

SPECIES PROFILE

Common Tern

Sterna hirundo

Federal Listing: Not listed

State Listing: Endangered

Global Rank: G5

State Rank: S1

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ELEMENT 1: DISTRIBUTION AND HABITAT

1.1 Habitat Description

Common tern nest on rocky islands, barrier islands, and salt marshes that are close to feeding areas and that provide protection from predators. Common terns nest in the open, on bare ground, or on vegetation, and rarely under cover (but often adjacent to vegetation) (Kress and Hall 2002). On average, nest sites have more than 90% visibility from above (Gochfeld and Burger 1987). A preliminary study of nest site parameters for the New Hampshire Seavey Island colony in 1998 showed that 54% of the nests were located at the rock-vegetation interface, 24% were located on rock and 22% were located in the vegetation.

Common terns feed primarily on juvenile marine fish, but will also eat aquatic and terrestrial invertebrates (Hall 1999, De Luca et al. 1998-2002). Foraging success depends on the abundance and depth of the prey, tidal height, wind speed, and sea surface conditions (Hall 1999). Common terns have a broader diet than roseate and arctic terns and seem to adapt to changing feeding conditions more readily (Safina et al. 1990). At Seavey Island, Isles of Shoals, feeding data collected from 1998 to 2002 identified more than 40 food items. With the exception of 2001, when Atlantic herring (*Clupea harengus*) was eaten with the highest frequency, juvenile white hake (*Urophycis tenuis*) has constituted the largest part of the common tern diet on Seavey Island, totaling 45%

to 55% of all feedings. Some terns have been observed to feed exclusively on insects or amphipods.

Although no formal study of foraging locations has been conducted, the rate and timing of observed feedings highlight the importance of the waters that immediately surround the Isles of Shoals. Foraging has also been consistently observed in the Hampton and Seabrook harbors, Rye Harbor, and at the mouth of the Piscataqua River.

1.2 Justification

The common tern is a species of regional and state concern. In the Northeast, common tern success is necessary for the recolonization of roseate terns. The common tern colony on Seavey Island should be maintained to successfully manage roseate terns. Managing for common terns will also address the needs of other coastal island species including Arctic Tern, common eider, black guillemot, and purple sandpiper.

Efforts to restore the northeastern common tern population began in the 1970s but have been more organized since 1984, when the Gulf of Maine Tern Working Group was formed. Although common tern restoration efforts have been successful in increasing the number of breeding pairs, the number of islands that support tern colonies remains low. After near extirpation in the late 1800s, the Gulf of Maine now supports over 20,000 pairs of common terns at 47 sites (Kress and Hall 2004). However, 84% of this population nests on 8 islands, leaving them vulnerable to predation, oil spills, and catastrophic weather.

The primary limiting factor for common terns is the loss of nesting sites and predation that led to concentrated colonies in a small number of suitable sites (Kress and Hall 2004, Nisbet 2002). Gull populations took over many of the offshore islands that had supported terns, and other habitats were lost

to erosion. This resulted in common terns nesting at marginal inshore islands where the habitat quality was low and the risk of predation was high.

Regionally, the species is in jeopardy due to predation and loss of suitable nesting habitat. In the northeastern United States, gulls, great horned owls, black crowned night heron, coyote, mink, and rats eat eggs, chicks, and adults. Reduced prey abundance, competition for nest sites, contaminants, human disturbance, inclement weather, and insufficient funds to protect colonies also contribute (Nisbet 2002). Little is known about factors affecting the population on its wintering grounds (Kress and Hall 2004, Nisbet 2002).

Common tern nesting is required for successful recolonization of roseate terns in the Northeast. The Seavey Island roseate tern colony largely depends on the protection and success of the common tern colony. Greater than 85% of the entire northeastern population of roseate terns currently nests on four islands from Buzzard's Bay to Long Island, New York, making the entire population vulnerable

1.3 Protection and Regulatory Status

- The common tern is protected in the United States under the Migratory Bird Treaty Act of 1918, which prohibits the taking of bird, nest, and eggs.
- Seavey Island is under the management of New Hampshire Fish and Game (NHFG). Seavey Island is posted as an endangered species breeding site, and the public is restricted from 1 May to 1 September. Seavey Island is actively managed through the breeding season, and biologists are present at the colony from late April to August.

1.4 Population and Habitat Distribution

Historically, common terns bred on several islands at the Isles of Shoals. Anecdotal evidence suggests that common terns nested in high numbers at Duck Island in the mid 1880s (Borrer and Holmes 1990). Jackson and Allen (1931) noted that common terns bred on Lunging Island as early as 1922 and the colony grew rapidly to 1,000 pairs by 1928. Jackson (1947) estimated that 1,500 to 2,000 pairs continued to nest there until 1938, and smaller numbers persisted at this site until the late 1940s. This site was abandoned before 1955 (Taber 1955), apparently be-

cause of displacement by herring gulls (Drury 1973, Erwin 1979). Herring and great black-backed gulls continue to nest at this location.

F.B. White (1927) discovered a common tern colony on the mainland coast in Seabrook near the bridge over the Hampton Harbor Inlet. This colony, which fluctuated in size during the 9 years White observed it, apparently peaked in 1929 with at least 118 nests (White 1935). The year of its abandonment is unknown, but existing records indicate the presence of a single nest with eggs in 1953.

Several islands in the Great Bay estuary, including Nannie, Hen, Goat, and the two Footman Islands, have supported nesting terns in recent decades. These colonies apparently peaked around 1970 with approximately 12 pairs on the Footman Islands and 30-40 pairs on Nannie Island (Art Borrer, personal communication). Hen Island has supported 1 to 20 pairs of common terns from 1989 to 2004. The Footman Islands have sporadically supported small numbers of nesting pairs in the last 30 years. Nannie Island has not had any documented breeding in recent years. All of these inshore islands have been subjected to significant predator pressures as well as human disturbance.

