meaningful way. The Natural History section discusses biological characteristics of the species that are important to its management. The Management section contains history of regulations and regulatory authority, past management, past goals and objectives, and current management. The Habitat and Population sections address historic, current, and projected conditions for the species. The Use and Demand section addresses past, current, and projected use and demand of the species and its habitat. A Summary and Conclusions section summarizes the major points of the assessment.

# NATURAL HISTORY

## Description

The Least Tern (*Sterna antillarum*) is the smallest of 13 species of terns that breed in North America. It is distinguished from other coastal terns in Maine; the Arctic (*S. paradisaea*), Common (*S. hirundo*), and Roseate (*S. dougallii*) Terns; by its diminutive size, white forehead contrasted by a black cap, and yellow bill. Like other terns they have long slender wings, thin pointed bill, and black cap during the breeding season. They measure about 21-24 cm long and have a 51 cm wingspread. Boyd and Thompson (1985) developed the following criteria to differentiate sexes. Female's usually have a wing chord < 171 mm and males usually have a wing chord > 174 mm. Males' feet and bill are brighter orange than female's. Female's bill depth is 4.5-5.5 mm while the males' $\geq$ 6.0 mm. Immature birds have darker plumage than adults, a dark bill, and dark eye stripes on their white foreheads. Jackson (1976) described the development of Least Tern chicks. Further details on plumage development and variation were presented by Massey and Atwood (1978) and Thompson and Slack (1983).

## Taxonomy

The Least Tern in North America was first described by Lesson in 1847 (American Ornithologists' Union 1957, 1983). The Least Tern in interior North America was described later as a race (*Sterna albifrons athalassos*) of the Old World little tern (*Sterna albifrons*) (Burleigh and Lowery 1942). Two other New World races are the

eastern or coastal Least Tern (*Sterna albifrons antillarum*), and the California Least Tern (*Sterna albifrons browni*). The coastal Least Tern breeds along the Atlantic and Gulf coasts, and the California Least Tern breeds along the California coast.

As a result of studies on vocalizations and behavior of this group of terns in the Old and New Worlds, the American Ornithologists' Union (1983) now treats the New World Least Terns as a distinct species, *Sterna antillarum*. Subspecies of New World Least Terns recognized by the American Ornithologists' Union (1957, 1983) are the interior Least Tern (now *Sterna antillarum athalassos*), the eastern or coastal Least Tern (*Sterna antillarum*), and the California Least Tern (*Sterna antillarum browni*). However, the validity of Least Tern subspecies has been questioned in recent years (Massey 1976, McCament and Thompson 1987). The most recent morphometric and biochemical assessment of North American Least Terns could not distinguish subspecies (Thompson et al. 1992).

Breeding Behavior

Least Terns arrive at breeding sites on southern Maine beaches from late April to early June. Courtship behavior of Least Terns is similar throughout North America. Courtship occurs at the nesting site or nearby beach (Tomkins 1959). It includes the fish flight, an aerial display involving pursuit and maneuvers culminating in a fish transfer on the ground between two displaying birds. Other courtship behaviors include nest scraping, copulation and a variety of postures, and vocalizations (Ducey 1981, Hardy 1957, Wolk 1974). Least Terns dive and defecate on intruders to nesting colonies. Because of this behavior, they are often referred to as "the little striker".

In Maine, Least Terns nest exclusively in scattered colonies on points and spits of sand beaches south of the Kennebec River. These sand beaches are characterized by highly dynamic areas of accretion and erosion, sparse vegetation, and coarse sand, gravel, and bits of broken shells. Nearly all Least Tern nesting sites in Maine are characterized as baymouth barrier-spit and salt marsh complexes (Nelson and Fink 1980). The geologically dynamic tips of sand spits provide ideal nesting habitat. Salt marshes and beach faces adjacent to nesting areas are highly productive ecosystems that provide feeding and brood-rearing habitat. Nesting habitats are ephemeral, and considerable shifting between nesting areas often occurs between years. The Least Tern nests in close association with the Piping Plover (*Charadrius melodus*) in Maine and throughout New England.

The Least Tern's nest is a shallow and inconspicuous depression in an open, sandy area, gravely patch, or exposed flat, usually between the high tide line and dune vegetation on the frontal dune. Small stones, twigs, pieces of wood and debris usually occur near the nest. Least Terns nest in colonies (often called terneries) and nests can be as close as just a few meters apart or widely scattered up to hundreds of meters (Stiles 1939, Hardy 1957, Anderson 1983, Ducey 1988, Kirsch 1990, Smith and Renken 1990). The benefit of semi-colonial nesting in Least Terns may be related to anti-predator behavior and social facilitation (Burger 1988). Age at first breeding is 2 to 3 years.

Least Tern eggs are pale to olive buff and speckled or streaked with dark purplish-brown, chocolate, or blue-grey markings (Hardy 1957, Whitman 1988). The birds usually lay two or three eggs (Hardy 1957, Anderson 1983, Faanes 1983, Smith

1985, Sweet 1985, Kirsch 1987-89). The average clutch size for Least Terns nesting in New England ranges from 1.82 - 1.95 eggs (McLean et al. 1991). Egg-laying begins by late May. Both sexes share incubation which generally lasts 20-25 days but has ranged from 17 to 28 days (Moser 1940, Hardy 1957, Faanes 1983, Schwalbach 1988). Females readily renest if clutches are destroyed. Individuals may renest several times, and renesting individuals tend to have lower clutch sizes, fledging success, and productivity (Massey and Atwood 1981).

