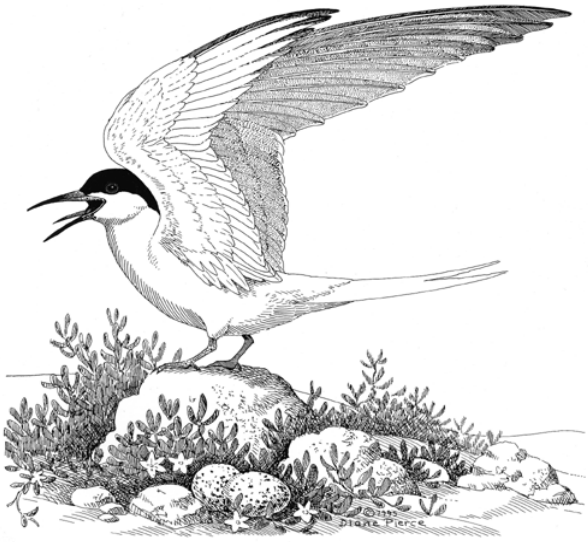
COSEWIC
Assessment and Update Status Report

on the

Roseate Tern
Sterna dougallii

in Canada



Roseate Tern. Diane Pierce © 1995

ENDANGERED
2009

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

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Previous reports:

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Whittam, R.M. 1999. Update COSEWIC status report on the Roseate Tern *Sterna dougallii* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-28 pp.

Kirkham, I.R. and D.N. Nettleship. 1986. COSEWIC status report on the Roseate Tern *Sterna dougallii* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 49 pp.

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COSEWIC
Assessment Summary

Assessment Summary – April 2009

Common name
Roseate Tern

Scientific name
Sterna dougallii

Status
Endangered

Reason for designation
In Canada, this colonial species is part of the northeastern population that breeds on small islands off the Atlantic coast from the Magdalen Islands in the Gulf of St. Lawrence south to Long Island, New York. It winters in South America, from Colombia to eastern Brazil. The most recent (2007) population estimate for Canada was 200 mature individuals occupying 7 locations (approximately 98% are in only 2 locations). The number of mature birds has been fairly stable over the past decade despite recovery efforts. Rescue through immigration of birds from the United States is unlikely since the species is endangered in New England and the population there is also small (circa 7600 mature individuals in 2007). The primary factors limiting the population are predation of eggs, young and adults, low adult survival rates, and stochastic events (e.g. hurricanes).

Occurrence
Quebec, New Brunswick, Nova Scotia

Status history
Designated Threatened in April 1986. Status re-examined and designated Endangered in April 1999. Endangered status re-examined and confirmed in October 1999 and in April 2009. Last assessment based on an update status report.

COSEWIC
Executive Summary

Roseate Tern
Sterna dougallii

Species information

The Roseate Tern (*Sterna dougallii*) is a medium-sized, pale seabird, closely related to gulls, with a long and deeply forked tail. During breeding, adults are mostly white with a black cap, have long white tail streamers, and a white breast suffused with pale pink. The bill of the Roseate Tern is black with red appearing at the base later in the breeding season. Recent genetic analyses suggest two subspecies, *S. d. dougallii* in Europe, North America and the Caribbean, and *S. d. gracilis* in western Australia.

Distribution

The Roseate Tern occurs on six continents in the Atlantic, Indian, and Pacific oceans. In North America, two populations of Roseate Tern breed on the Atlantic coast in distinct locations. The northeastern population breeds from the Magdalen Islands in the Gulf of St. Lawrence south to New York. The second population breeds from Florida and the Bahamas to the Lesser Antilles. Both populations winter in South America, from Colombia to eastern Brazil. The Canadian population of Roseate Tern constitutes approximately 2.6% of the northeastern population and breeds almost exclusively on coastal islands in Nova Scotia, although small numbers of birds also breed on islands in Quebec and New Brunswick. The location of small colonies changes unpredictably between years and only two colonies in Nova Scotia have maintained relatively large numbers of Roseate Tern since the 1980s.

Habitat

Roseate Terns nest in colonies almost exclusively on small islands, frequently vegetated with beach grass and herbaceous plants. In northeastern North America, Roseate Terns always nest in association with Common or Arctic terns, which help provide protection from diurnal predators through communal mobbing (Nisbet and Spendelow 1999). Roseate Terns nest under cover, usually in the form of dense vegetation or under and among strewn rocks, boards, driftwood, and artificial structures like boxes and half-buried tires. Roseate Terns have specialized foraging habitat requirements, preferring shallow areas close to shore near shoals and tide rips.

Biology

The majority of Roseate Terns breed first at three years, and the average age of breeding adults in the northeastern population is estimated at 7.8 years. Roseate Terns usually lay 1-2 eggs and in the absence of predation they fledge at least one chick per pair. About 32% of fledglings are estimated to survive to breeding age, and about 83.5% of adults survive annually. Site fidelity is high, with 88-98% of surviving adults returning to the same site to breed each year. Movement of birds between major breeding colonies in the U.S. and Canada has been recorded, but it is not extensive. After the breeding season, Roseate Terns stage at a number of specific sites in the Gulf of Maine and around Cape Cod. They then migrate south in late August and early September, arriving at wintering sites ranging from western Colombia to eastern Brazil in October. Roseate Terns forage on small fish such as Sand Lance, herring and hake.

Population sizes and trends

The number of Roseate Terns breeding in Canada has remained relatively stable at around 100 pairs since the 1980s when detailed data collection began. The number of colonies used by Roseate Terns has fluctuated annually with a high of 14 colonies in 1999 and a low of four in 2003. Numbers at the two major Nova Scotia colony sites (The Brothers and Country Island) continue to be relatively high, although recent declines have been noted at Country Island (from 53 pairs in 2000 to 25 pairs in 2007). The small colony on Machias Seal Island, New Brunswick, which has been occupied since 1979, was abandoned by terns in 2006, 2007 and 2008. As of 2007, the Canadian population consisted of an estimated 200 mature individuals nesting at 7 locations.

Limiting factors and threats

Roseate Terns in Canada are limited by the number of predator-free breeding sites in close proximity to suitable foraging areas. The following threats have been identified: 1) high levels of predation and displacement by large gulls; 2) increased predation by other species, especially American Mink; 3) erosion of North Brother Island leading to loss of breeding habitat; 4) human disturbance, especially in Mahone Bay, Nova Scotia; 5) industrial development and associated increases in large ship traffic, especially in Country Harbour, where undersea natural gas pipelines and a liquefied natural gas receiving plant are in development; 6) severe weather events such as hurricanes; 7) natural biological factors including low adult survival rates, a short overall breeding lifetime, and specialized foraging habitat requirements; 8) a skewed sex ratio (127 females:100 males) that lowers estimates of the effective size of the adult breeding population; and 9) unidentified sources of wintering mortality.

Special significance of the species

The Roseate Tern has become a symbol of coastal conservation in North America, as evidenced by its inclusion in the logo of at least four conservation organizations ranging from international to local.

Existing protection or other status designations

The Roseate Tern is currently designated as *Endangered* in Canada and is protected under Schedule 1 of the *Species At Risk Act* and the *Migratory Birds Convention Act.* In the United States, the northeastern population of Roseate Tern is listed as *Endangered*, and the Caribbean population is listed as *Threatened*. It is also *Endangered* as of 2000 in Nova Scotia and protected under the Nova Scotia *Endangered Species Act*. It is designated globally by the IUCN (World Conservation Monitoring Centre) as Least Concern.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS (2009)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.

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Canada

The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

Update
COSEWIC Status Report

on the

Roseate Tern
Sterna dougallii

in Canada

2009

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SPECIES INFORMATION

Name and classification

Scientific name: *Sterna dougallii*
English name: Roseate Tern
French name: Sterne de Dougall

Two genetically valid subspecies are recognized, *S. d. dougallii* (Europe, North America and Caribbean) and *S. d. gracilis* in western Australia (Indo-Pacific Basins; Lashko 2004; Szczys *et al.* 2005a; Figure 1). This report deals with *S. d. dougallii*.