Tern nesting activity on the salt marshes of the Hampton Harbor estuary dates back to at least 1964. Approximately 50 pairs nested in the salt marsh in the 1970s and 1980s. These numbers have continued to decline and fewer than 25 pairs remain. Heavy predation and flooding have caused very low productivity in most years. This population is unlikely to survive under current conditions.

Although the year of origin for the Back Channel colony is unknown, New Castle residents recall tern activity dating back at least 50 years. Past nesting has occurred on Pest and Leach's Islands as well as on 3 small islands known as the Back Channel Islands. Numbers fluctuated from 15 to 20 pairs in the early 1960s to only 1 pair in 1971, and back up to 44 pairs in 1982 (Foss 1982). This colony continued to decline through the 1980s and early 1990s due to predation and disturbance. This site was abandoned in 1998 after the Seavey Island colony was established.

In 1997, NHFG and the New Hampshire Audubon (NHA) began a project to restore terns to the Isles of Shoals. They worked with the New Hampshire Coastal Program, the Department of Resources and Economic Development – Parks Division, Wild-

life Services of the USDA, Shoals Marine Laboratory, Isles of Shoals Steamship Company, the Gulf of Maine Seabird Working Group and the United States Fish and Wildlife Service (USFWS) to complete the first year of this project using nonlethal means of gull control, along with decoys and sound to attract breeding terns back to the Isles of Shoals. In 1997, a small colony of six pairs raised and fledged six young at this site. This colony has continued to show significant growth, with breeding pairs climbing from 6 pairs in 1997 to 2582 pairs in 2004 (figure 3).

Regionally, the distribution of the common tern is unchanged since the first records in 1870 (Nisbet 2002), although the numbers have fluctuated widely. Common terns nest from North Carolina to Newfoundland and west through the Great Lakes into northwestern Canada (Kress and Hall 2004). Currently, the estimated number of nesting pairs in this entire region is 82,000 (Nisbet 2002).

In New Hampshire, 99% of common terns currently nest on Seavey Island, Isles of Shoals. Seavey Island is part of a cluster of islands known as the Isles of Shoals (see Coastal Islands profile). The Shoals are located approximately 9 km from Rye Beach and 13 km from the mouth of the Piscataqua River (figure 1). Seavey Island is approximately 1.5 hectares in size, with rugged granite outcroppings pocketed with herbaceous vegetation. Seavey Island is connected to White Island by a cobble tombolo at low tide. The predominant plant species found in the Seavey Island nesting areas include grasses, yarrow (*Achillea millefolium*), seaside goldenrod (*Solidago sempervirens*), black mustard (*Brassica nigra*) and dodder (*Cuscuta gronovii*) (De Luca et al. 1998).

Other nesting sites in New Hampshire include the rocky islands at the Isles of Shoals, small inshore islands in Great and Little Bays and along the Piscataqua River, and the extensive thatched areas in the Hampton-Seabrook salt marshes. In the salt marsh, they build shallow nests atop the mats of dead thatch. On Seavey Island and the tern islands in Great Bay they create shallow grass and stick cups atop the rock and/or vegetation.

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

The New Hampshire GRANIT System was used to identify coastal islands. Very small islands were grouped with the nearest adjacent neighboring islands. In total, 96 polygons were grouped into 48 islands, which in turn were clustered into 15 conservation units.

Each conservation unit was defined by parameters such as size, shoreline, development, distance from known and potential contaminant sources, and the distances to the nearest aquaculture operations, oil spill response staging areas, recreational fishing areas, marinas and public beaches. New Hampshire Department of Environmental Services provided the locations of known contamination sources, heliports, oil spill response staging areas, recreational fishing, marinas and aquaculture locations, and airport locations were provided by the New Hampshire Department of Transportation.

1.7 Sources of Information

Basic natural history information in this profile is largely gathered from the literature cited in element 5. Information on habitat and distribution was gathered from scientific literature, recovery conservation plans, technical field reports, published literature, NHA and NHFG Seavey Island data, New Hampshire Bird Records data, Gulf of Maine Seabird Working Group (GOMSWG) and Roseate Tern Recovery Team (RTRT) discussion and minutes. Information for mapping was provided as cited in 1.6.

1.8 Extent and Quality of Data

Common terns have been followed closely since the formation of the Gulf of Maine Tern Working Group in 1984. Regionally, common tern breeding colonies have been managed and intensively monitored for more than 20 years. The Seavey Island common tern population has been intensively studied since recolonization in 1997. In New Hampshire, all current and recently occupied tern-nesting sites are surveyed annually during June. Historical habitat at the Isles of Shoals was surveyed in 1977, 1985 and 1995, and an all-island census at the Isles of Shoals is scheduled for June 2005.

Habitat parameters were identified at common tern

nests on Seavey Island in 1998. This pilot study produced baseline data for the development of habitat and vegetation profiles of common tern nest sites. The update and continuation of this study, along with the generation of vegetation profiles, will help in the development of a habitat management plan.

Common tern foraging habitat is largely unknown in New Hampshire, though sightings between 1998 and 2001 suggest that common terns forage close to Seavey Island. It will be important to identify critical foraging areas for this species and to explore staging areas in nearby waters.

Little is known about common tern migration and wintering habitat. Large winter concentrations have been identified in Suriname, Trinidad, Brazil, and Argentina (Hays et al. 1997, 1999). It is important to identify and assess common tern wintering habitat.

1.9 Distribution Research

- Continue intensive monitoring of common terns on Seavey Island
- Characterize common tern breeding habitat on Seavey Island
- Evaluate other islands at the Isles of Shoals for suitable tern habitat. Lunging and Duck Islands both supported common and roseate terns historically
- Identify priority habitats and potential sites for restoration
- Conduct surveys and analyze existing data to determine significant foraging and staging areas
- Band tern chicks on Seavey Island to determine recruitment levels and inter-colony movement
- Develop protocol for re-sighting banded birds and coordinating with other islands for data exchange
- Understand movement patterns of common terns within the Gulf of Maine using the marked known aged population
- Evaluate annual interchange of birds between Gulf of Maine and “warm water” groups
- Continue to research migration routes, winter habitat, and winter distribution

ELEMENT 2: SPECIES/HABITAT CONDITION

2.1 Scale

Fifteen conservation units have been identified for coastal islands. All 9 islands at the Isles of Shoals are recognized as separate units.

