U.S. Fish and Wildlife Service

Maine Coastal Islands National Wildlife Refuge

Seabird Restoration Efforts at Petit Manan Island: 1984 — 2005

Petit Manan is a 16 acre island located three miles south of Petit Manan Point in Steuben, Maine. The Island has historically been one of the most important seabird colonies in the Gulf of Maine. Throughout the

early 1900's, rapidly increasing gull populations eliminated nesting terns from many of Maine's islands. Gulls are highly effective predators of tern eggs, chicks, and adults. Their presence on a nesting island may result in lower productivity or complete abandonment of the island by terns.

Fortunately for the terns on Petit Manan, the lighthouse keepers kept the island "gull free". However when the light was automated in 1972, the keepers and their families left the island. The U.S Fish and Wildlife Service acquired the island in 1974. The gulls quickly returned to Petit Manan, and displaced all nesting terns by 1983. The USFWS initiated a seabird restoration effort in 1984, and removed gulls from the island. Terns returned to the island within one week of the predator control effort and have continued to nest on the island every year.

In 2005, Petit Manan Island supported 1,007 pairs of common terns, 595 pairs of Arctic terns, nine pairs of roseate terns, 51 pairs of Atlantic puffin, 1,151 pairs of laughing gulls, and one pair of razorbills.

Common eider, Leach's storm-petrel, and black guillemot also nest on the island. Migratory and wintering shorebirds and waterfowl feed on the surrounding inter-tidal ledges throughout the year.

Historic photo of Petit Manan light house and light keepers in the early 1900's

Restoration Highlights:

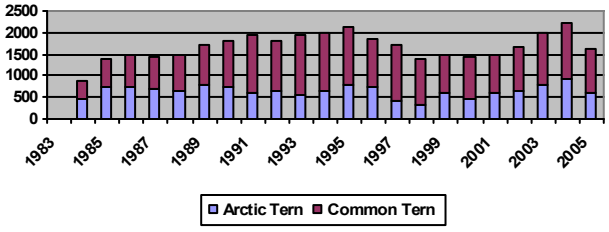
- Petit Manan Island is the second largest tern colony in Maine.
- A record high of 51 pairs of Atlantic Puffin nested on the island in 2005.
- Arctic Tern metapopulation study documented movement among the tern colonies in the Gulf of Maine, and determined an adult survival rate of 85%
- Atlantic puffin metapopulation study summarized 30 years of banding efforts and calculated an adult survival rate of 88%
- Over 11,000 seabirds have been banded on Petit Manan Island.
- Common Eider survival and recruitment study surpasses 7,400 ducks banded.

Common and Arctic Terns

In 2004, Petit Manan Island supported 2,200 pairs of terns, second only to the 2,300 pairs nesting on Seal Island NWR. Unfortunately a severe storm battered the terns as they arrived for the 2005 breeding season. As a result, the Petit Manan colony declined by 33%, but we are hopeful this is a short term loss of breeding pairs.

We annually hire technicians to spend the summers living with the terns monitoring population growth, productivity, survival, and conducting feeding and behavior studies from observation blinds. Technicians have also been involved in numerous research projects over the years.

Data collected from these studies indicate the colony is generally 60% common terns and 40% Arctic terns, and both species of terns routinely move around to other nesting islands in the Gulf of Maine. Herring and hake are the primary prey species fed to the tern chicks. In recent years, harsh weather events have been responsible for killing up to 50% of the tern chicks in a single day. The monitoring and management techniques developed on Petit Manan Island have been used on several other tern restoration projects in the Gulf of Maine.