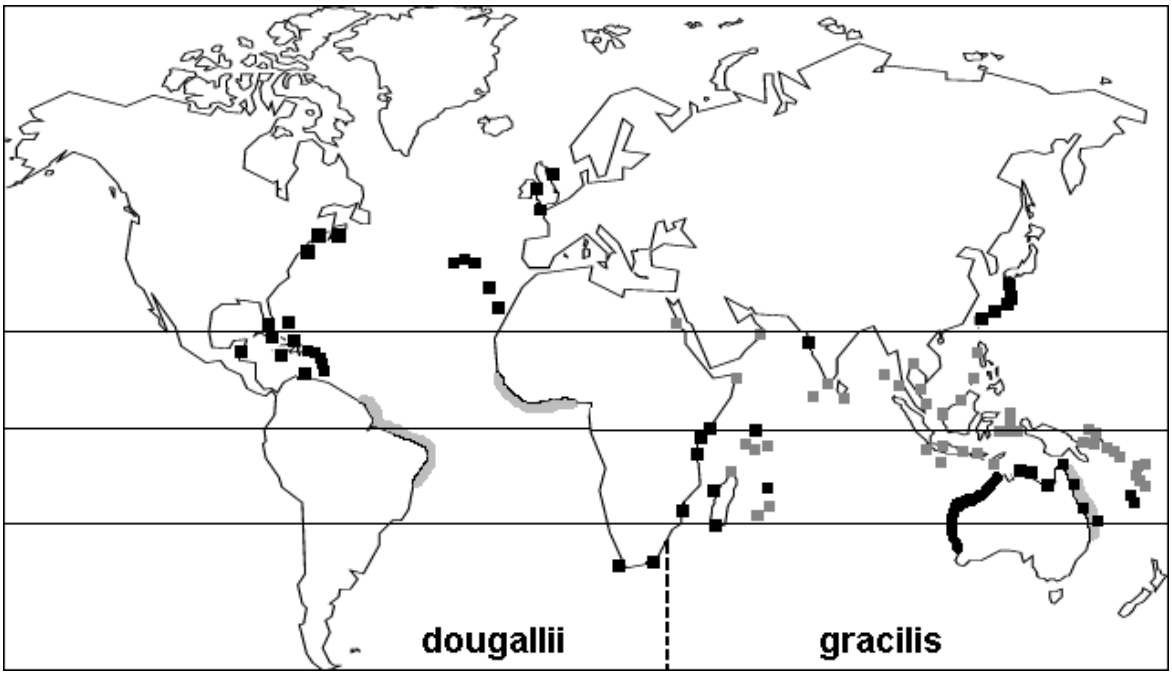

Figure 1. Global range of Roseate Tern. Black squares are known breeding sites, grey squares are putative range or historic records and pale grey shading indicates the temperate breeding populations' wintering areas. The dotted line indicates the line of separation between *dougallii* and *gracilis* (Source: N. Ratcliffe and I. Nisbet unpublished data).

Morphological description

The Roseate Tern is a medium-sized, pale tern with a long and deeply forked tail (Gochfeld *et al.* 1998). Males and females are outwardly identical in appearance. During breeding, adults are mostly white with a black cap. They have long white tail streamers and a white breast suffused with pale pink. The wings and mantle are pale grey, and the outer 2-4 primaries appear blackish on the upper wing. Roseate Terns are very similar to Common and Arctic terns and are best distinguished from them by their shorter wings, longer tail and paler plumage with no grey or black on tail streamers, less black on the outer primary feathers and complete lack of black on the underwings. An adult

Roseate Tern in non-breeding plumage has a black mask, a white forehead and a shorter tail than during breeding, but it can still be distinguished from other terns by its all-white underwing, compared with the black trailing primary edge on the underwing of Common and Arctic terns (Gochfeld *et al*. 1998). The bill of the Roseate Tern is all black with progressively more red appearing at the base as the breeding season advances (Gochfeld *et al.* 1998). The bill of the Arctic Tern is all red, and the Common Tern's bill is red with a black tip, similar to the bill of the Roseate Tern late in the season. Roseate Tern is also distinguished from Common and Arctic tern by its "chi-vik" call given in flight or raspy "craaak" call when mobbing predators (Gochfeld *et al.* 1998). To a trained ear, these calls allow a single Roseate Tern to be picked out of a mixed species colony.

Genetic description

No genetic research has been done on the Canadian population alone, but two recent genetic studies (Lashko 2004; Szczys *et al.* 2005a) have included data from northeastern U.S. colonies which are considered the same population as Canadian colonies (Gochfeld *et al.* 1998). There is no reason to suspect barriers to gene flow in the Canadian population, because band resighting data have indicated movement of individuals between Canadian and U.S. colonies (see **Dispersal/migration**).

Lashko (2004) used mitochondrial DNA to examine historical relationships among global Roseate Tern colonies, including one colony in the U.S. (Bird Island, MA), Ireland, the Azores, South Africa, the Seychelles, Japan, and Australia. Mitochondrial DNA revealed two strongly supported clades, one comprised of the Atlantic Ocean breeding colonies, and a second including the Indian and Pacific Ocean breeding colonies, with a high inter-oceanic corrected sequence divergence of 4% corresponding to a genetic separation of up to one million years. None of the six haplotypes present within the Atlantic lineage were present in Roseate Terns from the Indo-Pacific, with analyses showing strong evidence for isolation by distance (using the correlation coefficient for genetic versus geographic distance: $r = 0.96$, $P = 0.001$). Based on sequences of the two mitochondrial DNA genes, ND6 and ND2, Lashko (2004) found minimal phylogenetic structure within the Atlantic lineage. There was a single fixed nucleotide difference (G → A) between the east and west Atlantic lineages, with the Azores and Ireland (east Atlantic) sharing the fixed difference that differentiates them from the U.S. colony (west Atlantic; but see contrasting microsatellite results below).

Szczys *et al.* (2005a) identified four novel microsatellite markers and one other marker using blood samples from two U.S. colonies (Bird Island, MA and Falkner Island, CT) and two colonies in Western Australia. These markers were used to determine population genetic structure within and between the two populations. Four of the five markers showed greater Allelic Richness (R_S) in Western Australia than in the North Atlantic, ranging from 1.5 to 4 times higher. Szczys *et al.* (2005a) found significant population differentiation at the global scale ($F_{ST} = 0.48$, $P < 0.05$), and Lashko (2004), using the same four microsatellites, also found strong differentiation between the Atlantic and the Indo-Pacific populations: 38.7% of the observed genetic variation was distributed between the two ocean basins ($F_{ST} = 0.43$, $R_{ST} = 0.52$ $P< 0.001$). Szczys *et*

al. (2005a) found no evidence for differentiation between the two northern U.S. colonies (F_{ST} = 0.03). However, Lashko (2004) found that breeding colonies in Ireland and the U.S. have diverged from the Azores (R_{ST} = 0.28-0.36, $P < 0.05$). Colonies in Ireland and the U.S. were not significantly divergent from one another, which may be due to true genetic homogeneity, or could be a result of low sample sizes or recent population declines in the U.S. (40-50% in the 1970s) and Ireland (40% in the 1960s) leading to reduced genetic diversity in these colonies relative to the Azores, making them appear more genetically homogeneous (Lashko 2004).

The relative reduction in genetic diversity in the North Atlantic population relative to western Australia is likely a result of smaller population size, but inbreeding was not apparent at the two colonies studied by Szczys *et al.* (2005a; F_{IS} = 0.05). The lower F_{ST} values in pairwise comparisons of the North Atlantic populations indicated higher gene flow between North Atlantic colonies compared with those in the Azores or Western Australia; this result was validated by band resighting data indicating movement of individuals between U.S. colonies (Spendelow *et al.* 1995; Lebreton *et al.* 2003). In addition, limited band recovery data supports the possibility of greater gene flow between the U.S. and Ireland, than between the U.S. and the Azores or Ireland and the Azores (Lashko 2004). Roseate Terns banded on Rockabill Island in Ireland have been found at breeding colonies in the U.S. (Nisbet and Cabot 1995; Hays *et al.* 2002) and two individuals banded as chicks at colonies in the U.S. have been reported from Rockabill Island (Newton and Crowe 2000).

Lashko (2004) identified two evolutionarily significant units (ESU) of Roseate Tern: the Indo-Pacific ESU and the Atlantic ESU. Africa has served as a barrier to gene flow between these two ESUs and is considered a zone of secondary contact between them (Lashko 2004). Within the Atlantic ESU, there was insufficient data to identify separate management units, but the two proposed (potential) management units are the Azores and the North Atlantic (Canada, U.S. and Ireland; Lashko 2004).

Designatable units

There is only one designatable unit in Canada, because all birds belong to one population of one subspecies, and are found in one ecozone. There is no reason to believe that Canadian birds are genetically distinct from the adjacent U.S. population.

DISTRIBUTION

Global range

The Roseate Tern occurs on six continents in the Atlantic, Indian, and Pacific Oceans (Figure 1). In North America, two populations of Roseate Tern breed on the Atlantic coast in distinct locations. The northeastern population breeds from the Magdalen Islands in the Gulf of St. Lawrence south to Long Island, New York. The second population breeds from Florida and the Bahamas to the Lesser Antilles (Cramp 1985). Both populations winter in South America, from Colombia to eastern Brazil (Nisbet 1984; Hays *et al.* 1997).