2.2 Relative Health of Populations:

Productivity on Seavey Island has dropped from an average of 1.63 chicks per pair between 2000 and 2002 to 0.75 chicks per pair in 2004 (table 2). Smaller clutch sizes in 2003 and 2004 may have resulted from cool weather and rough seas. It will be important to follow productivity trends and address low productivity if it persists.

The Isles of Shoals population is home to all of New Hampshire’s roseate and Arctic terns, and to more than 98% of common terns. This concentration at one site in New Hampshire makes this population very vulnerable to any form of disturbance or catastrophic event. The potential for tern recolonization at any of the identified conservation units outside the Isles of Shoals is low. Predation, disturbance, and the attendant issues of marginal habitat significantly threaten inshore colonies of terns.

Common terns have not nested on any other islands at the Isles of Shoals since the late 1940s. Anecdotal evidence from Duck Island makes the possibility of common and roseate breeding high, with numbers of terns described in the “thousands”. Both Lunging and Duck Island are potential tern breeding habitat but currently support large herring and great black-backed gull colonies.

In 2004, common tern colonies were confirmed at two remaining “mainland” sites—Hen Island in Newington and the Hampton salt marsh. The only nesting site with confirmed productivity was at Hen Island in Little Bay. This colony has had approximately 12 pairs since the early 1990s. Productivity has varied but averaged about 1 chick per pair for most years. Although a few birds still attempt to nest in the Hampton salt marsh, they fledge few chicks. Encroachment, predation, human disturbance, and flooding all threaten the salt marsh terns.

2.3 Population Management Status

The Seavey Island tern nesting colony intensively managed. Biologists live on the island during the breeding season to control predators, monitor the productivity of the colony, and implement public outreach. Seavey Island is also posted from 1 May to 1 September to minimize disturbance.

Common terns were re-colonized at this site using techniques that included nonlethal gull control and tern attraction techniques. Nonlethal gull control at Seavey Island included the presence of a dog during the latter half of April, pyrotechnics, regular circumnavigation of the island beginning 30 minutes before sunrise and continuing until 30 minutes after sunrise, and the placement of a large rock in any gull nest cups (NHA and NHFG unpublished reports 1997-2003). Tern attraction techniques included the placement of decoys in suitable habitat along with the broadcast of tern colony sounds (Kress 1983). Common terns nested at this site in the first year of restoration efforts (1997).

Resident tern biologists are able to continue active gull control through the breeding season. Specialist predatory gulls can be removed from the island. Gull control data clearly show that changes in the intensity of direct intervention can affect the success of the colony.

Although it is difficult to land on Seavey Island, the summer months allow for increased boat traffic and visitation to the Isles of Shoals. Tern biologists act as stewards and can help regulate any visitation. Educational visits from Shoals Marine Lab, Star Island, and various other conservation organizations foster the conservation of this seabird colony.

Lighthouse renovation is scheduled to begin in 2005. Construction crews will be working on the lighthouse and other island structures during the breeding season. Coordination with tern project biologists, New Hampshire Parks and Recreation oversight staff, and construction personnel will be imperative to avoid any disturbance to the terns.

There has not been any systematic identification or monitoring of critical foraging resources for the common tern. It is important to understand variation in prey use and the effects on breeding success. In addition, little is known of staging area usage before and after breeding season.

2.4 Relative Quality of Habitat Patches

Nest parameters on Seavey Island were recorded in 1998 to develop habitat and vegetation profiles for common tern nest sites on Seavey Island. Ongoing studies will evaluate the capacity of the island to support more nesting pairs and to document habitat changes, leading to more effective habitat and vegetation management.

The quality of foraging habitat and prey availability near Seavey Island is largely unknown. Foraging studies will determine how prey availability and foraging effort affect productivity. The productivity level of the Seavey Island colony in 2004 (0.75 chicks per nest) was below the level considered productive in the Northeast (more than 1.1 chicks per nest) and well below the high of 2.24 in 1998. It will be important to evaluate the drop in productivity.

The 2 other historic nesting sites for common terns at the Isles of Shoals are Duck Island and Lunging Island. These islands have good potential for tern nesting, yet they each support large numbers of nesting gulls. The presence of raccoons and gulls make tern nesting impractical on Smuttynose Island, though the island once hosted one of the largest gull populations at the Isles of Shoals. Appledore Island is unsuitable for terns because of large populations of gulls, rats, muskrats, raccoon, and humans.

The Hen Island tern colony in Great Bay, which has averaged 12 pairs since 1989, has been disrupted by rats, Canada geese, great horned owl, and humans. A small but persistent tern colony remains in the Hampton salt marsh, though it has been plagued by flooding, predation and human disturbance. Efforts to protect this habitat may improve the potential for nesting.

2.5 Habitat Patch Protection Status

- White and Seavey Islands have been managed by the Department of Resources and Economic Development (DRED)-Parks and Recreation Division as part of Odiorne State Park since 1993. A Memorandum of Agreement on tern restoration exists between DRED – Parks Division and NHFG. Seavey Island is managed by NHFG as an endangered species nesting area and is afforded both state and federal protection under endangered species law.
- The Coastal Islands National Wildlife Refuge pur-

chased Duck Island in July 2003. This island will be managed for its wildlife resources, protected as a seabird colony, posted for closure during the breeding season, and evaluated for habitat management and restoration (B. Benedict, USFWS, personal communication).