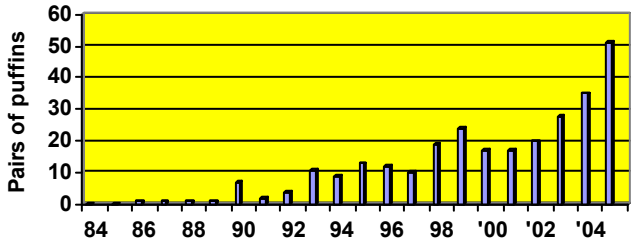


Recovery of common and Arctic terns on Petit Manan Island

Atlantic Puffins: Petit Manan Population increases by 45%

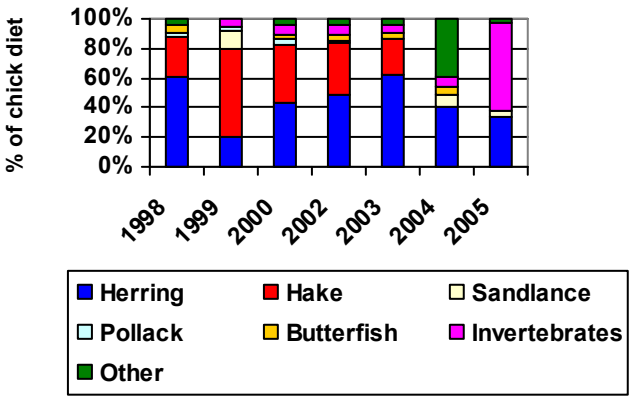
Adult Atlantic puffin

Maine is the only state to support breeding Atlantic puffin, and within Maine, they only breed on four islands. They are listed as a threatened species in Maine and we estimate the population at 600 pairs. Although there are no historic records of puffins breeding on Petit Manan, the birds began visiting the island shortly after the gull control effort. The first pair bred in 1986 and the first chick was produced in 1987. The puffin colony has continued to increase, and this year a record high 51 pairs of puffin nested. Since 1984 we have banded 156 puffins on Petit Manan Island, and 66% of these birds have been observed again. In an effort to increase nesting habitat for puffins we have been experimenting with artificial nest burrows. Several pairs have used the structures and we are hopeful that additional pairs will nest in them in the future.



Colonization of Atlantic Puffin at Petit Manan Island

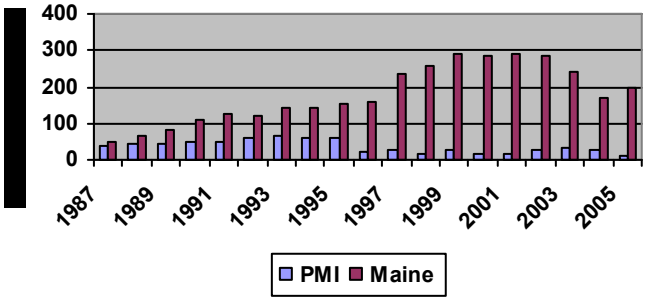
Decline in Herring Availability Causes Concern throughout Gulf of Maine



Although the Refuge and our conservation partners have worked for years to provide the seabirds with safe nesting islands, the birds need an abundant supply of fish to raise their young. Each year we monitor tern nests to determine how often and what species are fed to tern chicks. Our research has shown that 40-70 % of the terns diet consists of herring and hake. In recent years, terns on Petit Manan have not been able to locate sufficient fish to feed their young chicks. The adults are desperate to feed the young birds and will even try feeding them invertebrates like ants. Declining fish availability directly affects the survival rates of the young terns and alcids nesting throughout the Gulf of Maine. The Refuge is working with our conservation partners to support commercial fish harvest regulations that will protect the nesting birds.

Where have all the roseate terns gone?

Roseate terns are listed as an endangered species by the USFWS and the State of Maine. When seabird restoration efforts started in the early 1980's we estimated that only 75 pairs of roseate terns nested in Maine. In 2005, we documented 195 pairs nesting on six islands. Petit Manan Island was once the largest roseate tern colony in Maine, but the number of roseates breeding at the island has significantly declined in recent years. Although numbers appeared to be improving in 2002 and 2003, the colony dropped to only nine pairs in 2005. In the past five years, the entire northeast population has declined by 28%. The Refuge is working with researchers in the US and Canada and the Roseate Tern Recovery Team to try and determine the cause of this decline. Within Maine, 70% of the roseate terns now nest on Eastern Egg Rock.



Recovery of Roseate terns on Petit Manan and within Maine

Ongoing and New Research Projects

Arctic Tern Metapopulation Project

Arctic tern chick

Adult Arctic tern banded with field readable band

In 1999, the University of New Brunswick, National Audubon Society, and the Refuge initiated an Arctic tern metapopulation study. We were concerned that after nearly 20 years of restoration efforts, the Arctic tern population was not recovering at rates experienced by common terns. The group felt that we needed a better understanding of Arctic tern movement among the colonies in the Gulf of Maine and Bay of Fundy. The four largest Arctic tern colonies in the region: Machias Seal, Petit Manan, Seal, and Matinicus Rock are all protected by Maine Coastal Islands NWR.