Canadian range

The Canadian population of Roseate Tern constitutes approximately 2.6% of the northeastern population and breeds almost exclusively (98%) in Nova Scotia, with small numbers of birds (1-2 pairs) known to breed in the Magdalen Islands, QC and until recently on Machias Seal Island, NB (Figure 2).

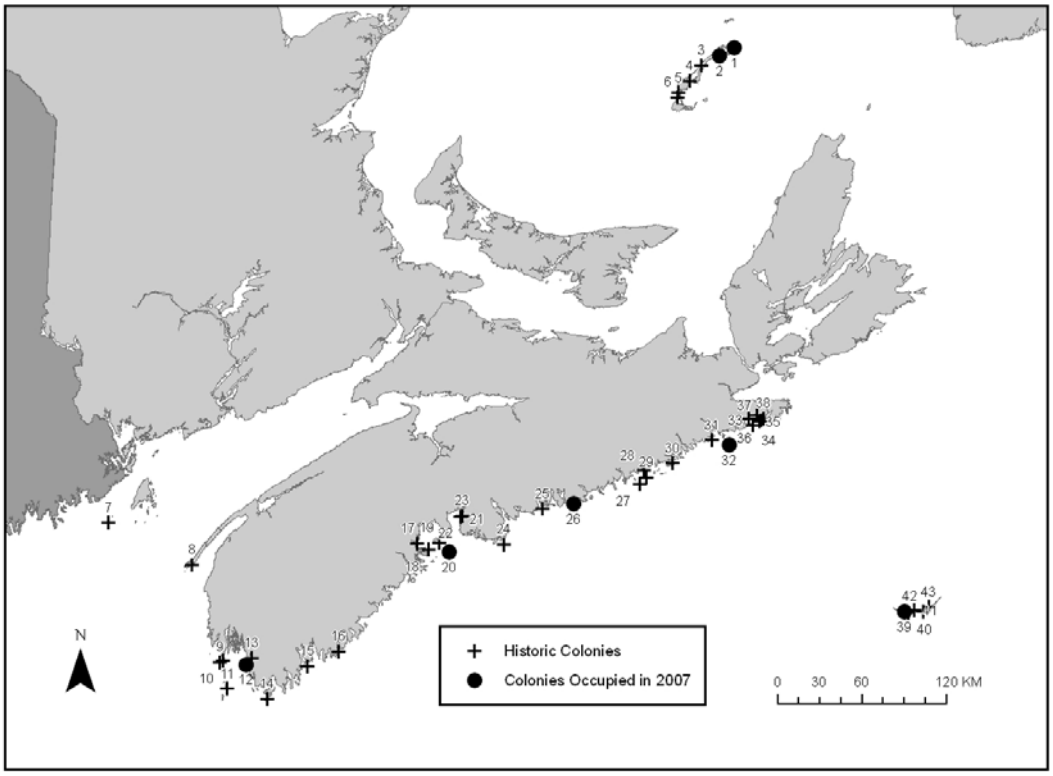

Figure 2. Canadian Roseate Tern breeding locations. Historic colonies had at least one pair of Roseate Terns at least once since 1982 but not in 2007. For colony names and details see Appendix 1.

Since 1982, Roseate Terns have occupied 43 distinct sites, 26 of which are coastal islands, and five of which are coastal headlands, in Nova Scotia. The remainder include five separate colony sites on Sable Island, NS, six small islands in Quebec's Magdalen Islands, and a single island in New Brunswick (Figure 2). The location of small colonies changes unpredictably between years (Appendix 1). Over the last three generations (~23-24 years for Roseate Tern), the number of occupied colonies has fluctuated from four to 14 annually (Table 3, p. 17), with only two colonies maintaining relatively large numbers of Roseate Terns since the 1980s (Appendix 1).

In the Magdalen Islands, QC, at least six sites have been known to support small numbers of Roseate Terns since the 1980s (Figure 2) although only three of these sites have had Roseate Terns in more than two years (Appendix 1). Similarly, on Sable Island, NS at least five sites have been known to support Roseate Terns since the 1980s (Figure 2, Appendix 1).

In New Brunswick, Roseate Terns have nested in small numbers (1-2 pairs) on Machias Seal Island since 1979. The entire tern colony (Common, Arctic and Roseate terns) abandoned this site in July 2006 and again in June 2007 (Appendix 1) and June 2008 (A. Diamond pers. comm. 2008). Roseate Terns have not bred at this site since at least 2004 (Appendix 1).

The Extent of Occurrence (EO) of Roseate Terns in Canada is estimated at 98,707 km^2, based on the area of a polygon joining four colonies (The Brothers, Sable Island and two colonies on the Magdalen Islands) and including within them the additional three colonies (Country, Duck and Pearl islands) occupied in 2007. The EO has decreased from a historic maximum of 145,035 km^2 in 1982-85, a difference of 46,328 km^2 or 32%. However, abandonment of the small colony on Machias Seal Island (colony #7 in Figure 2) is the primary driver of this change.

The current Area of Occupancy of Roseate Terns in Canada is estimated at less than 25 km^2, using the area of the breeding colony for biological AO. Using the 2 x 2 km grid system, the figure would be between about 20 and 100 km^2. Both these figures fluctuate based on the number of colonies occupied in any given year (maximum of 14 in 1999, 12 three generations ago, 7 in 2007).

HABITAT

Habitat requirements

Foraging habitat of breeding Roseate Terns

Roseate Terns generally forage in shallow areas close to shore, near shoals and tide rips (Safina 1990; Rock *et al.* 2007). At some colonies, Roseate Terns travel up to 30 km round trip to find food (Heinemann 1992). The only study of Roseate Tern foraging habitat in Canada found that Roseate Terns foraged up to 23.9 km from the colony on Country Island, with an average distance of 6.9 ± 1.5 km from the colony, with

90% of observations made over water < 5 m deep (Rock *et al.* 2007). Common Terns forage under a wider range of habitat conditions, and are less restricted by physical oceanography (Safina 1990). Arctic Terns forage farther from land in deeper water (Rock 2005). As a result, Roseate Terns prey on a limited number of fish species, whereas Common and Arctic terns have a more diverse diet (Richards and Schew 1989; Safina *et al.* 1990; Rock 2005).

Staging and wintering habitat

Roseate Tern staging habitat has been identified in Saco Bay, ME (Stratton Island; Shealer and Kress 1994) and on Cape Cod (Trull *et al.* 1999). At Stratton Island, terns stage on the southern end of the island as well as on a sandy beach at nearby Proutt's Neck. During the day they feed in shallow water areas (<10 m depth) and over sandy substrates on abundant Sand Lance (*Ammodytes* spp.; Shealer and Kress 1994). In Cape Cod, at least 20 discrete sites consisting of beaches or sand flats at or near the end of barrier islands or barrier beaches, or near tidal inlets or tide rips, were reported to have staging Roseate Terns (Trull *et al.* 1999).

Little is known about wintering habitat. The largest concentration of wintering Roseate Terns was located at Mangue Seco, Bahia, Brazil (11°27'S 37°21'W) between December 1996 and February 1997. The area is a sandy point on the south side of the mouth of the Rio Real. At low tide, extensive sandbars and mudflats lie west of the point; Cayenne (*S.* [*sandvicensis*] *eurygnatha*),Yellow-billed (*S. superciliaris*) and Least (*S. antillarum*) terns gather during the day. Roseate and Common terns were found roosting only at night (Hays *et al.* 1999).

Breeding habitat

Roseate Terns nest in colonies almost exclusively on small islands, frequently vegetated with beach grass and other herbaceous plants (Nisbet 1981). They will occasionally (though not consistently) nest on mainland spits (Whittam 1999, Appendix 1: site numbers 23, 25, 31, 34, 35).