- There is no protection at privately owned Lunging Island beyond current shoreline and wetland regulations.
- Smuttynose Island is privately owned but was protected in August 2001 by a conservation easement held by the Coastal Islands National Wildlife Refuge. This conservation easement allows the refuge to manage the site for wildlife resources (B. Benedict, USFWS, personal communication).
- The Town of Newington owns Hen Island. Since the early 1990s, the town has worked with NHFG and NHA to close the island during the breeding season. The proximity of the island to the mainland has subjected Hen Island terns to disruption by rats, Canada geese, great horned owl, and humans.

2.6 Habitat Management Status

Seavey Island is managed for terns through the NHFG and NHA Tern Restoration partnership. Restoration efforts between 1997 and 2004 focused eliminate gull nesting and controlling predation, which allowed some re-colonization by common terns. There has been a gradual shift in the Seavey Island vegetation from yarrow and seaside goldenrod to tall dense grasses. Although the height of the grass makes the habitat more suitable for roseate terns, the density can cause problems for movement of adults and chicks. In 2005, approximately 100 feet of boardwalk was laid through the grassy area to give more structure and opening to the nesting habitat, and to allow biologists access to this part of the island.

It will be important to continue the common tern nest site analysis to evaluate habitat suitability, and to have baseline data from which to make management decisions regarding habitat improvement. Other islands identified in section 2.4 as having the potential for tern recolonization need to have baseline habitat assessments. If determined to be suitable for restoration efforts, a habitat restoration plan would need to be developed and implemented.

2.7 Sources of Information

Information on habitat and distribution was gathered from scientific literature, recovery conservation plans, technical field reports, published literature, NHA and NHFG data, GOMSWG and Roseate Tern Recovery Team (RTRT) discussion and minutes. Information for mapping was provided as cited in 1.6.

2.8 Extent and Quality of Data

Census and productivity numbers have been taken since common terns began nesting in 1997. Chick provisioning data was collected from 1998 to 2001, and baseline habitat data for common tern nesting sites was collected in 1998. More data are needed to determine the habitat parameters of preferred nesting areas.

The habitat on Lunging and Duck Island needs to be evaluated through a nest census and a vegetation/habitat profile at each site. The identification of important foraging and staging areas for roseate terns in New Hampshire is critical.

2.9 Condition Assessment Research

Monitoring

- Continue intensive monitoring of common terns on Seavey Island, using established methods as outlined by the GOMSWG and the Roseate Tern Recovery Plan to determine productivity
- Resume monitoring of the mainland colonies to assess condition and the potential for protection

Research and Assessment

- Characterize common and roseate tern breeding habitat on Seavey Island. Determine the habitat parameters in preferred nesting habitat. Evaluate the need for vegetation management to maintain and increase common and roseate habitat on Seavey Island.
- Conduct habitat assessments at the other historic Isles of Shoals islands.
- Identify and characterize preferred foraging habitat and evaluate vulnerability of principal foraging sites to human disturbance
- Assess seasonal prey availability and how it relates

to tern productivity

- Assess potential effects of an oil spill near Seavey Island.

Research and Survey:

- Identify the location and use of staging and roosting areas for common and roseate terns
- Determine if pre-migratory staging areas constitute a vulnerable population bottleneck
- Identify important wintering areas

ELEMENT 3: SPECIES THREAT ASSESSMENT

3.1.1 Predation and Herbivory (Gulls)

(A) Exposure Pathway

Herring gulls and great black-backed gulls are major predators on terns and other small seabirds. The protection of all seabirds, changes in human land use along coastal islands, the fishing industry, and the use of open landfills caused gull populations to exponentially increase in the twentieth century (figure 2). Gulls prey on tern eggs and chicks and displace them from prime nesting habitats (Foss 1994). Gulls were partly to blame for the extirpation of roseate terns from New Hampshire, but initiation of active gull control on Seavey Island has allowed for the recolonization of this species. Gulls continue to nest on all the other islands at the Isles of Shoals, making them unsuitable for terns.

Nearshore tern colonies are vulnerable to predators such as rats, raccoons, skunk, and fox. Increased development and human use of coastal areas has allowed for an abundance of potential tern predators (USFWS 1998, Kress and Hall 2004). Great horned owl and black-crowned night heron will fly many kilometers to feed on tern chicks and adults. Other avian predators seen at Seavey Island include peregrine falcon, harrier, and cattle egret. With 99% of the common terns and 100% of the roseate terns in New Hampshire nesting at Seavey Island this species is vulnerable to predation.

(B) Evidence

More effective control of municipal and fishing wastes is helping to control gull populations. However, the New Hampshire seacoast still has a large open landfill located in Rochester, about 46 kilometers from the

Isles of Shoals. This landfill supports large numbers of gulls during the winter. The Isles of Shoals remains an active fishing area, and there is evidence that discarded lobster bait and other fishing wastes subsidize local gull populations (Goodale 2000). Lack of gull control has been shown to sharply increase predation and disturbance of nesting terns (Donehower 2003). Although non-lethal gull control has successfully removed nesting gulls from Seavey Island, gull predation continues at this site and is particularly intense during the fledging period.

Nocturnal predators such as the great horned owl and black-crowned night herons prey on terns and may cause colony desertion (Nisbet 1999). A great horned owl killed significant numbers of roseate adults in the 2 largest roseate colonies in Buzzard's Bay, Massachusetts. Black-crowned night heron predation has been documented on Stratton Island, Maine and on Falkner Island, Connecticut. The Stratton Island colony grew from 1 pair in 1995 to 127 pairs in 2001 after black-crowned night herons were controlled. The Falkner Island population fell from 135 pairs in 1997 to 37 pairs in 2004 after black-crowned night heron appeared.

Since 2000, mink have invaded 5 common and roseate tern colonies, resulting in dramatic loss of common and roseate terns and the abandonment of tern colonies from Ship Island, Stratton Island, and Jenny Island. Mink killed every roseate chick on Brothers Island (Canada) in 2 consecutive years. Laughing gulls increased by 75% (close to 4,500 pairs) in the Gulf of Maine in the last 5 years. Laughing gulls may compete with terns for nesting habitat or food and some individuals will eat eggs and chicks. Boats have brought predators (rats and raccoons) to Star, Smutynose, and Appledore Islands in the Isles of Shoal, causing widespread nesting failure.