The precocial behavior of Least Tern chicks is similar to other terns. They hatch within one day of each other and are brooded for about one week. Chicks usually remain within the nesting territory, but as they mature, they may wander. Fledging occurs after 3 weeks, although parental attention continues until migration (Hardy 1957, Tomkins 1959, Massey 1972). Departure from colonies by both adults and fledglings varies but is usually complete by early September (Bent 1921, Stiles 1939, Hardy 1957).

Productivity is measured as the number of chicks fledged per breeding pair. Chicks are considered fledged at 25 days old. Productivity varies greatly between nesting sites and years. Maximum potential productivity is approximately 1.8-1.9 chicks fledged/pair (i.e. avg. clutch size), but is seldom achieved. In California Massey and Atwood (1981) gauged productivity as good (1.0-1.5 chicks fledged/pair), moderate (0.5-1.0 chicks fledged/pair), or poor (0-0.5 chicks fledged/ pair). In New Jersey Burger (1984) classified colonies as successful (>0.5 chicks fledged/ pair) or moderately successful (0.25-.49 chicks fledged/pair). Productivity in Maine has varied from 0.09-1.47 chicks fledged/pair (Table 1).

Table 1. Least Tern Productivity data from Maine 1977-1993.

| Year | No. of chicks fledged | No. of nesting pairs | No. of chicks fledged/pair |
|---|---|---|---|
| 1977 | 50 | 55 | .90 |
| 1978 | 66 | 93 | .70 |
| 1979 | 31 | 78 | .39 |
| 1980 | 34 | 62 | .54 |
| 1981 | 21 | 78 | .26 |
| 1982 | 26 | 39 | .66 |
| 1983 | 29 | 54 | .53 |
| 1984 | 82 | 88 | .93 |
| 1985 | 12 | 105 | .11 |
| 1986 | 30 | 124 | .24 |
| 1987 | 12 | 89 | .13 |
| 1988 | 40 | 98 | .40 |
| 1989 | 8 | 83 | .09 |
| 1990 | 44 | 65 | .69 |
| 1991 | 25 | 52 | .48 |
| 1992 | 123 | 94 | 1.47 |
| 1993 | 114 | 125 | .92 |

Survival and longevity

Massey et al. (1992) estimated mean annual survival rates of 0.16 for first-year birds and 0.88 for adults, based on a sample of 186 color-banded individuals. Thompson (1982) documented longevity exceeded 20 years.

Feeding

Least Terns in Maine and the Northeast most often nest on beaches in close association with estuaries and salt marshes.

Productive salt marsh ecosystems provide abundant food in close proximity to nesting areas and are also important "training grounds" for juvenile birds learning to

forage (Massey and Atwood 1986). Adult and young also feed in the high-energy shallow-water environment along the beach face. They rarely venture far offshore.

Least Terns usually feed in close proximity to nest sites (< 3.2 km), but sometimes travel as far as 6.4 km (Talent and Hill 1985). Fishing behavior involves hovering and diving over standing or flowing water.

Least Terns feed on small fish, crustaceans, insects, mollusks, and annelids (Whitman 1988) although their diet has not been well-documented (Atwood and Kelly 1984). Least Tern diet in Maine is unknown, however, Dorr (1976) believed the sand launce, *Ammodytes americanus*, was important in the diet of Maine birds.

Migration and Wintering

Migration patterns of Atlantic Coast Least Terns are poorly understood. Both spring and fall migration routes are believed to follow a narrow corridor along the Atlantic Coast. Maine birds probably begin leaving the state in mid-August and are completely gone by mid-September (Dorr 1976). Least Terns winter primarily along the coasts of South America. Birds breeding along the Atlantic Coast are believed to winter in the Caribbean and along the northeastern coast of South America.

# MANAGEMENT

## Regulatory Authority

Least Terns are protected by both federal and state legislation. A Federal statute, the Migratory Bird Treaty Act of 1918, provides protection from take and harassment. Under provisions of the U.S. Endangered Species Act, the U.S. Fish and Wildlife Service (USFWS) has listed the Interior and California populations of Least Terns as endangered.

At the state level, Maine's Endangered Species Act of 1973 also protects the Least Tern from take or harassment. The Least Tern is classified as Endangered by the Maine Department of Inland Fisheries and Wildlife. A 1988 amendment to the Act authorizes the Maine Department of Inland Fisheries and Wildlife 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 Habitats or that violate protection guidelines. Essential Habitat has not been designated for Least Terns in Maine.

Habitats of endangered and threatened species, including the Least Tern, receive regulatory oversight by the Maine Department of Environmental Protection (DEP) under provisions of the Natural Resources Protection Act (NRPA) of 1988. Also, Maine's Comprehensive Growth Management Act mandates MDIFW to provide information on rare species habitats to the Department of Economic and Community Development for use by towns for comprehensive planning purposes.

## Past Goals and Objectives

In 1980, Maine Inland Fisheries and Wildlife adopted a "Least Tern Management Plan" (Lello and Cross 1980). The Department outlined the following goals and objectives:

Management goal: To ensure the continuation of the Least Tern population in Maine at or above the existing level.

Management objectives:

1. Maintain the Maine Least Tern breeding population at 100-170 birds.
2. Determine the number of Least Terns in Maine and their current distribution.
3. Determine the feasibility of increasing the distribution and abundance of Least Terns.

## Past Management

The first recorded nesting colony of Least Terns was at Pine Point, Scarborough in 1961 (Hunter 1975). Since then, Least Terns have nested at 11 other sites in Maine (Table 2). Following a 1975 visit to Maine by Erma Fisk, a national advocate of the Least Tern, interest increased for a more active effort to protect these nesting birds. Also in 1976, local residents became active at several nesting sites. In 1977, the Maine Critical Areas Program prepared a report which recommended registration of the known Least Tern nesting areas (Dorr 1976).