In northeastern North America, Roseate Terns always nest in association with Common or Arctic terns, presumably because the presence of large numbers of congenerics elevates communal colony defence. In fact, the presence of Common Terns is the most important habitat feature (summarized in Gochfeld *et al.* 1998). Terns require colony sites that are relatively free from predators, and will abandon a colony after a season of heavy predation (Nisbet 1981; Whittam and Leonard 1999). Roseate Terns breeding in North America are limited by the number of available predator-free (or predator-controlled) colony sites that are also in close proximity to good foraging sites (Whittam 1999). Within a colony, Roseate Terns nest at sites that provide more cover than nest sites of Arctic or Common terns (Burger and Gochfeld 1988; Ramos and del Nevo 1995; Whittam 1997). This cover is usually in the form of dense vegetation or strewn rocks, boards, or driftwood (Nisbet 1981; Spendelow 1982; Environment Canada 2006). Roseate Terns will also nest in boxes, half-buried tires, or other artificial shelters

provided by humans (Spendelow 1982, 1991b). Reproductive success is greater under artificial shelters than in natural sites (Spendelow 1996). Table 4 in Whittam (1999) provides specific information on the type of nesting habitat used by Roseate Terns at major Canadian breeding colonies. Similar descriptions of nest sites at U.S. colonies can be found in Nisbet (1981, 1989).

Habitat trends

In Canada, Roseate Terns nest only in association with large breeding colonies of Arctic and Common terns. The number of tern colonies in the region is therefore an important factor in an assessment of Roseate Tern habitat trends. While overall tern numbers have increased in Nova Scotia and stayed about the same in New Brunswick between the 1980s and present (Figures 3, 4), the number of tern colonies in the Maritimes has fluctuated since the early 1980s. In Nova Scotia, the number of mixed-species tern colonies has varied from a low of 15 in 1987 to a high of 104 in 1995 and appears relatively stable in 2007 at 78 colonies (Figure 3). In New Brunswick, the number of colonies has undergone a steep decline, from 26 in 1983 to only 14 in 2001 and 10 in 2005 (Figure 4). In the Magdalen Islands, the number of tern nests has remained relatively stable, but the number of colonies has fluctuated from a low of four in 1999 to a high of 11 in 1993 (Figure 5).

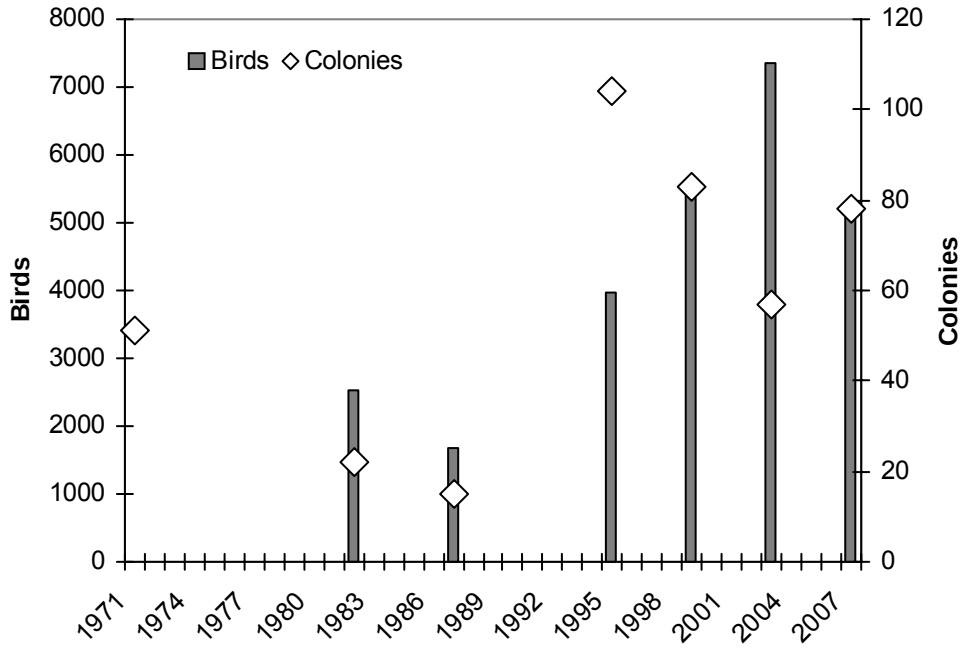

Figure 3. Numbers of terns and tern colonies (all species combined) counted in Nova Scotia between 1971 and 2007 (Source: Lock 1971, 1983; Boyne unpublished data).

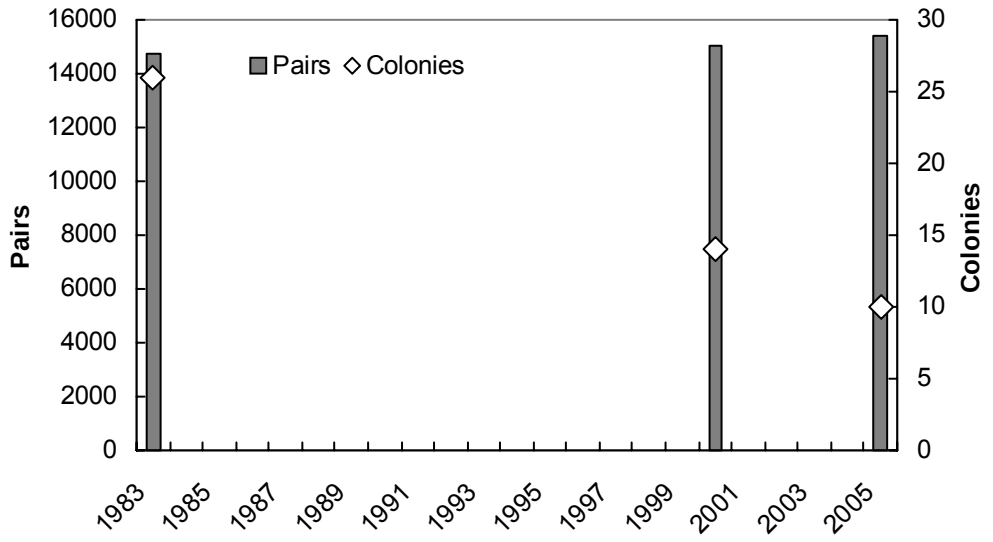

Figure 4. Numbers of tern pairs and tern colonies (all species combined) counted in New Brunswick between 1983 and 2006 (Source: Lock 1984; Boyne *et al.* 2006).

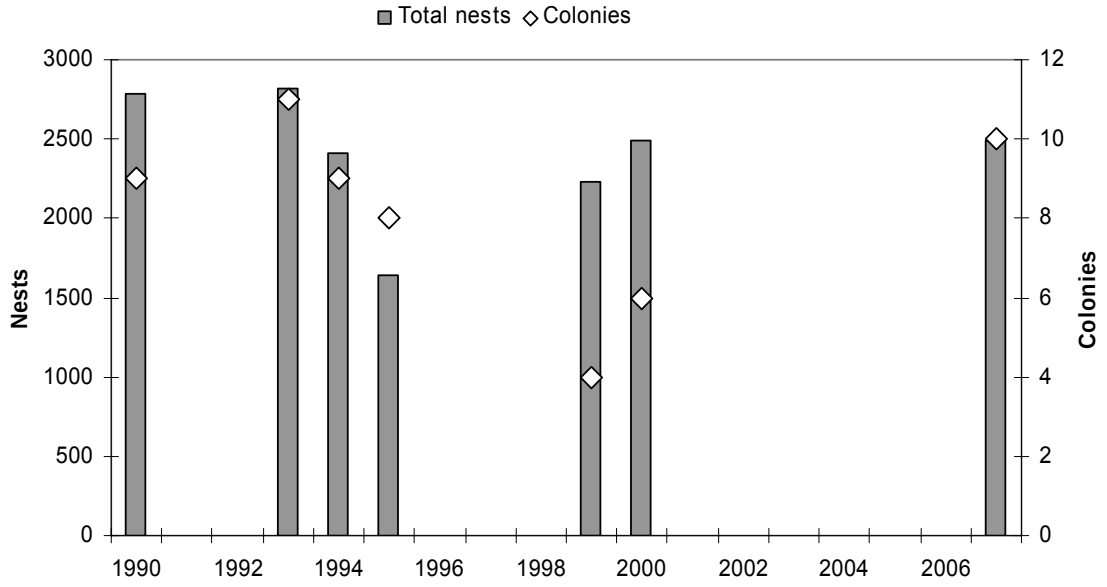

Figure 5. Numbers of tern nests and tern colonies (all species combined) counted in the Magdalen Islands between 1990 and 2007 (Source: Shaffer unpublished data).

Many tern colonies have been abandoned this century due to the presence of gulls (Crowell and Crowell 1946; Kress 1983; Howes and Montevecchi 1993). In 1997 Roseate Terns abandoned Country Island, almost certainly due to gull predation (Whittam and Leonard 1999). The number of gulls in the region, and the availability of gull-free breeding habitat are, therefore, important factors in an assessment of Roseate

Tern habitat trends. In general, the number of large *Larus* gulls in the Maritimes, especially Herring Gulls (*L. argentatus*), appears to be lower than estimates from the 1970s, but populations of all species do not appear to be undergoing continued declines (Table 1). In the Magdalen Islands, surveys between 1990 and 2007 indicate steady declines in Herring Gulls but recent stabilization of Great Black-backed Gulls (*L. marinus*; Table 1).