3.1.2 Development (Habitat Loss and Conversion)

A) Exposure Pathway

Nearly one-third of the population in the United States (over 75 million people) and Canada (over 9 million people) live within a day's drive of the Gulf of Maine. Vast areas of coastal and offshore marine habitat have been lost or degraded in the last three centuries. The northeastern common tern population is restricted to a small number of islands and many

historic nesting islands been lost to erosion or are occupied by gulls. Degradation and disturbance in these areas would all have a negative impact on common tern success. Little is known of critical habitat (foraging, staging, and wintering habitat) of common or roseate terns. Nisbet (2002) cites the need for increased research into winter habitat where it is believed the highest mortality occurs.

(B) Evidence

Critical habitats for common terns and roseate terns should be identified and protected. Seavey Island is important because most of New Hampshire's common terns and all of its roseate terns nest there. Yet scientists do not know basic information such as the location of foraging or staging areas. The 2 known staging areas in the Northeast are in highly developed areas of the coast and may be vulnerable (Casco Bay, Maine and South Beach, Massachusetts).

3.1.3 Unsustainable Harvest (Overfishing)

(A) Exposure Pathway

According to the United Nations Food and Agriculture Organization, more than 70% of the worldwide marine fish stocks are either fully exploited or depleted. In the North Atlantic, the American Fisheries Society has identified 82 species at risk of extinction including Atlantic salmon, Atlantic halibut, and a number of species of sharks, skates, sturgeons, and groupers. Fishing can change the abundance of exploited species and degrade marine habitat (e.g., trawling) (Collie et al. 1997).

Point and non-point source runoff from agricultural and developed coastal areas can negatively impact estuarine and subtidal areas that support food webs in coastal and offshore waters. Climate change will likely warm sea surface temperatures and oceanic circulation, leading to changes in nutrient cycling and marine productivity (Tyrell 2005). Many other activities threaten coastal marine habitat in the Gulf of Maine (for a review, see Tyrell (2005)).

(B) Evidence

Changes in prey availability affect the growth and survival of chicks and the condition of adults (Safina et al. 1988, Nisbet et al. 1995). Prey availability may also impact the size and distribution of colony sites (Nisbet 1999). However, the correlation of reduced

prey availability and common and roseate tern productivity has not been firmly established. Other seabirds, including terns, have shown very significant impacts from changes in prey availability. In Britain, breeding failure and diminished adult survival in Arctic terns was linked to changes in fish prey availability due to commercial fisheries activities (Suddaby and Ratcliffe 1997 in Kress and Hall 2004).

In 2004, disappearance of sand eels devastated Scottish seabird colonies; 1,200 guillemot nests on the isle of Shetland failed completely, 24,000 Arctic tern nests were almost entirely empty, and the world's largest colony of great skuas produced only a few chicks. Scientists believe that the sand eels are disappearing because the cold-water plankton that these fish depend on no longer flourishes in these coastal areas. The North Sea has warmed 3.6°F over the last 20 years, shifting the phytoplankton blooms northward or earlier in the season (Schulman 2005). Global warming is widely believed to be responsible for the relatively rapid rise in worldwide ocean temperatures.

3.1.4 Disease (Avian Cholera, Avian Botulism, Salmonella)

(A) Exposure Pathway

Avian cholera is an increasing threat to seabirds (USFWS 1998) and its spread is linked to the poultry industry. It is a highly infectious, lethal disease caused by the bacterium *Pasteurella multocida* (Kress and Hall 2004). The bacterium can persist in carcasses for up to 3 months and in freshwater sources for upwards of 3 weeks. Another bacterial disease, avian botulism, is transmitted through sewage discharge or buildup of organic matter. It infects scavengers (e.g., gulls) and accumulates in dead birds (Kress and Hall 2004). The source and transmission of salmonella in birds is not well understood.

(B) Evidence

In 1988, 37 common terns were found dead on Eastern Egg Rock from avian cholera. This resulted in complete abandonment of the colony with only 37% recolonizing later in the season (Kress 1997). In 1991, large numbers of terns and laughing gulls died from avian botulism on Eastern Egg Rock after a massive menhaden die-off in Muscongus Bay. Avian cholera has killed terns, gulls, and eiders on islands in

Maine. In 2004, close to 2000 common tern chicks were found dead on the nests at Monomoy Island, Massachusetts, with no evidence of external trauma. Test results identified salmonella as the cause of death, but there is no conclusive evidence for the source or transmission of this bacterium.

3.2 Sources of Information

Information on threats to common terns was taken from the literature, the USFWS Tern Management Plan, from the list of threats developed as part of regional bird conservation planning (BCRs 14 and 30), and from Seavey Island management experience. Threats developed for Coastal Islands were also used, with some modification, in the development of the threats and threat rankings for the roseate tern.

3.3 Extent and Quality of Data

Threats to common terns and their breeding habitat are well documented in management and conservation plans. The threat posed by reduced prey availability still needs research and monitoring to determine the correlation with tern productivity. Direct threats to foraging and staging areas are unclear until these areas have been identified.

3.4 Threat Assessment Research

- Assess the effects of tern predators and evaluate means of controlling those species in different critical habitats and at different times of the year
- Determine laughing gull impacts on common and roseate tern nesting success
- Assess and monitor of the effects of aquaculture, fishing practices, and other stressors on terns, tern predators, and habitats
- Identify and protect (if feasible) critical habitats such as foraging, staging, and wintering areas
- Identify seasonal and spatial variation in prey (composition and abundance) and potential effects on colony productivity

ELEMENT 4: CONSERVATION ACTIONS

4.1.1 Manage and monitor the Seavey Island colony, Restoration and Management

(A) Direct Threats Affected: Predation, Human disturbance, Oil spill, Avian cholera (disease)

(B) Justification

Tern restoration projects in Maine and Massachusetts in the last 25 years have documented that the productivity and stability of these tern colonies depends on continued management. Currently, all productive tern colonies in the Northeast are being actively managed (USFWS 1998, Kress and Hall 2004). Since 1997, management of the Seavey Island colony has allowed for the successful recolonization of terns to the Isles of Shoals after a more than 50-year absence. Resident biologists act as stewards for the Seavey tern colony and can enforce the closure of this island during the breeding season, as well as providing annual population and productivity estimates. Active management occurs annually during the breeding season from 21 April to 31 August. Active management through the breeding season allows for an immediate response or change in response to all the threats identified above (predation, human disturbance, disease and oil spill).