Table 2. Historical record of Least Tern nesting areas in Maine (adapted from Dorr, Dale K. 1976. Least Tern nesting habitat in Maine. State Planning Office Planning Report Number 11, Augusta, ME. 20pp).

| Site | Town | Known Active Years | Source of Data |
|---|---|---|---|
| 1. Pine Point | Scarborough | 1961-63, '65, '67, 1986-87 | 12 |
| 2. Webhannet Beach (Wells Marina) | Wells | 1968-69, 1971-74 | 3 |
| 3. Wells Beach | Wells | 1979-80 | 2 |
| 4. Laudholm Beach | Wells | 1967, '77, 1979-81, 1991-93 | 12 |
| 5. Crescent Surf | Scarborough | 1977-78, 1980-83, 1985-90, 1992-93 | 2 |
| 6. Goose Rocks | Kennebunkport | 1975, 1977-91, 1993 | 2 |
| 7. Western Beach | Scarborough | 1975-80 | 45 |
| 8. Cape Elizabeth | South Portland | 1967 | 1 |
| 9. Seawall Beach | Phippsburg | 1975-93 | 26 |
| 10. Popham Beach | Phippsburg | 1973-74, 1976-77, '81, '83, 1987-93 | 247 |
| 11. Reid State Park | Georgetown | 1980-84, 1987-93 | 2 |


1. Packard, C. Data obtained from species report cards on file with the Portland Society of Natural History materials. Unpublished.
2. Jones, J., J. Logan, and S. Stockwell. 1992. 1992 Least Tern protection project report. Unpubl. Rept. to Endangered and Threatened Species Project, Maine Dept. of Inland Fisheries and Wildlife. 12pp.
3. Grace, P.W. 1976. A report on the nesting activities of the Least Tern (*Sterna albifrons*) at the Wells Harbor, ME colony. July, 1976 Rept. Unpubl.
4. Dorr, D.K. Observations and records. Unpublished.
5. Pratt, H. Personal observations. Unpublished.
6. Vickery, P. Personal observations. Unpublished.
7. Hunter, M.L. 1975. Least Tern breeding range extension in Maine. Auk 93:143-145.

In 1977, the Maine Audubon Society began coordinating management for Least Terns. MDIFW initially supported management with technical assistance and later (c.a. 1986) with funding from the Endangered and Nongame Wildlife Fund. The St. John family in Phippsburg granted an easement for Seawall Beach to the Maine Chapter of The Nature Conservancy in the 1970's. In the mid-1980's, The Maine Chapter of The Nature Conservancy assumed monitoring and management of the Seawall Beach colony. The Bureau of Parks and Recreation has assisted with management of the Popham and Reid colonies. Starting in 1986, an annual report was prepared by Maine Audubon for MDIFW. In 1989, MDIFW facilitated the formation of a "Piping Plover and Least Tern Working Group". This group of state, federal, and private cooperators meets annually to discuss the management of these species.

Current Management

In 1992, The Nature Conservancy and Maine Audubon coordinators began working together to fence, census, and patrol all Least Tern nest sites. Current management includes an annual population and productivity survey, identifying and fencing nesting areas, and posting and maintaining educational signs at nesting beaches. In some years, portions of colonies are fenced to deter predators. Skunks are occasionally trapped and removed from nesting sites. Management activities are implemented primarily by a coordinator hired by Maine Audubon and The Nature Conservancy. Much of the effort comes from unpaid volunteers and landowners that are trained as "plover and tern wardens" by Maine Audubon. Standardized protocols are used for evaluating numbers and productivity. Without intensive management, Maine would likely lose its small population of Least Terns.

# HABITAT ASSESSMENT

## Past Habitat

### *Atlantic Coast Habitat*

Least Tern nesting habitat along the East coast has diminished in the past century. Physical loss of habitat is attributed primarily to building on and stabilizing beaches and dunes. Furthermore, much of the physical habitat that remains has become functionally unavailable to Least Terns because of disturbance and direct mortality caused by human recreational use of beaches.

### *Maine Habitat*

Sand beach habitat suitable for Least Tern nesting (particularly those associated with estuaries/salt marshes) are not abundant in Maine and are only found south of the Kennebec River estuary (Nelson and Fink 1980). Prior to European settlement, there may have been 15 to 20 potential nesting beaches in Maine. About half of these potential nesting sites are no longer suitable habitat because of development. For example, suitable nesting habitat likely once existed at Moody Beach, Wells Beach, Old Orchard Beach, and Biddeford Pool. Habitat at these sites is now severely degraded by construction of houses, roads, and seawalls on the dunes. Least Terns nested at Pine Point in the 1960's but eventually abandon the site, apparently because of excessive residential development and associated disturbance (Dorr 1976). Physical loss of habitat in Maine has continued, but at a slower rate since sand dune laws and regulations were passed beginning in the 1970's (St. Pierre 1978). Least Tern carrying

capacity at active colony sites has likely decreased further in the last 2 decades, as a result of increasing recreational pressure on the last remaining "undeveloped" beaches.

Least Terns sometimes nest on artificial substrates (dredge spoil, roofs, parking lots) (e.g. Gore and Kinnison 1991). In 1968, a colony at the Wells Marina was established on dredge spoil deposit in the salt marsh. The colony grew rapidly to a peak of 50 pairs in 1972, and then declined to no nests by 1975 (Dorr 1976). The decline was tied to the planting of beach grass on the site by the Soil Conservation Service starting in 1972.

Current Habitat

Least Tern nesting habitat is extremely limited in Maine. The birds have consistently nested at just 6 sites in the last 17 years (Table 3). In some years, not all sites are available because of beach erosion or reconfiguration. All nesting beaches receive high recreational use in the summer. Carrying capacity in Maine is limited by the small number of nesting sites and disturbance associated with human use of the beaches. Reduction in carrying capacity from human disturbance is currently being mitigated by use of symbolic fencing of nesting areas (see Current Management section).