Table 1. Historic and current estimates of the number of pairs of Great Black-backed Gulls, Herring Gulls, and Ring-billed Gulls breeding in the Bay of Fundy, mainland Nova Scotia, the Gulf of St. Lawrence coast of New Brunswick, and the Magdalen Islands.

	1971	1979	1986	1987	1990	1998	2000	2001	2002	2005	2007
Bay of Fundy[1]											
Great Black-backed Gull		600				1771		602			
Herring Gull		13800				5367		11809			
Mainland Nova Scotia[2]											
Great Black-backed Gull	9547			16608					11393		
Herring Gull	8720			11569					6434		
New Brunswick[3]											
Great Black-backed Gull			1134				910			1025	
Herring Gull			5950				2330			2406	
Ring-billed Gull			1534				3544			3947	
Magdalen Islands[4]											
Great Black-backed Gull					1169				753		779
Herring Gull					1664				1152		545

1. Lock unpublished data; Mawhinney *et al.* 1999; Ronconi and Wong 2003
2. Not including Cape Breton Island; Lock 1971; Boyne and Beukens 2004
3. Lock unpublished data; Boyne *et al.* 2006; Bond *et al.* 2006
4. Shaffer unpublished data

Non-lethal predator control (destruction of gull and corvid nests, scaring of gulls using noise makers) is carried out at the two major Canadian Roseate Tern colonies (The Brothers and Country Island). At Country Island, the number of successful predator intrusions (where an egg or chick was taken) has declined from 0.84/hour to 0.09/hour between 1996 and 2007 (Toms *et al.* 2008). The number of gull nests initiated on both The Brothers and Country Island has also declined over the last decade (D'Eon 2007; Toms *et al.* 2008). These results suggest that the quality of habitat in terms of predation risk has been enhanced at these sites over the last decade.

At The Brothers, the amount of physical habitat available to terns is declining due to erosion. Between 2007 and 2008, North Brother Island lost about 0.7 m of land mass at its southern tip and about 0.3 m along the south-west edge (D'Eon 2008), which is a significant one-year loss considering that the island is only about 100 m x 200 m in size.

Recent efforts by the Bluenose Coastal Action Foundation (BCAF) to restore a colony of Roseate, Arctic and Common terns in Mahone Bay (Quaker Island) have been unsuccessful, most likely due to human disturbance (BCAF 2006, and see below under Threats).

Habitat protection/ownership

Critical habitat for Roseate Tern has been identified at Sable Island, The Brothers, Country Island and the Magdalen Islands (Paquet Island, Deuxième Îlet and Chenal Island; Environment Canada 2006). New critical habitat may be identified if it is occupied by Roseate Terns for three consecutive years (Environment Canada 2006). Protection and ownership of sites occupied in 2007 are described below.

Sable Island is protected as a Migratory Bird Sanctuary under the *Migratory Birds Convention Act*.

The Brothers Islands are owned by the province of Nova Scotia and this site has been designated a Wildlife Management Area under the provincial *Wildlife Act* (s. 113).

Country Island is federal crown land administered by the Department of Fisheries and Oceans. The Department of Fisheries and Oceans and Environment Canada are currently engaging in discussions on how best to protect the critical habitat at this site.

A single pair of Roseate Terns was located on Duck Island in a colony of about 270 other terns for the first time in 2007. This island is owned by the province of Nova Scotia and is currently zoned "Category 2" for wildlife under the Department of Natural Resource's Integrated Resource Management Crown Land classification system because Common Eiders (*Somateria mollissima*) are also known to nest there. This means that the island must be managed with the natural resource (in this case, nesting Common Eiders) in mind (see http://www.gov.ns.ca/natr/irm/introduction.html for details). An extension of the Eastern Shore Islands Wildlife Management Area is being considered, and if such an extension occurs Duck Island would become part of this management area (Archibald pers. comm. 2008).

Pearl Island has had Roseate Terns present (breeding unconfirmed) in 1992 (Kress and Duley 1992), 1999-2001 (Stevens pers. comm. 2008) and in 2007 (Rodenhizer pers. comm. 2008). Pearl Island is owned by the province of Nova Scotia and is designated as a Wildlife Management Area under their *Wildlife Act* (s. 113).

Environment Canada is working in collaboration with the province of Quebec to ensure the effective protection of Roseate Tern critical habitat located in Quebec's Magdalen Islands archipelago. In Quebec, islands or peninsulas inhabited by colonial birds are protected as "wildlife habitat" under Quebec's *Loi sur la conservation et la mise en valeur de la faune* (s. 128.6). Individual sites in Quebec are discussed below.

Deuxième Îlet and Chenal Island

These islands are owned by the government of Quebec and protected as wildlife habitat under section 128.6 of *Loi sur la conservation et la mise en valeur de la faune* (Shaffer pers. comm. 2008).

Paquet Island

This island is partially private and partially the property of the government of Quebec. The Government of Quebec's parcel of land is protected as wildlife habitat under section 128.6 of *Loi sur la conservation et la mise en valeur de la faune*. In an effort to protect the private part of the island, stewardship activities will be pursued (Shaffer pers. comm. 2008).

Pointe de l'Est

Roseate Terns were observed here for the first time in 2006 and again in 2007 (1 individual). The site is owned by the Government of Quebec and is designated as a provincial wildlife refuge (Refuge faunique de la Pointe-de-l'Est; Shaffer pers. comm. 2008). In addition, the provincial refuge is surrounded by the Pointe-de-l'Est National Wildlife Area.

BIOLOGY

The most comprehensive sources of information on Roseate Tern biology include Gochfeld *et al.* (1998) and several recent northeastern U.S. metapopulation studies (Spendelow *et al.* 2002; Lebreton *et al.* 2003).

Life cycle and reproduction

Several cases of Roseate Terns breeding at age two have been recorded (Donaldson 1971; Spendelow 1991a), although the majority of birds breed first at age three (Lebreton *et al.* 2003). For example, 77% of birds surviving to breeding age at Falkner Island, CT bred first at age three (Spendelow *et al.* 2002). Age-specific breeding probabilities of Roseate Tern estimated from capture-recapture modeling using data from three U.S. colonies indicate that 1.0-4.5% of birds breed by age two, 45%-67% by age three, 62%-100% by age four, and 100% by age five or six (Lebreton *et al.* 2003). Some pairs may forego breeding in poor food years but the proportion of non-breeders is not known (Gochfeld *et al.* 1998). Generation time (average age of breeding adults in the population) is estimated at 7.8 years (median = 7 years; Spendelow unpublished data). This is two to three years less than the known generation time for Common Tern (median = 9-10 years; Nisbet 2002) and four to five years shorter than for Least Tern (*Sterna antillarum*, breeding lifetime estimated at 9.63 years after reaching maturity; Massey *et al.* 1992). Longevity estimates for Roseate Tern are hindered by band loss, but the oldest known bird (banded as a chick in Massachusetts) was 25.6 years (Gochfeld *et al.* 1998).

Clutch size ranges from one to four eggs with a mode of two, which is somewhat smaller than the typical clutch size for Common Tern (2-3 eggs; Nisbet 2002). The proportion of one versus two egg clutches varies depending on phenology, parental quality, food supply and other environmental factors (summarized in Gochfeld *et al.*

1998). In Canada on Country Island, mean annual clutch size ranged from 1.0 to 1.66 between 1997 and 2007 (Toms *et al.* 2008). Supernormal clutches (i.e., ≥3 eggs) are primarily associated with multi-female associations (mostly pairs) that appear to be the result of a skewed sex ratio (1.27 females per 1 male at Bird Island, MA; Nisbet and Hatch 1999). Eggs are laid two to four days apart (Nisbet 1981). Both weather and food constrain the first and peak dates of egg-laying (Gochfeld *et al.* 1998). Eggs hatch after about 23 days but this incubation period can be prolonged by up to 13 days at colonies where adults desert at night to avoid nocturnal predation (owls, night-herons; Nisbet 1981). There is no evidence that adults attempt to produce second broods (Gochfeld *et al.* 1998). Hatching success is generally high in the absence of predation (i.e., greater than 80% at Bird Island, MA) but is lower in nests without males that are attended by female pairs or trios (Nisbet and Hatch 1999). There may be a slight female-biased sex ratio at hatching (Szczys *et al.* 2001; Szczys *et al.* 2005b). On Country Island, mean annual hatching success has varied from 0.0 to 1.0 between 1997 and 2006 (Toms *et al.* 2007). It is noteworthy that predator control began in 1998 at Country Island, and hatching success has been greater than 0.57 eggs hatched/eggs laid in all years since then, except in 2001 when only one Roseate Tern nest was found and the eggs did not hatch (Toms *et al.* 2007).