(C) Conservation Performance Objective

The objective of continued intensive management at Seavey Island is to increase and secure both the common and roseate tern populations. Although there are no established recovery criteria for common terns in the northeast region, a productivity rate in the range of 1.1–1.8 chicks per nest is considered adequate to sustain population growth. The primary objective of the Northeast region roseate tern recovery program is to promote an increase in breeding population size, distribution, and productivity to warrant reclassification to threatened status and eventual delisting. The criteria for recovery include a minimum of 6 large colonies (≥ 200 pairs) with high productivity (at least 1.0 fledged young/nest) for 5 consecutive years. Successful management and monitoring at Seavey Island would maintain productivity of the common tern colony and expand the roseate population to the level cited above and maintain this level for at least 5 years.

(D) Performance Monitoring

The productivity of the Seavey Island common and roseate terns will be monitored annually using established methods outlined in the Roseate Tern Recovery Plan, The Tern Management Handbook and through the regional roseate tern metapopulation study (Nisbet 1990). An all island census will also be conducted annually during the census window of June 12 to 20 as established by the regional tern working group (GOMSWG). Downward trends in either colony census numbers or productivity estimates need to be addressed immediately.

(E) Ecological Response Objective

The desired ecological response to continued monitoring and management is to increase the likelihood that common and roseate terns will successfully breed, reach target levels of productivity, and increase in population numbers on Seavey Island. Successful management will be indicated by a positive growth rate in common terns and the achievement of roseate tern recovery objectives (USFWS Roseate Recovery Plan).

(F) Response Monitoring

Annual census numbers and productivity estimates will indicate the health and success of the Seavey Island colony. Trend analysis will allow managers to adjust the level of intensity and type of management.

(G) Implementation

Implementation will require the cooperation of the two major partners in the Tern Restoration Project (NHFG and NHA) as well as other cooperators and supporters including the USFWS, DRED, USDA – Wildlife Services, NHCP, Shoals Marine Lab, Roseate Tern Recovery Team (RTRT) and GOMSWG. Collaboration will occur with state and federal partners working with terns in other northeastern states including Maine, Massachusetts, Connecticut and New York, as well as with international partners in Canada. Important guidance for establishing monitoring protocols will be provided by the New Hampshire Tern Management Team along with the methodologies outlined by the Roseate Tern Recovery Plan and the Tern Management Handbook.

(H) Feasibility

Management and monitoring has been occurring at Seavey Island since 1997. The expertise to carry

out this project currently exists in New Hampshire. Guidance and collaboration will come from regional tern biologists participating in GOMSWG and members of the RTRT. Securing long term funding will be critical to continued monitoring at this site.

4.1.2 Develop predator management plan, Restoration and Management

(See also: section 3.1.1 and 4.1.1 for predator management on Seavey Island and other island and mainland locations)

(A) Direct Threats Affected: Predation

(B) Justification

Research shows that tern management must continually adapt to changing predator threats. More effective control of municipal and fishing wastes is helping to control gull populations. The New Hampshire sea-coast still has a large open landfill located in Rochester, about 46 kilometers from the Isles of Shoals. This landfill supports large numbers of gulls during the winter. The Isles of Shoals remains an active fishing area, and there is evidence that discarded lobster bait and other fishing wastes subsidizes local gull populations (Goodale 2000).

A proactive management plan should exist to better respond to predation from a suite of predators including gulls, great horned owl, black-crowned night heron, and mammalian predators such as mink, raccoons, and rats. Minimizing predator impacts will help achieve long-term growth objectives and reduce the possibility of movement of breeding adults to alternate sites. Incidence of predation and predator concentrations would need to be evaluated periodically (minimum twice per year) to assess management success. If foraging and staging areas are identified, predator management may need to be expanded beyond the breeding season.

(C) Conservation Performance Objective

The objective of continued and more effective management of predator concentrations is to increase and secure common and roseate tern populations, while minimizing mortality and movement.

(D) Performance Monitoring

Methods to evaluate trends in predator populations/

concentrations would need to be established. Obvious sources such as the Rochester landfill could be surveyed on a regular basis to identify changes in predator usage. Fishing regulations, specifically the discarding of fishing wastes, could be assessed in terms of their contribution to predator (gull) populations. Downward trends in either colony census numbers or productivity estimates need to be addressed immediately. See section 3.1.1 for management specific to Seavey Island.

(E) Ecological Response Objective

The desired ecological response to predator management is to increase the likelihood that common and roseate terns will successfully breed, reach target levels of productivity, and increase in population numbers. Successful management will be indicated by a positive growth rate and the achievement of recovery objectives (USFWS Roseate Recovery Plan).

(F) Response Monitoring

Annual census numbers and productivity estimates will indicate the health and success of colonies. Trend analysis will allow managers to adjust the level of intensity and type of management.

(G) Implementation

Implementation will require the cooperation of the two major partners in the Tern Restoration Project (NHFG and NHA) as well as other cooperators and supporters including the USFWS, DRED, USDA – Wildlife Services, NHCP, Shoals Marine Lab, Roseate Tern Recovery Team (RTRT) and GOMSWG. Collaboration will occur with state and federal partners working with terns in other northeastern states including Maine, Massachusetts, Connecticut and New York, as well as with international partners in Canada. Important guidance for establishing monitoring protocols will be provided by the New Hampshire Tern Management Team along with the methodologies outlined by the Roseate Tern Recovery Plan and the Tern Management Handbook.