Feeding and brood-rearing habitat adjacent to nesting beaches may not limit carrying capacity but are essential to maintaining productivity. Intense recreational activity may occasionally preclude foraging activity in waters along the beach face, especially by young birds. Salt marshes and estuaries adjacent to beaches receive little human use and provide secluded foraging habitat. In some instances, the carrying

Table 3. Pairs of Least Tern nesting in Maine colonies 1977-93.

| COLONY | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Laudholm | [3]a | 0 | 3 | N [6] | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 14 | 1 |
| Crescent Beach | 14 | [7] | 0 | 17 | 55 | 27 | [9] | 0 | 4 | 26 | [20] | 45 | 46 | 16 | 0 | 15 | 64 |
| Goose Rocks Beach | 10-25 | 55 | [22] | 15 | 6-15 | 0 | 22 | 39 | 57 | 25 | 19 | [12] | 5 | 3 | 9 | 0 | |
| Breakwater Beach | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Wells Beach | 0 | 0 | 25 | [2] | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Seawall Beach | 13 | 18 | 20 | 12 | 4 | 4 | 14 | 40 | 36 | 72 | 48 | 13 | 18 | 18 | 0[b] | 33 | 29 |
| Popham Beach | [4-5] | 0 | 0 | 0 | 4 | 0 | 10 | 0 | 0 | 0 | 14 | 40 | 36 | 20 | 30 | 0[c] | 8 |
| Ferry Beach | 6-8 | 20 | 30 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Reid State Park | 0 | 0 | 0 | 12 | 15 | 5 | 8 | 9 | 0 | 0 | [8] | [12] | 6 | 8 | 12 | 32 | 22 |
| Pine Point | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 8 | 0 | 0 | 0 | 0 | 0 | |
| Total # of Pairs Least Terns | 50-60 | 93 | 78 | 62 | 78 | 39 | 54 | 88 | 105 | 124 | 89 | 98 | 83 | 65 | 52 | 94 | 125 |

[a]Brackets indicate colony was deserted.
[b]Colony was originally located at Seawall but moved to Popham.
[c]Colony was originally located at Popham but moved to Seawall.

capacity of salt marshes and estuaries may have declined because of the cumulative impact of shorefront development and declining water quality (Jones 1986, Eco-Analysts 1986).

Some degree of habitat protection (public ownership, easements, shoreland zoning, sand dune regulations) exists at all sites. However, the extent of protection is not consistent between sites. Habitat protection alone does little to prevent further functional declines in carrying capacity caused by human disturbance.

Habitat Projection

Physical nesting, feeding, and brood-rearing habitat is restricted to 6 primary sites (Laudholm, Crescent Surf, Goose Rocks, Seawall, Popham, and Reid). The carrying capacity of habitat at secondary sites (Pine Point, Western Beach) is greatly reduced, yet these are important alternate nesting areas when primary colonies are physically unavailable or colonies fail.

Without habitat protection measures, further deterioration of physical nesting habitat is possible at Laudholm, Crescent Surf, Goose Rocks, Pine Point, and Western Beach. Only Seawall, Popham, and Reid have adequate protection of beaches to ensure the integrity of nesting habitat. Carrying capacity of feeding and brood-rearing habitat (esp. salt marshes) at nearly all sites could deteriorate from the cumulative impact of shorefront residential development.

Recreational use of Maine's few remaining public beaches is increasing (Bureau of Parks and Recreation, unpubl. data). If current trends in recreational use continues, the functional capability of beaches to support Least Tern colonies may be reduced or

even eliminated at some sites. Despite management efforts to control human activity (symbolic fencing, patrolling beaches, signs), incidents of human disturbance occur at all sites annually. Human related disturbance sometimes is of a magnitude to result in reduced productivity or causes colony failure. If current management efforts to control human activity in the vicinity of Least Tern colonies is not maintained, it is unlikely that this species will recover from endangered status.

There are few opportunities to increase carrying capacity for Least Terns in Maine. Hunnewell Beach (adjacent to Popham and at the mouth of the Kennebec River) may have suitable nesting habitat, however, extensive, uncontrolled recreational use of the beach has precluded colonization of this site. Similarly, Pine Point and Western Beach may have potential for more regular nesting if recreational use can be regulated. Nesting habitat could be created at new sites with the deposition of dredge spoil. Least Terns in Maine have shown no predilection for nesting on other artificial substrates (e.g. roof tops, gravel pits, parking lots) as they do in other parts of their range. If this should occur, new nesting possibilities may arise.

# POPULATION ASSESSMENT

## Past Populations

### *Atlantic Coast Population*

Least Terns were once one of the most abundant nesting seabirds along the Atlantic and Gulf Coasts. Historic records indicate that they once bred on nearly every suitable beach from Texas to Massachusetts (Bent 1921). It is probable that the Atlantic Coast population exceeded 100,000 pairs. Between 1880 and 1900 Least Terns were nearly extirpated on the East Coast by the feather trade and egg collectors. Bent (1921) documented as many as 1200 birds killed a day along the Virginia coast and 100,000 killed in a single season. By 1900 only a few hundred nesting pairs remained in Virginia and southeastern Massachusetts. The Atlantic Coast Least Tern population recovered dramatically as a result of passage of the Migratory Bird Treaty Act in 1918 and other protective measures. By the late 1930's and early 1940's, Least Terns had recolonized much of their former nesting range and were once again locally common.