Annual reproductive success for the U.S., Culebra and Puerto Rico is summarized in Appendix 2 of Gochfeld *et al.* (1998). Reproductive success can vary from 0.0 to 1.6 fledglings/nest, depending on food supply, egg size, parental performance, year, colony, and predation rates (reviewed in Gochfeld *et al.* 1998). In the northeast, reproductive success is generally more than 1.1 fledglings/pair, with productivity lower than 1.0 fledgling/pair seen only at small colonies or colonies experiencing predation (Gochfeld *et al.* 1998). Information on reproductive success at Canadian colonies is limited to rough estimates from Country Island. Reproductive success is generally low at this site, ranging from 0.0 to 0.3 fledglings/nest between 1999 and 2007 when estimated at chick age 20 days, and ranging from 0.0 to 0.72 fledglings/nest when estimated at chick age 15 days (Toms *et al.* 2008). Challenges associated with estimating reproductive success of Roseate Terns (nests inaccessible, chicks hide in dense vegetation or under rocks often far from the nests; Gochfeld *et al.* 1998) suggest Canadian estimates should be considered minimums, yet they are clearly well below the 1.1 fledglings/nest seen on average at relatively large U.S. colonies.

Research in the U.S. has shown that, in the absence of predation, 97% of first-hatched (A) chicks survive to fledging, and survival of second-hatched (B) chicks is lower, more variable between years, and strongly dependent on hatching date, with earlier-hatched B chicks more likely to survive (Nisbet *et al.* 1995, 1998; Burger *et al.* 1996). Survival of B chicks can be predicted based on growth during the first four days of life (Nisbet *et al.* 1998), which in itself is predicted by egg size and hatching date, both factors attributable to parental quality (Nisbet *et al.* 1998).

In most years, about 32% of fledglings from the northeastern population are estimated to survive to breed at age three (Lebreton *et al.* 2003, with estimate obtained by multiplying average 2-year survival of fledgings, 0.3762, with average adult survival,

0.8501, Spendelow pers. comm. 2008). Survival to first breeding varies with the year of fledging and can be impacted by single large events such as Hurricane Bob, which hit the coast of Cape Cod in August 1991 and led to reduced survival to breeding age of birds fledged in 1991 (only 6% survival; Lebreton *et al.* 2003; Spendelow pers. comm. 2008). Annual adult survival probability is estimated at 0.84 (range 0.81-0.85; Spendelow *et al.* 2008), which reflects a higher annual mortality than other marine birds (i.e., Common Tern annual adult survival estimated at 0.88-0.91; Nisbet and Cam 2002; California Least Tern annual adult survival estimated at 0.78-0.93 with an average of 0.89; Akçakaya *et al.* 2003).

Predation

See below, under **Limiting Factors and Threats**.

Physiology

The only relevant information available on Roseate Tern physiology relates to temperature regulation of adults and chicks. By age three days, chicks are able to maintain a nearly stable body temperature independent of ambient temperature but still slightly lower than the 40.9–43.6°C temperature of adults (LeCroy and Collins 1972). Both chicks and adults rest in the shade during hot periods. Adults and chicks (1–2 d old) gular-flutter when air temperatures are high (Gochfeld *et al.* 1998). Newly hatched second chicks may succumb to chilling when adults are away catching food for the larger first-hatched chick (LeCroy and Collins 1972).

Food

Sand Lance are commonly taken on Sable Island (Whittam 1999). On The Brothers, Roseate Terns have been observed feeding on Atlantic Silversides (*Menidia menidia*), Butterfish (*Peprilus triacanthus*) and Atlantic Herring (*Clupea harengus;* D'Eon 1994, 1996, 2007). Roseate Terns on Country Island were found to prey primarily on Sand Lance (82% of deliveries in 2003) and hake (*Urophycis* spp.; 72% of deliveries in 2004) along with smaller numbers of herring and Atlantic Cod (*Gadus morhua;* Rock *et al.* 2007). The strong reliance on Sand Lance is consistent with other studies of foraging in the United States (Richards and Schew 1989; Safina *et al.* 1990; Heinemann 1992; Nisbet and Spendelow 1999).

Dispersal/migration

Results of capture-recapture modelling from three major U.S. colony sites indicate that 88-98% of surviving adults return to the same site to breed each year (Lebreton *et al.* 2003). In addition, 58-91% of birds hatched at one of these three sites are likely to return to that site to breed in future (Lebreton *et al.* 2003). The rate of dispersal away from a colony that was suffering from high predation was greater than the rate of dispersal away from sites where predation was not an issue (Lebreton *et al.* 2003).

In Canada, birds are known to disperse between major breeding colonies (Country Island to The Brothers; Table 2) from one breeding season to the next. In addition, movement has been noted between U.S. colonies and The Brothers (Table 2). However, the amount of movement noted between birds nesting in the warmwater areas south and west of southern Cape Cod (i.e., the bulk of the northeastern Roseate Tern population), and those nesting in the coldwater-influenced areas north and east of Cape Cod in the Gulf of Maine and Canada, is low compared with movement within the warm and cold water groups (Spendelow *et al.* in review). Relatively little standardized effort has been made to resight banded birds at either The Brothers or Country Island, and it is likely that more movement than that depicted in Table 2 occurs.

Table 2. Roseate Terns of foreign origin resighted at North Brother Island, 2002-2007[1].

Date of resighting	Band number	Origin of banded bird	Date banded
7-7-07	34C1 [1182-65634 L-U]	Eastern Egg Rock, ME	7-13-02
7-18-07	5V77 [9822-80577 L-U]	Stratton Island ME	6-17-99
7-24-07	1V51 [0802-69901 L-U]	South Brother	7-03-02
7-4-02	IL44 [0802-98688]	Petit Manan ME as a chick	6-30-99
7-16-06			
7-24-07			
7-24-07	070E [1172-77674]	Country Island as a chick	7-03-05
7-4-02	2K70 [892-94270]	Bird Island, MA as a chick	6-24-96
7-4-02	V507	Petit Manan, ME as a chick	6-23-95

1. D'Eon 2002, 2007

Table 3. Estimated number of Roseate Tern pairs and colony sites recorded between 1982 and 2007 in Nova Scotia, New Brunswick and Quebec. Because the majority of Roseate Terns are found in Nova Scotia, this table reports only numbers for years in which full surveys of the Nova Scotia coastline were done. Colony details are found in Appendix 1.

	1982-85	1995	1999	2003	2007
Nova Scotia[1]					
Pairs	91-106	96	119-143	130	98
Colonies	10	5	12	3	5
New Brunswick[2]					
Pairs	1	2	Present, non-breeding	Present, non-breeding	0
Colonies	1	1	0	0	0
Quebec[3]					
Pairs	2	2	2	1	2
Colonies	1	2	2	1	2
TOTAL					
Pairs	94-109	100	121-145	131	100
Colonies	12	8	14	4	7

1. Kirkham and Nettleship 1985; Leonard *et al.* 2004; Boyne unpublished data
2. Kirkham and Nettleship 1985; Whittam 1999; Bernard *et al.* 1999; Charette *et al.* 2004; Kennedy pers. comm. 2008
3. Shaffer unpublished data

After fledging in early August, juvenile Roseate Terns from the northeastern population disperse with their parents to staging areas located from Long Island to Nantucket and Cape Cod (Trull *et al.* 1999), and in the Gulf of Maine (e.g., Stratton Island; Shealer and Kress 1994). Little is known about staging areas used by Canadian birds, but in 2002 two Roseate Terns banded as chicks on The Brothers were sighted at Great Gull Island, New York within a month of fledging (Environment Canada 2006). At Stratton Island from 1989-1992, banded Roseate Terns were identified from at least eight breeding colonies in Maine, Massachusetts and Connecticut (Shealer and Kress 1994). It was estimated that at least 4.9% of all adult Roseate Terns in the U.S. visited Stratton Island in 1991 and at least 10.4% visited the island in 1992 (Shealer and Kress 1994). At nine of 20 known staging sites in Cape Cod, numbers of Roseate Terns ranged from 100-1500 (Trull *et al.* 1999). Only two of the Cape Cod sites hosted night-roosting Roseate Terns, one with between 3000 and 4000 individuals (half of the northeast population at a single site; Trull *et al.* 1999). The largest numbers of Roseate Terns were reported at Cape Cod sites between 26 August-19 September (Trull *et al.* 1999). At least one of these Cape Cod staging areas includes birds marked from all major breeding sites in the northeast and with the proportion of juveniles equal to the numbers of chicks banded at these breeding sites (Trull *et al.* 1999).