(H) Feasibility

The expertise to carry out this project currently exists in New Hampshire. Further guidance will come from regional tern biologists. The cooperation of landowners or managers at sites that are identified as predator concentrations is unknown. Wildlife Services has

many years of working in collaboration with some of these land managers so their involvement and expertise is critical. The long term funding of mainland predator management will need to be assessed and potential funding sources identified.

4.1.3 Identify and protect important staging and foraging areas for common and roseate terns, Habitat Protection

(A) Direct Threats Affected: Predation, Habitat Loss, Recreation and Tourism, Contamination

(B) Justification

Little is known of common and roseate tern foraging and staging habitat utilized by Seavey Island birds. The identification and protection of these habitats is critical to the long-term stability of this colony (USFWS 1998, Kress and Hall 2004). The distribution of suitable feeding locations and the availability of prey fish at these locations may influence colony size, distribution, and breeding success (Nisbet and Spindelow 1999). Research shows that common and roseate terns from several sites concentrate and stage at a limited number of locations. This concentration makes large numbers of the entire Gulf of Maine tern population vulnerable during these staging periods. Protection of staging areas should be timely and permanent on a year round basis, with increased protection during identified windows of high use.

(C) Conservation Performance Objective

The objective of identifying and protecting tern foraging and staging areas is to maintain breeding colonies and minimize mortality.

(D) Performance Monitoring

The productivity of the Seavey Island common and roseate terns will be monitored annually using established methods outlined in the Roseate Tern Recovery Plan, The Tern Management Handbook and through the regional roseate tern metapopulation study (Nisbet 1990). An all island census will also be conducted annually during the census window of June 12-20 as established by the regional tern working group (GOMSWG). Downward trends in either colony census numbers or productivity estimates need to be addressed immediately.

(E) Ecological Response

The desired ecological response to protection of foraging and staging areas is to increase the likelihood that common and roseate terns will successfully breed, reach target levels of productivity, and increase in population numbers on Seavey Island. Successful management will be indicated by a positive growth rate and the achievement of recovery objectives (USFWS Roseate Recovery Plan).

(F) Response Monitoring

Annual census numbers and productivity estimates will indicate the health and success of the Seavey Island colony. Trend analysis will allow managers to adjust the level of intensity and type of management.

(G) Implementation

Implementation will require the cooperation of the two major partners in the Tern Restoration Project (NHFG and NHA) as well as other cooperators and supporters including the USFWS, DRED, USDA – Wildlife Services, NHCP, Shoals Marine Lab, Roseate Tern Recovery Team (RTRT) and GOMSWG.. Important guidance will be provided by the NH Tern Management Team along with the methodologies outlined by the Roseate Tern Recovery Plan and the Tern Management Handbook.

Coordination with land protection specialists from local, state and federal agencies to maximize the potential for successful protection of identified foraging and staging areas. The protection of these habitats may require the innovative protection strategies such as those outlined in the GOMC Marine Protected Areas Project. Federal and state partners from the NHCP, the Coastal Islands Wildlife Refuge, the Great Bay Refuge, and the Great Bay National Estuarine Research Reserve would be important partners. It is likely that areas will be identified across state boundaries and necessitates coordination with Maine and/or Massachusetts partners.

(H) Feasibility

The expertise to carry out this project currently exists in NH with guidance from regional tern biologists. Securing immediate and long term funding will be critical to the identification and protection of foraging and staging areas. Protection of these habitats will take cooperation and coordination of federal, state and local officials.

4.1.4 Develop regional partnerships, Restoration and Management

(B) Justification:

The Tern Restoration Project will benefit from collaboration with other organizations that are focused on resource conservation and management in the Gulf of Maine. NHCP provides the leadership in coordinating local communities, state and federal agencies in the planning and policy issues needed to balance the preservation of New Hampshire's natural resources with the social and economic needs of the coastal region. The Gulf of Maine Council brings together partners from Massachusetts, New Hampshire, Maine, and the Canadian provinces of New Brunswick and Nova Scotia (www.gulfofmaine.org). The Gulf of Maine Habitat Conservation Subcommittee is working with partners in the region to develop and advance marine habitat conservation strategies.

4.1.5 Monitor prey availability during the tern nesting season, Habitat Protection

(A) Direct Threats: Reduced Prey Availability, Contamination

(B) Justification

Further research is needed to assess the role of commercial fisheries on prey availability for seabird colonies. In addition, it is important to support research and policies that help to reduce negative impacts on nursery areas for prey items such as herring, hake and other fish stocks that are important food for seabirds. Some of the partners outlined in section 4.1.1 (G) could coordinate with the NHFG Department Marine Resources Division and the Shoals Marine Laboratory to monitor prey availability. An established monitoring program coupled with the chick provisioning studies taking place on Seavey Island would allow seabird biologists and fisheries managers to collaborate on actions that could benefit seabird restoration.

4.1.6 Education and Outreach

(A) Direct Threats Addressed: All

(B) Justification

The Tern Restoration Project has provided an excel-

lent opportunity for educational outreach. The focus of this outreach has been to foster stewardship, appreciation, and protection for the seabird colony on Seavey Island as well as other Gulf of Maine seabird nesting islands. Opportunities have come through welcoming visitors and other organized classes to the island, sharing the details of the project with charter and ferry boats that visit the Isles of Shoals, and taking the project out to many groups around New Hampshire through a slide presentation and display. It is important that we continue to strengthen and expand outreach efforts on seabird conservation. The development of classroom curriculum and teacher resources will capture an important audience. A tern restoration web page will foster stewardship, increased understanding and appreciation for seabird conservation issues. A web page addition would reach a large, broad audience and expand educational opportunities manifold. These efforts lay the groundwork for increased awareness and understanding of coastal issues that impact seabird islands, and promote stewardship for coastal resources.