Little data are available to assess population trends prior to the late 1970's. Nisbet (1973) presented data that suggests the southern New England population declined between the 1950's to the early-1970's. The East coast population of Piping Plovers declined, during this same period largely in response to habitat loss. Despite a possible declining population of Least Terns during this era, colonization of beaches north of Cape Ann, MA continued. Drury (1973) chronicled the colonization of Plum Island (1937), Ipswich Beach (1945), Seabrook Beach (1953) and Scarborough Beach,

ME (1961). With the advent of beach management and protection programs in the mid-1970's, Least Tern populations again increased. Engstrom et al. (1990) analyzed Least Tern population trends from 1977-1986. The total number of breeding pairs from Maine to Virginia increased from 6,740 in 1977 to 9,341 in 1986. Regression analysis indicated a 5.0% increase per year over the 12-year study period. However, this increase was not statistically significant and perhaps was attributed, in part, by improved survey effort rather than true population increases.

*Maine Population*

The nesting status of Least Terns in Maine, prior to their near-extirpation on the East Coast in the late 1800's, is uncertain. N.C. Brown (1882 in Palmer, 1949) wrote, "This beautiful little species occurred every year in the Green Islands [in outer Casco Bay]. It is now extremely rare - in fact for a number of years I have not seen a single specimen." The validity of this report is questionable. The Green Islands (located approximately 3 mi. offshore) are small, barren islands known to have been used by Common Terns. The closest suitable Least Tern nesting habitat is at least 10 mi. distant. Knight (1908) also cites Brown's observation but stated "there seems to be no records of its [Least Tern's] occurrence within the last fifteen to twenty years...". Palmer (1949) described the Least Tern as being "Formerly a summer resident to Casco Bay and of rare occurrence eastward into Washington County."

In the absence of nest records for Maine, the historical nesting status of Least Terns in Maine is uncertain. Given the presence of suitable nesting and feeding habitat in southern Maine, it is reasonable to deduce that the range of the Least Tern extended

to the Kennebec prior to European settlement. Many of Maine's earliest settlements (Popham, Georgetown, York, Wells, Saco, Biddeford, Scarborough) were settled prior to 1630 and were located nearby likely tern nesting areas. If present, Least Terns would have been extremely vulnerable to subsistence hunting, egg collecting, and indiscriminate shooting. Given these pressures, it is possible Least Terns were long extirpated in Maine prior to when the first serious attempts were made to assemble natural history information in the 1800's.

It is uncertain when Least Terns colonized (or recolonized) Maine. Connie St. John, life-long resident of Small Point, recalled being mobbed by Least Terns on Seawall Beach in the 1930's (pers. comm. to M. McCollough and A. Hutchinson, MDIFW). Least Terns were first recorded nesting in Maine on Scarborough Beach (Pine Point) in 1961 (Packard 1961, Bagg and Emery 1961) and a second colony in Wells in 1968 (Finch 1969). By 1972, Least Terns had colonized beaches at the mouth of the Morse River (Hunter 1975) which currently represents northernmost extent of the species range on the East Coast.

## Current Population

Maine's population of Least Terns has been monitored annually since 1977 by biologists with Maine Audubon and Maine Chapter of The Nature Conservancy. During this period, the number of pairs reported has fluctuated between a low of 39 pairs at 3 sites in 1982 and highs of 124 pairs at 6 sites in 1986 and 1993 (Table 3). Engstrom et al. (1990) reported a non-significant 2.9% annual increase in Maine's Least Tern population using a weighted regression model on the 1975-86 data. This resulted in a

37% increase in the population during this time period. No clear long-term increasing or decreasing population trends are evident from 1975-1993.

The productivity of Least Terns in Maine, has ranged from a low of 0.09 chicks per pair in 1989 to a high of 1.47 chicks per pair in 1992. There seems to be no long-term trend in productivity from 1977-1993. A demographic study of Least Terns conducted by Massey et al. (1992) indicated that Least Terns needed to produce a minimum of 0.6 chicks per pair to incur population increases, and that productivity < 0.5 resulted in population declines. Productivity in Maine (1977-1993) has averaged 0.54 chicks per pair and was < 0.6 in 10 of the last 17 years (Table 1).

It is likely that significant interchange occurs between Least Terns nesting in Maine and other Northeastern populations. Many studies suggest that Least Terns exhibit relatively little fidelity to breeding areas (Nisbet 1973, McNicholl 1975). Burger (1984) reported that about 15% of East Coast (NY to VA) Least Tern colonies are either new or abandoned each year. Nesting locations of color-marked individuals on Long Island were usually within 50 km of their natal site, and a significant number of birds returned to their colony of origin to nest (McLean et al. 1991).

The Least Tern population from Virginia to Maine seem to be stable and numbers about 10,000 pairs. The birds are generally benefiting from increased protection of nesting beaches and other management activities associated with Piping Plover recovery. Despite modest population increases in the last decade, the Least Tern is considered Endangered in 4 of 10 Northeastern states (ME, NH, NY, and NJ), Threatened in RI and MD, and a species of Special Concern in MA.

Carrying Capacity and Population Projections

Prior to European settlement, there may have been 15 to 20 beaches in Maine, situated adjacent to river mouths and salt marshes, that could have been potential colony sites for Least Terns. With an average colony size of 45 to 60 pairs (McLean et al. 1991), Maine could have supported 675 to 1200 pairs (Table 4).

There is currently sufficient habitat in Maine to physically support approximately 250-400 pairs of Least Terns (Table 4). However, because of disturbance caused by people and pets mortality from predators, and occasional losses from high tides, existing habitat is functionally only able to support 40-130 pairs.