Roseate Terns migrate south in late August and early September. They arrive in South America by October, where they have been recovered along the north coast from western Colombia to eastern Brazil, between 11° and 18° S (Hays *et al.* 1997). A large concentration of about 10,000 terns, including up to 3000 Roseate Terns, was discovered in 1997 at Mangue Secco, Bahia, Brazil (Hays *et al.* 1999). This concentration contained banded Roseate Terns from the Caribbean population as well as from every major breeding colony in the northeastern U.S. (Hays *et al.* 1999).

Interspecific interactions

In northeastern North America and Europe, Roseate Terns always associate with large colonies of Common and/or Arctic terns (Gochfeld *et al.* 1998). In Nova Scotia between 1995 and 2007, based on aerial estimates, tern colonies with Roseate Terns averaged 532 individuals (mixture of Arctic, Common and Roseate terns); tern colonies without Roseate Terns averaged only 58 individuals (Toms unpublished data), illustrating the dependence that Roseate Terns exhibit for large breeding colonies of other tern species.

Interbreeding between Roseate and Common terns (Robbins 1974; Hays 1975; Zingo *et al.* 1994) and Roseate and Arctic terns (Whittam 1998) does occur. Nisbet estimates one of every 800 Roseate Terns on Bird Island, MA to be a hybrid Roseate-Common tern, and also notes that hybridization appears most common at small peripheral colonies, perhaps due to lack of conspecific mates (Nisbet pers. comm. 1997). On the Magdalen Islands, copulation between Roseate and Common terns has been observed during three different breeding seasons (Shaffer pers. comm. 2008).

Adaptability

Roseate Terns, like other tern species, are sensitive to human and other disturbance and may desert colony sites especially if disturbed early in the breeding cycle (Nisbet and Drury 1972). Roseate Terns usually move to other sites within one to two years of the disturbance event, whereas Common Terns are slower to move (Nisbet and Spendelow 1999). Roseate Terns choose nest sites with greater cover (vegetation or human-made nest structures) than Common Terns (Gochfeld and Burger 1987) and they are known to benefit from the aggressive behaviour of Common and Arctic terns against diurnal predators (Nisbet and Spendelow 1999). Dispersal to new or historic breeding sites is likely an adaptation to disturbance and may partly explain why small Roseate Tern colonies in Nova Scotia are so ephemeral.

Roseate Terns exhibit a relatively narrow range of years for recruiting to the breeding population compared to other seabirds (age 3-5 years), an adaptation which is expected in a species with relatively low adult survival probabilities (Spendelow *et al.* 2002).

POPULATION SIZES AND TRENDS

Search effort

Nova Scotia

The Nova Scotia Department of Natural Resources (NSDNR) conducted aerial surveys of approximately 60% of the Nova Scotia coastline in 1995, 1999, 2003 and 2007. The same observer conducted the surveys and the same route was flown each year. Coastal aerial surveys are limited in that they do not easily differentiate between species of terns. Hence, the NSDNR (1995) or the Canadian Wildlife Service (1999, 2003, 2007) conducted follow-up ground surveys in June or July at all tern colonies estimated aerially to have more than 100 terns present as well as at a subset of smaller colonies (Leonard *et al.* 2004; Boyne pers. comm. 2008). The ground surveys consist of a systematic survey of nests (each nest is marked to avoid double counting), ensuring that the entire area of the colony is surveyed. After 1999, in years that fell between these “full” surveys, the colonies considered critical Roseate Tern habitat (Country Island, The Brothers) were surveyed as part of ongoing studies at those sites. Between 1982 and 1985, a compilation of surveys was done of the coastline (Kirkham and Nettleship 1985) and these results are compared to the more recent surveys for the purposes of this report. Additional observations, usually made by local naturalists and/or members of the Nova Scotia Bird Society, are also included in Appendix 1 when available.

New Brunswick

Machias Seal Island has been surveyed annually since 1995 as part of the Atlantic Cooperative Wildlife Ecology Research Network's ongoing studies of seabirds breeding there (Bond *et al.* 2007). The intensive work at this site makes it possible in most years to state whether Roseate Terns were breeding or present but not breeding (see Appendix 1). Prior to 1995, terns on Machias Seal Island were surveyed by various researchers (summarized by Bond *et al.* 2007).

Quebec

Since 1990, tern surveys on the Magdalen Islands have been conducted using the following protocol: in 1990, 1993, 1994, 1995, 1999, 2000, and 2007 all tern colonies were visited on the ground and nest counts were done. The surveys were conducted during the last 10 days of June, just before the hatching period, at historic colonies as well as new colonies. No special effort was made to find Roseate Tern nests in order to avoid undue disturbance to the colonies. However, Roseate Terns were counted if present at any colony. The largest known tern colonies were visited at least once a year since 1990 to check for Roseate Terns and efforts were made at these sites to find evidence of breeding (Shaffer pers. comm. 2008).

Abundance

In 2007, 100 pairs of Roseate Terns were estimated breeding at seven colonies in Canada, with 98 of these pairs found at five colonies in Nova Scotia (Table 3, p.17).

Fluctuations and trends

The number of Roseate Terns breeding in Canada has remained relatively stable over the last three generations (~24 years) at around 100 pairs. In 1999, more birds were detected (between 119-145) due to the presence of birds at several previously unused sites (Table 3, p. 17, Appendix 1). Historically, the number of Roseate Terns in Canada has probably always been relatively low, although there is some speculation that numbers were greater in the first half of the last century than they are now, at least in Nova Scotia (Leonard *et al.* 2005). In 1970-71, up to 200 pairs were suspected to breed at six sites in Nova Scotia (Lock 1971).

The number of colonies used by Roseate Terns has fluctuated annually, with a high of 14 colonies occupied in 1999 and a low of 4 colonies occupied in 2003 (Table 3, p. 17). New sites continue to be found in any given year; for example Salmon Island had 16 Roseate Terns in 1999 (but none since then) and Duck Island had a single pair of Roseate Terns in 2007 (Appendix 1).

Numbers at the two major colony sites (The Brothers and Country Island) continue to be relatively high. At The Brothers, Roseate Terns increased from just 20 pairs in 1991 to a high of 90 pairs in 2002, but then declined and have remained steady at 67-68 pairs since 2005 (D'Eon 2007, Appendix 1). At Country Island, Roseate Terns reached a high of 53 pairs in 2000, dropped to just 1 pair in 2001, remained steady at around 40 pairs from 2002-2005, but then dropped to 29, 25 and 20 pairs in 2006-2008, respectively (Toms *et al.* 2008, Appendix 1).

In 2007, Sable Island had the highest number of Roseate Terns (4 pairs suspected, 2 nests confirmed) since 1993 (also 4 pairs; Appendix 1). Two nests with chicks were found (Dillon pers. comm. 2008). Historically, Sable Island was believed to have had many more Roseate Terns, with 250 individuals estimated in 1971, albeit based on extrapolations made from birds trapped after the breeding season (McLaren 1981).

Roseate Terns were known to breed in small numbers (1-3 pairs) on Machias Seal Island in 1994, 1995, 1996 (Whittam 1999), 2001 (Devlin and Diamond 2001) and 2002 (Devlin *et al.* 2003). In 2003, an attempt was made to attract larger numbers of Roseate Terns to nest at this colony using a sound system and Roseate Tern decoys. Small numbers were observed for 19 days between 10 May and 17 August but they did not nest (Charette *et al.* 2004). In 2006, the terns abandoned Machias Seal Island midway through the breeding season (Bond *et al.* 2007). In 2007, some terns were seen flying over the colony site in May and June (up to 100), half a dozen nests were initiated but not incubated, and Roseate Terns were not seen (Kennedy pers. comm. 2008). Terns abandoned the colony in early June 2008 (Diamond pers. comm. 2008). The reasons for the abandonment of Machias Seal Island in the last three years may include a decline in food quality, bad weather during chick hatching, increased gull predation, disturbance due to construction activities (solar panels, wind turbine; Diamond pers. comm. 2008) or increased fishing next to the island with an associated increase in gulls feeding on offal (MacKinnon pers. comm. 2008). The loss of Machias Seal Island as a tern breeding colony for three years straight is unprecedented and does not appear to be part of a regular cycle; terns were known to completely abandon Machias Seal Island only once previously, in 1944, but since that time have occupied this site every year until 2006 (MacKinnon and Smith 1985).