A large scale banding effort would also allow us to determine survival and recruitment estimates for the Arctic tern, a first in North America. In an effort to increase the likelihood of reading bands we developed field readable bands that have larger characters than traditional bird bands. Over the past seven years we have trapped and banded incubating Arctic terns, banded tern chicks, and read bands through spotting scopes. To date we have banded 2,164 adults and 4,362 tern chicks.

Over 50% of the adults have been observed again. Observations of banded birds indicate that the terns are frequently moving among the colonies. We have estimated an annual adult survival rate of 0.85, a level considered minimal for population stability in a long lived species. We are hopeful that when birds banded as chicks are recruited into the breeding population we will get additional information on survival rates and inter-colony movement.

Atlantic Puffin Metapopulation Project

The Refuge has also been working with National Audubon Society and the University of New Brunswick on an Atlantic puffin metapopulation project. We wanted to determine the rate of movement among the colonies and determine age specific survival rates. Four of the five islands in the study (i.e. Machias Seal, Petit Manan, Seal, and Matinicus Rock) are part of the National Wildlife Refuge System.

Puffins have been banded with field readable bands throughout the seabird restoration effort. Initially the birds were banded with plastic bands, color specific to each island. Due to excessive band wear, we switched to metal field readable bands in 1999. Between 1980-2003, 2,050 puffin chicks were banded and released from the five islands in the study, and these birds were resighted over 17,000 times. Annual survival estimates for birds up to three years old was 0.59, and this increased to 0.77 by age four.

Survival estimates peaked at age five, reaching 0.88. After age five the survival rate decreased to 0.69 but that may be the result of band loss or wear. We did not detect any differences in survival rates among the colonies. The study concluded that mortality events generally occurred during the non-breeding season and the effects would be shared among the colonies. The primary cause of adult mortality appears to be significant winter storm events. Unfortunately we know very little about puffin distribution during the winter months.

Up to 25% of the pre-breeding puffins (age 1-5 years) visited a number of other puffin colonies. These young birds may spend the summer at one site, or travel around to all the different colonies. Once the birds reach breeding age (i.e. 5-6 years) they generally will stay at one colony. In addition, the likelihood that a puffin will return to the island it hatched on (i.e. philopatry) increases with size of the puffin colony (i.e. larger colonies retained a greater percentage of their chicks). We will continue banding and resighting efforts on all five islands in the study.

Banded Atlantic puffin

Atlantic puffin chick

Are Elevated Stress Hormones Limiting the Reproductive Capabilities of Common and Arctic Terns?

Gull control efforts on the 10 managed tern colonies in the Gulf of Maine have resulted in a significant increase in both common and Arctic tern populations. Unfortunately, trend information indicates that Arctic terns are recovering at a slower rate than common terns. Arctic terns are at the southern limit of their breeding range in Maine and are listed as a threatened species by Maine Dept. of Inland Fisheries and Wildlife. The two species of terns nest on many of the same islands and generally share diet items. Due to the similarities on the breeding colonies, we think that conditions outside the breeding season may be limiting the recovery of Arctic terns in Maine. In 2005 the Refuge initiated a research project with the University of Maine to determine what factors might be limiting the recovery of Arctic terns in Maine. Researchers have begun collecting blood samples from common and Arctic terns throughout the breeding season (i.e. arrival, incubation, and chick rearing) . These samples will be analyzed for stable isotopes, parasites, stress and sex hormones. Similar work on neotropical migrants and shorebirds has found that habitat quality on the wintering grounds and migration distance significantly influence a birds reproductive capabilities. Arctic terns have the longest known migration of any bird, traveling over 25,000 miles each year. The Refuge is concerned that changes in habitat quality and forage availability along the terns' migration route may be limiting their recovery rate here in the Northeast. Stable isotope analysis will allow us to determine if the birds arrive with the resources they need to lay eggs, or if they need to replenish their body reserves before eggs are produced. Stable isotope analysis may also help us understand differences in foraging behavior between common and Arctic terns.

Blood and feather samples have been submitted to the University of Maine for analysis. We anticipate continuing this research in 2006 and 2007.