During the next 15 years, if current levels of management are maintained, there will likely continue to be habitat that is functionally available for 40-130 pairs of terns. If management were intensified to further minimize human disturbance and predation, the functional carrying capacity may increase to 150-250 pairs. However, if management

Table 4. Estimated historical, present, and future carrying capacity of Least Terns habitat in Maine.

| Time Period | Carrying Capacity (no. of pairs) Physical[a] | Functional[b] |
|---|---|---|
| Historical[c] | 675-1200 | 675-1200 |
| Current | 250-400 | 40-130 |
| Future, with management[d] | 250-400 | 150-250 |
| Future, without management[d] | 150-300 | 0-50 |

[a] Habitat that is physically suitable for breeding Least Terns.
[b] Habitat that is both physically suitable and functionally available to breeding Least Terns.
[c] Prior to European settlement.
[d] 15-year projection.

programs are reduced or eliminated, the functional carrying capacity may decline to 0-50 pairs. Future carrying capacity, in large part, will be dependent on controlling predators, initiating habitat protection, and increasing on-site management to control the effects of coastal recreation and development.

Limiting Factors

The loss of nesting habitat, disturbance and direct mortality caused by humans and their pets, predation, and loss of nests to high-tides are the most important factors limiting the abundance, distribution, and productivity of Least Terns in Maine. High energy sand spits associated with salt marshes and estuaries are uncommon in Maine and have often been so altered by construction and stabilization activities that they are no longer appropriate habitat for terns.

There are potential nesting beaches in Maine that are physically suitable for Least Terns, but are functionally unavailable to the birds because of high recreational use of the beach. Disturbance causes terns to leave the nest, exposing eggs to the summer sun or predation. Excessive disturbance often results in colony abandonment. Foot traffic on beaches can crush eggs or young, or prevent young from feeding. Current management efforts, that include symbolic fencing, patrolling beaches, and signs, largely mitigate human disturbance as a limiting factor. If these management actions were to cease, human disturbance would be the most important factor limiting Least Terns in Maine.

At Least Tern colony sites in Maine, predation on eggs or chicks by Red Fox (*Vulpes vulpes*), Striped Skunk (*Mephitis mephitis*), Raccoon (*Procyon lotor*), American

Crow (*Corvus brachyrhynchos*), and gulls (*Larus spp*.) may seriously limit reproductive success in some years. Free-roaming dogs and cats that chase adults, kill chicks, and eat eggs are a serious problem at several sites. High predation rates are correlated to human use of beaches. Higher predator populations are likely maintained by litter on the beaches, picnic areas adjacent to beaches and nearby housing developments. Pets are brought to the beaches by recreational users.

Maine Audubon summarized all nesting data collected from 1982-91 (Jones 1992). During this time period, 67% (1003 of 1504) of all nesting attempts failed. Seventy-three percent of nest failures were attributed to predation, 4% to abandonment, and 14% to high tides. In instances where the source of predation could be documented - foxes, skunks, and cats were the most common predators. Foxes caused predation at most of the major nesting sites and had the most dramatic effect of any single predator.

## USE AND DEMAND ASSESSMENT

The demand for rare flora and fauna, especially those listed as Threatened or Endangered, is unequivocally mandated in the preamble to the Maine Endangered Species Act of 1975:

> "The Legislature finds that various species of fish or wildlife have been and are in danger of being rendered extinct within the State of Maine, and that these species are of esthetic, ecological, educational, historical, recreational and scientific value to the people of the State. The Legislature, therefore, declares that it is the policy of the State to conserve, by according such protection as is necessary to maintain and enhance their numbers, all species of fish or wildlife found in the State, as well as the ecosystems upon which they depend."

As such, MDIFW is committed to preserving the diversity of all wildlife in the state and is entrusted with the preservation of Maine's natural heritage for future generations. This responsibility is manifested by an increasing commitment to management and research programs that protect and enhance Endangered and Threatened species of all taxa.

The protection and ecological understanding of highly visible species, such as the Least Tern, are vital to proper ecosystem management and to the preservation of Maine's natural heritage. Least Terns contribute to the biological diversity of our state, and their presence adds to the ecological value of Maine's beach and salt marsh ecosystems. Hundreds of thousands of recreational beach users use Least Terns and Piping Plovers nesting beaches annually. These highly visible, high-profile recovery programs provide an opportunity to educate the public and provide an example of how Endangered Species and traditional public land uses can coexist with proper management.

A recent study of the economic values of Maine's wildlife resources (Boyle et al. 1990) provides insights into the nonconsumptive use and demand for wildlife. An estimated 91% of the state's adult population participate in nonconsumptive use of wildlife. Fifty-five percent of households in Maine actively attract wildlife to their homes or camps, and 35% make trips annually to view wildlife. Eighty percent believe the opportunity to view wildlife in Maine is very important, and 40% indicate the presence of wildlife influences where they chose to live.

This high public demand for nonconsumptive use of wildlife is of considerable value to Maine's economy (Boyle et al. 1990). In 1989, expenditures to attract and observe wildlife totaled $50.3 million (this figure represents a minimum expenditure for Maine residents and does not include expenditures of non-residents). The aggregate annual surplus value of 10 federally-listed Endangered species in Maine was valued at $5.1 million. Thus, a very conservative estimate of the nonconsumptive value of wildlife in Maine was $55.4 million annually and was comparable to the economic contribution of resident hunting.

As the popularity of photography and nature study and appreciation, and awareness of Maine's wildlife resource grows, the demand for observational and photographic use of rare species, such as the Least Tern, will increase. Moderate increases in recreational activity on nesting beaches could adversely affect Least Tern behavior and nesting success. As interest in Least Terns intensifies, there will likely be increased public demand for interpretive and educational materials to explain recovery programs and habitat protection.