(G) Implementation

Improve public outreach and education on seabird restoration issues in New Hampshire and the Gulf of Maine through the following mediums:

- Further develop and implement outreach and education to Isles of Shoals users including the Shoals Marine Lab, Star Island, Seacoast Science Center, and island visitors
- Further develop and implement an outreach program and educational materials for passengers aboard charter vessels in and around the Isles of Shoals including the Uncle Oscar, ISSCO ferry and the Granite State
- Develop a tern restoration presentation and curriculum to be included in the coastal ecology unit presented to middle and high school students aboard the Granite State
- Further develop and implement a teacher workshop that highlights the tern restoration project and seabird conservation issues
- Develop a seabird conservation curriculum that can be used in classroom presentations. Use roseate terns as an example of a successful restoration model
- Create a Tern Restoration/Seabird Conservation

Page with live streaming tern video from Seavey Island on the NHA/NHFG Web pages

4.2 Conservation Action Research

- Monitor and manage predator populations on islands and the mainland
- Identify and protect foraging and staging areas
- Assess prey availability and its effect on breeding success and colony dynamics

ELEMENT 5: REFERENCES

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5.2 Data Sources

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Gulf of Maine Seabird Working Group Minutes
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ELEMENT 6: LIST OF FIGURES

Figure 1. Common tern productivity, 1997-2004

Figure 2. Nesting pairs of herring and great black-backed gulls at the Isles of Shoals 1920-1995 (Numbers compiled from Drury 1973, Borrer 1990, USFWS Colonial Waterbird Survey 1995).

Figure 3. Seavey Island common tern population numbers 1997 - 2004

Year	Nests monitored	Mean clutch size	Mean hatch	Fledglings/nest
1997	6	1	1	1
1998	45	2.56	2.02	1.6
1999	25	2.84	2.48	2.24
2000	43	2.6	2.33	1.58
2001	73	2.44	2.18	1.68
2002	184	2.52	2.09	1.63
2003	163	1.96	1.61	1.33
2004	138	1.84	1.67	0.75

Table 1. Common tern census numbers at Seavey Island 1997-2004.

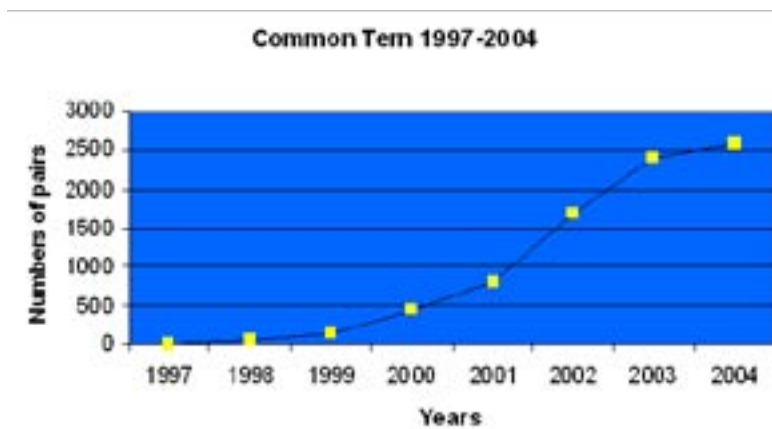


Figure 2. Nesting pairs of herring and great black-backed gulls at the Isles of Shoals 1920-1995 (Numbers compiled from Drury 1973, Borror 1990, USFWS Colonial Waterbird Survey 1995).

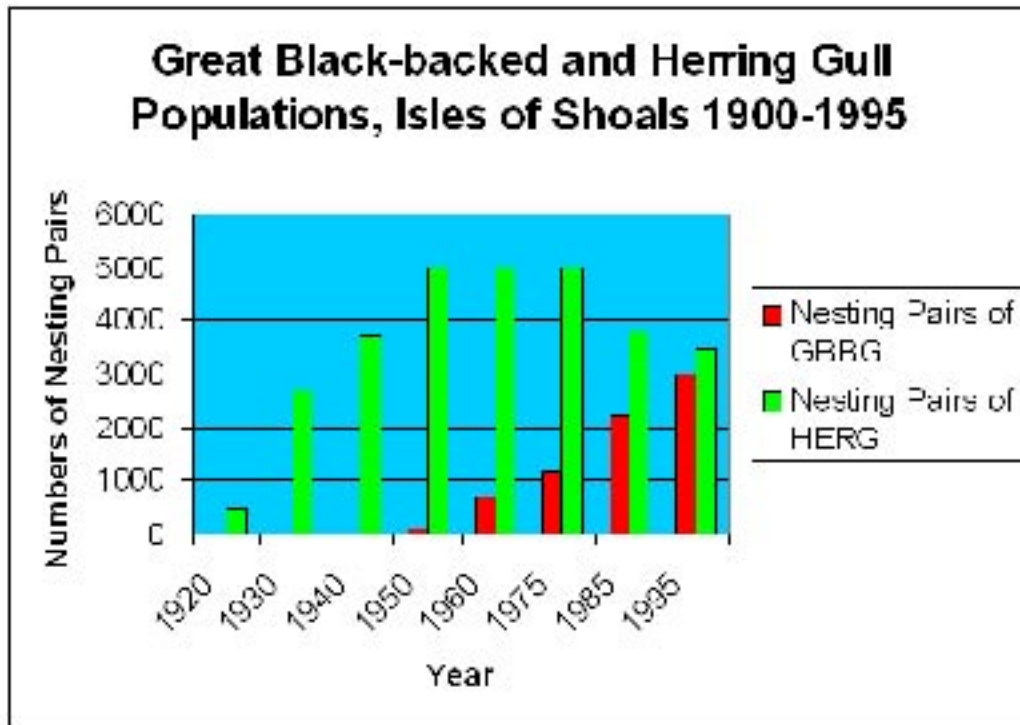


Figure 3. Seavey Island common tern population numbers 1997 - 2004