Arctic tern

Common tern chick begging for food

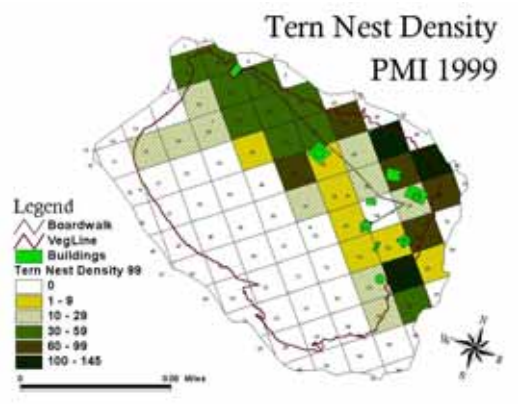


Figure 1—Distribution of tern nests in 1999

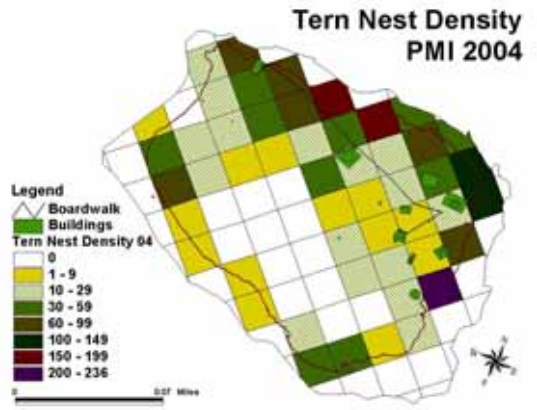


Figure 2—Distribution of tern nests in 2004

Habitat Management on Petit Manan Island

Common and Arctic terns prefer to nest in a mix of low, sparse vegetation and open ground. Over the past 22 years of seabird restoration efforts, the Refuge has learned that without some level of vegetation management the habitat on coastal islands frequently becomes too rank for the nesting terns. In the past, many islands were grazed by sheep or periodically burned to maintain suitable forage for livestock.

The Refuge has been using prescribed burning and mowing to manage the habitat on Petit Manan Island. By the late 1990's vegetation on the island had become so rank that the terns were forced to nest along the perimeter of the island (Fig 1). Terns nesting along the perimeter of the island are subject to storm tides and flooding, as well as increased predation rates. In particular, the number of Arctic terns nesting in the interior section of Petit Manan had decreased significantly. With assistance from Regional Fire Management Officer Vollick and seasonal staff, the Refuge has completed a prescribed burn of the island each of the past four years. Burning has reduced the height and density of the rank vegetation, providing suitable habitat for the nesting terns.

The two figures to the left show tern distribution prior to initiating a prescribed burn program (Fig 1) and tern distribution in 2004, when a record high 2,200 pairs of terns nested on Petit Manan (Fig 2). Although many terns still nest on the northeast side of the island, they are no longer nesting on bare ledge in extreme densities of 10 nests / m^2 . They have moved into the newly restored vegetation and are experiencing greater productivity rates than observed prior to the burn program. The south west portion of the island is still dominated with raspberry and Canada blue joint, providing nesting habitat for common eider and laughing gulls.

Common Eider Study surpasses 7,400 eiders banded

In 2002, Maine Coastal Islands NWR began working with Patuxent Wildlife Research Center and Maine Dept. of Inland Fisheries and Wildlife biologists, on a long-term banding effort to determine survival, recruitment and recovery rates of common eiders in the Atlantic coast population. Nesting females are captured using hand nets on select islands and large rafts of flightless birds are "herded" into traps using kayaks and motorboats. These methods have proven extremely successful with over 7,400 eiders banded over the last four years. This season we caught and banded 1,337 molting birds, and 152 previously banded birds at Petit Manan Island.

Information gathered from this long-term project (5-10 years) will help managers better understand eider movements, age of first reproduction, survival and recruitment.

(top photo: banding an eider duckling, bottom photo: kayak herding raft of molting eiders)

Razorbills

Although the number of razorbills visiting Petit Manan has been increasing for years, 2004 marked the first successful breeding effort. In 2005, the pair returned to the same burrow but unfortunately the chick died during hatching. We are hopeful additional pairs will nest in future years. Razorbills nest on only six islands within Maine including four refuge islands.

Razorbill

Common Murre

Common murre have not bred in Maine in over 100 years, however, we are hopeful that may soon change. In recent years, murre have started to visit Petit Manan and several of the other restoration islands. The birds frequently loaf with the other alcids on the island. In 2003 Machias Seal Island had the first murre breeding effort in the Gulf of Maine.