Increasing numbers of citizens desire preservation of the greatest diversity of species possible, at state, national, and global levels (Kellert 1980). These desires are based on increasing public perception of scientific, utilitarian, and cultural values of biological diversity, as well as ethical arguments for preserving plant and animal species that are endangered by the actions of human society. At the state level, public support for the preservation of wildlife diversity in Maine is growing and is reflected in strong state legislation to protect Endangered and Threatened wildlife and their habitats.

## SUMMARY AND CONCLUSIONS

Least Terns were once extremely abundant breeding birds along the East Coast. They may have been present in Maine and were extirpated by the state's first settlers. Least Terns were nearly extirpated from the East Coast at the turn of the century from hunting for the millinery trade and egg collecting. With the passage of federal laws protecting migratory birds, populations rebounded and many former nesting sites were recolonized. First nesting in Maine was documented in 1961 at Pine Point in Scarborough. Since then, the birds have consistently nested at 6 sites. Numbers have fluctuated between 39 and 125 pairs. Productivity averaged 0.54 chicks per pair between 1977-93, which is indicative of a marginally stable or declining population. There is no statistically significant increasing or decreasing long-term trend in the population or productivity of Maine's population.

The Least Tern is limited by loss of nesting habitat, disturbance and direct mortality by humans and their pets, predation, and loss of nests to high tides. Recovery efforts in Maine and throughout the East Coast include public education, acquisition or easements of some sites, symbolic fencing to deter disturbance, and annually monitoring numbers of nesting pairs. Much of this activity is coordinated with management of Piping Plovers. Along the eastern seaboard, Least Tern population are increasing in response to this intensity of management. Maine's small population does not show significant increase. Management addressing protection of nesting, feeding and brood-rearing areas, predator control, and increased public education may be necessary to stimulate recovery. Recovery goals have not been established.

## LITERATURE CITED

American Ornithologists' Union. 1957. Checklist of North American birds. Fifth edition. Baltimore, American Ornithologists' Union. 691 pp.

American Ornithologists' Union. 1983. Checklist of North American birds. Sixth edition. Lawrence, Kansas, American Ornithologists' Union. 877 pp.

Anderson, E. A. 1983. Nesting productivity of the interior least tern in Illinois. Unpublished report, Cooperative Wildlife Research Laboratory Southern Illinois University, Carbondale. 19 pp.

Atwood, J. L., and P. R. Kelly. 1984. Fish dropped on breeding colonies as indication of least tern food habits. Wilson Bulletin 96:34-47.

Bagg, A. M., and R. P. Emery. 1961. Northeastern maritime region. Audubon Field Notes 15:450-453.

Bent, A. C. 1921. Life histories of North American gulls and terns. U. S. National Museum Bulletin 113. 345 pp.

Boyd, R. L., and B. C. Thompson. 1985. Evidence for reproductive mixing of least tern populations. Journal of Field Ornithology 56:405-406.

Boyle, K. J., S. D. Reiling, M. Teisl, and M. L. Phillips. 1990. A study of the impact of game and non-game species on Maine's economy. Dept. Agricult. and Resour. Economics, Univ. of Maine, Orono. 119 pp.

Burger, J. 1984. Colony stability in least terns. Condor 86:61-67.

Burger, J. 1988. Social attraction in nesting least terns: effects of numbers, spacing and pairs. Condor 90:575-582.

Burleigh, T. D., and G. H. Lowery, Jr. 1942. An inland race of *Sterna albifrons*. Museum of Zoology, Occasional Papers, number 10:173-177, Louisiana State University.

Dorr, D. K. 1976. Least tern, *Sterna albifrons*, nesting habitat in Maine and its relevance to the critical areas program. State Planning Off., Augusta, ME. Planning Rept. No. 11. 20 pp.

Drury, W. H. 1973. Population changes in New England seabirds. Bird-banding 44:267-313.

Ducey, J. E. 1981. Interior least tern (*Sterna antillarum athalassos*). U.S. Fish and Wildlife Service, Pierre, South Dakota. Unpublished report. 56 pp.

Ducey, J. 1988. Nest scrape characteristics of piping plover and least tern in Nebraska. Nebraska Bird Review 56:42-44.

Eco-Analysts. 1986. The cumulative impacts of development in southern Maine: Wetlands: their locations, functions, and value. Maine State Planning Office Publ., Augusta, ME. 69pp.

Engstrom, R. T., G. S. Butcher, and J. D. Lowe. 1990. Population trends in the Least Tern (*Sterna antillarum*) from Maine to Virginia: 1975-1986 Pp 130-138 *in* S. R. Sauer and S. Droege, eds. Survey designs and statistical methods for the estimation of avian population trends. U.S. Fish and Wildl. Serv., Biol. Rep. 90 (1). 166 pp.

Faanes, C. A. 1983. Aspects of the nesting ecology of least terns and piping plovers in central Nebraska. Prairie Naturalists 15:145-154.

Finch, D. W. 1969. Northeastern maritime report. Audubon Field Notes 23:637-643.

Gore, J. A. and M. J. Kinnison. 1991. Hatching success in roof and ground colonies of least terns. The Condor 93:759-762.

Goodrich, L. J. 1982. The effects of disturbance on the reproductive success of the least tern. M. S. Thesis, Rutgers State University, New Brunswick, New Jersey. 100 pp. Grover, P. B. 1979. Habitat requirements of charadriiform birds nesting on salt flats at Salt Plains National Wildlife Refuge, M. S. Thesis, Oklahoma State University, Stillwater. 38 pp.

Hardy, J. W. 1957. The least tern in the Mississippi River. Publication of the Museum, Michigan State University, Biological Series 1:1-60.

Hunter, M. L. 1975. Least Tern breeding range extension in Maine. Auk 92:143-145.

Jackson, J. A. 1976. Some aspects of the nesting ecology of least terns on the Mississippi Gulf coast. Mississippi Kite 6(2):25-35.

Jones, J. 1986. The cumulative impacts of development in southern Maine: important wildlife habitats. Maine State Planning Office Publ., Augusta, ME. 70pp.

_____, Logan, and S. Stockwell. 1992. Least tern protection project report. Unpub. rept. to Me. Inland Fisheries and Wildlife, Bangor, ME. 12 pp.

Kellert, S. R. 1980. Public attitudes toward critical wildlife and natural habitat issues. U.S. Govt. Printing Office, Wash. D. C.

Kirsch, E. M. 1987. Annual Report 1987: Least Tern and Piping Plover on the lower Platte River in Nebraska. Nebraska Game and Parks Commission. Unpublished report.

_____. 1988. Annual Report 1988: Least Tern and Piping Plover on the lower Platte River in Nebraska. Nebraska Game and Parks Commission. Unpublished report.

_____. 1989. Annual Report 1989: Least Tern and Piping Plover on the lower Platte River in Nebraska. Nebraska Game and Parks Commission. Unpublished report.

_____. 1990. Final report 1990: Least Tern and Piping Plover on the lower Platte River in Nebraska. Nebraska Game and Parks Commission. Unpublished report.

Knight, O. W. 1908. The birds of Maine. Charles H. Glass Co., Bangor, ME. 691 pp.

Lello, J. and P. Cross. 1980. Least tern management plan. Unpub. Rept. Me Dept. Inland Fisheries and Wildlife, Augusta, ME.

Massey, B. W. 1972. The breeding biology of the California least tern. M. S. Thesis, California State University, Long Beach. 101 pp.

_____. 1976. Vocal differences between American least terns and the European little tern. Auk 93:760-773.

_____, and J. L. Atwood. 1978. Plumages of the least tern. Bird-banding 49:360-370.

_____, and _____. 1981. Second-wave nesting of the California least tern: age composition and reproductive success. Auk 98:596-606.

_____, and _____. 1986. Application of ecological information to habitat management for the California least tern. Progress report number 6. U.S. Fish and Wildlife Service, Laguna Niguel, CA. 18 pp.

Massey, B. W., D. W. Bradley, and J. L. Atwood. 1992. Demography of a California Least Tern colony including effects on the 1982-1983 El Nino. The Condor 94:976-983.

McCament, D. and B. C. Thompson. 1987. Interior least tern distribution and taxonomy. Texas Parks and Wildlife Department. Final report, Federal aid project number W-103-R-17.

MacLean, D. C., T. S. Litwin, A. M. Ducey-Ortiz, R. A. Lent. 1991. Nesting biology, habitat use, and inter-colony movements of the least tern (*Sterna antillarum*) on Long Island, N.Y. Unpubl. Rept. to NY State Dept. of Env. Cons. 69 pp.

McNicholl, M. K. 1975. Larid site tenacity and group adherence in relation to habitat. Auk 92:89-104.

Moser, R. 1940. The piping plover and least tern in Omaha. Nebraska Bird Review 8:92-94.

Nelson, B. W. and L. K. Fink. 1980. Geological and botanical features of sand beach systems in Maine. Maine Seagrant Publication MSG-B-14-80, Darling Center, Walpole, ME. 163 pp.

Nisbet, I. C. T. 1973. Terns in Massachusetts: present numbers and historical changes. Bird-Banding 44:27-55.

Packard, C. M. 1961. Maine bird reports, May, 1961. Maine Field Observer 6(5):49-58.

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

Schwalbach, M. 1988. Conservation of least terns and piping plovers along the Missouri River and its major western tributaries in South Dakota. M. S. Thesis, South Dakota State University, Brookings.

Smith, J. W. 1985. Improving the status of endangered species in Missouri (interior least tern habitat and nest survey). Missouri Department of Conservation endangered species project number SE-01-12. 142 pp.

_____, and R. B. Renken. 1990. Improving the status of endangered species in Missouri: least tern investigations. Final report, Jobs 1 and 2, Missouri Department of Conservation endangered species project SE-01-19.

St. Pierre, James A. 1978. Maine's coastal sand beaches: recreation and conservation. Unpub. Rept. to Bureau of Parks and Recreation, Dept. of Conservation, Augusta, ME 69pp.

Stiles, B. 1939. The least tern in Iowa. Iowa Bird Life 14:18-21.

Sweet, M. J. 1985. Least tern population survey, 1984. Illinois Department of Conservation. Unpublished report. Swickard, D. K. 1972. Status of the least tern at Camp Pendeleton, CA. California Birds 3(3):49-58.

Talent, L. G., and L. A. Hill. 1985. Final report: breeding ecology of snowy plovers, American avocets, and interior least terns at Salt Plains National Wildlife Refuge, Oklahoma. Oklahoma State University, Stillwater. 186 pp.

Thompson, B. C. 1982. Distribution, colony characteristics, and population status of least terns breeding on the Texas coast. Ph.D. Dissertation. Texas A & M University.

_____, and _____. 1983. Post-fledging departure from colonies by juvenile least terns in Texas: implication for estimating production. Wilson Bulletin 96:309-313.

_____, M. E. Schmidt, S. W. Calhoun, D. C. Morizot, and R. D. Slack. 1992. Subspecific status of least tern populations in Texas: North American implications. Wilson Bull. 104:244-262.

Tomkins, I. R. 1959. Life history notes on the least tern. Wilson Bulletin 71:313-322.

Whitman, P. L. 1988. Biology and conservation of the endangered interior least tern: a literature review. U.S. Fish and Wildlife Service Biological report 88(3). 22 pp.

Wolk, R. G. 1974. Reproductive behavior of the least tern. Proceedings of the Linnaean Society, New York 72:44-62.