Common murre

Cooperative Research with Bar Harbor Whale Watch Company

The Bar Harbor Whale Watch Company runs several commercial whale and seabird viewing trips out of Bar Harbor. The boat brings over 25,000 tourists a year to visit the seabirds of Petit Manan Island.

In 2005, the Refuge began a cooperative research effort with the Whale Watch Company and College of the Atlantic. We have hired an observer to monitor pelagic seabirds and marine mammals that feed on the productive waters of the Gulf of Maine. This is the first pelagic monitoring effort in the Gulf of Maine in 30 years. This research will provide us information on where seabirds from Petit Manan are foraging, and help us identify areas in the ocean that provide foraging habitat for a variety of species. Many of the pelagic birds breed in the southern hemisphere and travel north to forage in the waters of the North Atlantic. We collected GIS information on the area covered by each survey and specific locations for each observation. We recorded over 35 species of birds and 11 species of whales, sharks, and fish.

Pomarine jaeger

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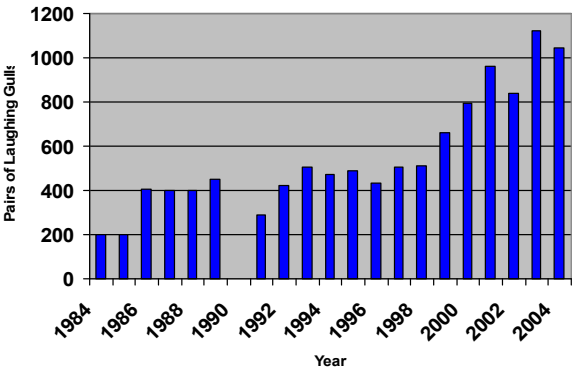
http://www.fws.gov/northeast/mainecoastal/

Laughing Gulls on Petit Manan Island

Laughing gulls are listed as a species of special concern by Maine Department of Inland Fisheries and Wildlife. Maine represents the northern limit of their breeding distribution, and they only breed on three managed tern colonies: Petit Manan, Egg Rock, and Matinicus Rock. During the early stages of tern restoration, we believed that laughing gulls could nest among the terns, with little conflict. In recent years we have observed an increasing rate of kleptoparasitism and direct predation on tern eggs and chicks. In addition, the laughing gull colony on Petit Manan was increasing at a rate of 20% / year.

We have used a combination of prescribed fire, to reduce preferred nesting habitat, and nest destruction in an effort to limit the growth of the colony and protect the terns. Gulls observed preying on terns are lethally removed.

Many of the Arctic terns on Petit Manan nest in the center of the island and were experiencing significant gull predation in the late 1990's. In recent years, the terns have benefited from the reduction in rank vegetation (i.e. decrease in laughing gull nesting habitat) and the destruction of gull nests. Productivity monitoring has shown Arctic terns are experiencing significantly higher productivity rates as a result of these management efforts.



Growth of Laughing gull population on Petit Manan

Laughing gulls

Maine Coastal Islands NWR Significance to Seabirds:

In the United States:

- **3 of 4 Atlantic puffin colonies occur on refuge islands**
- **4 of 6 razorbill colonies occur on refuge islands**

In the lower 48 states:

- **96% of Arctic terns nest on 4 refuge islands**

In Maine:

- **61% of common terns nest on refuge islands**
- **52% of laughing gulls nest on refuge islands**
- **47 islands important to seabirds, wading birds or bald eagles are now afforded protection as part of Maine Coastal Islands NWR.**

Future Research and Management Needs

The Refuge still has several important research questions that need to be addressed:

- Determine location of tern and puffin foraging areas
- Determine location of puffin and razorbill wintering areas
- Determine what factors may be limiting Arctic tern recovery
- Continuation of the Arctic tern metapopulation study will provide valuable information on survival and recruitment rates
- What are the most appropriate methods of controlling laughing gull predation and population growth?
- What can be done to increase roseate tern nesting on Petit Manan ?

- Can artificial nest structures provide additional nesting habitat for Atlantic puffins?
- How are ongoing vegetation management actions effecting the composition of plant communities on Petit Manan?
- Need to develop razorbill and storm petrel census techniques
- How is inter-tidal harvest of invertebrates effecting foraging quality for waterfowl?