Rescue effect

An estimated 3803 pairs of Roseate Terns nested in the northeastern U.S. in 2007, down from a peak of 4310 pairs in 2000 but higher than the low of 2743 in 1992, the year following Hurricane Bob (Figure 6). Numbers of Roseate Terns in the U.S. appeared to be on the rise between 1992 and 1999 but then declined between 2000 and 2007 (Figure 6). The entire northeastern population declined by about 20% between 2007 and 2008 (Nisbet pers. comm. 2008; U.S. Roseate Tern Recovery Team unpubl data). The Canadian population of 100 pairs makes up only about 2.6% of the northeastern North American population.

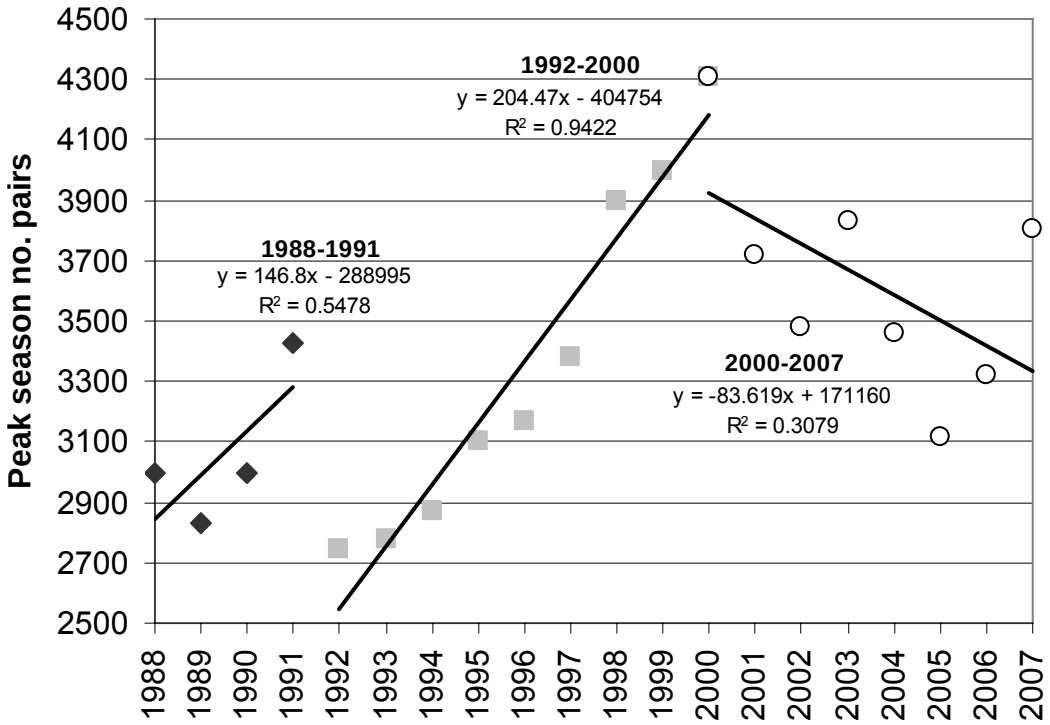

Figure 6. Roseate Tern abundance (peak season count of pairs) in the northeastern United States from 1988-2007 (Source: U.S. Roseate Tern Recovery Team unpubl. data). Abundance has fluctuated over the years.

A small number of birds banded in U.S. colonies have been resighted at The Brothers (Table 2), suggesting that dispersal from the U.S. to Canada does occur and could lead to the recolonization of a Canadian site in the event of local extirpation. It should, however, be noted that there is relatively little interchange of breeding adults between birds in the warm-water colony sites (containing more than 90% of the North American population) and the coldwater colony sites (including Canadian sites). For example, only five of 1520 individuals colour banded in Buzzard's Bay, MA between 2004 and 2006 were resighted as breeding adults at coldwater-influenced colony sites from 2005-2007 (Spendelow *et al.* 2008). Moreover, the potential for rescue in Canada is constrained by the fact that the northeastern U.S. population is itself small and Endangered.

LIMITING FACTORS AND THREATS

Predation and displacement by gulls

The major avian predators at Canadian tern colonies are Herring and Great Black-backed gulls. Gulls prey on tern eggs, chicks, and adults (Hatch 1970; Nisbet 1981; Whittam and Leonard 1999; Toms *et al.* 2008). Roseate Terns will abandon a colony after a season of heavy predation (Nisbet 1981; U.S. Fish and Wildlife Service 1998;

Whittam and Leonard 1999). Gulls are currently controlled using non-lethal methods at both major Canadian colonies (Country Island and The Brothers), and predation rates have decreased as a result (D'Eon 2007; Toms *et al.* 2008). As long as gull control continues at these sites, this threat should be relatively low, although gulls continue to take small numbers of tern chicks annually at Country Island (nine, 12 and six chicks were observed taken over the last three years; Toms *et al.* 2008).

In 2007, at least 200 tern nests (mixture of species) were counted on Pearl Island in Mahone Bay and six Roseate Terns were reported flying overhead on a boat survey. The colony abandoned the site in July (Rodenhizer pers. comm. 2008). About 400 pairs of gulls breed on Pearl Island (Boyne and Beukens 2004) and prey on terns (Kress and Duley 1992) and are the likely reason why terns have not been successful at this site in recent years.

In general, the numbers of large *Larus* gulls in eastern Canada are somewhat lower now than they were in the 1970s (Table 1); however, gulls are not continuing to decline and it is likely that they are still displacing terns from potential colony sites and preying on terns at unmanaged, chronically unsuccessful colonies such as those in Mahone Bay, NS. In the U.S., between Long Island, NY and Cape Cod, MA, the major effect of gulls is that they displace Roseate Terns from secure offshore islands to inshore sites where they are subject to other types of mainland-based predators such as Great Horned Owls (*Bubo virginianus)* and foxes (Nisbet and Spendelow 1999).

Predation by other species

Red Foxes (*Vulpes vulpes*) are major predators of tern eggs on the Magdalen Islands (Shaffer and Laporte 1996), and Northern Ravens (*Corvus corax*) and American Crows (*Corvus brachyrhynchos*) have been known to take tern eggs (including Roseate eggs) at several Nova Scotian colonies (Whittam 1997; D'Eon 1997). Great Horned Owls are major predators of Roseate Tern adults, chicks, and fledglings in the U.S. (reviewed in Nisbet and Spendelow 1999). Hunting owls cause adult terns to abandon their nests at night, leading to exposure of embryos and chicks, and greater predation by nocturnal species such as Black-crowned Night-Herons (*Nycticorax nycticorax*) and ants (Nisbet and Spendelow 1999). Nothing is known about potential Black-crowned Night-Heron predation on Roseate Terns in Canada. There are few Black-crowned Night-Heron colonies in Atlantic Canada, none of which are located near Roseate Tern colonies (Chardine unpublished data), although night-herons have been seen near The Brothers (D'Eon 2004). Ants are a known cause of mortality for hatching or recently hatched Common Tern chicks on the Magdalen Islands and may also impact Roseate Terns (Shaffer pers. comm.).

Great Horned Owl predation on adult Common Terns has been reported in Pubnico Harbour, Nova Scotia (D'Eon 1997, 2005, 2007, 2008). In 2008, a Great Horned Owl was trapped on The Brothers but only after it had killed at least 11 adult Roseate Terns, eight adult Common Terns and one adult Arctic Tern (D'Eon 2008). On the Magdalen Islands, Snowy Owls (*Nyctea scandiaca*) have been present in the

summer months during seven of the last 20 years; they are known to roost near tern colonies and their pellets have been found to contain remains of Common Terns (Shaffer pers. comm.). A Merlin (*Falco columbarius*) preyed upon terns at The Brothers in 2006 and 2007 but Roseate Terns did not appear to be affected (D'Eon 2007). A Northern Harrier (*Circus cyaneus*) was observed preying on a tern chick on Country Island in 2007 (Toms *et al.* 2008), and Merlins and Bald Eagles (*Haliaeetus leucocephalus*) were also noted in predator watches there over the last two years (Toms *et al.* 2008). Coyotes (*Canis latrans*) recently moved onto the Magdalen Islands and likely now prey on terns (Shaffer pers. comm.).

American Mink (*Neovison vison*) have been noted as serious predators at tern colonies in the northeast over the last decade. Predation by mink appears to be increasing, although there are no data available to assess the degree or cause of this increase. Mink predation at tern colonies not only causes direct mortality but can also lead to nocturnal abandonment by adult terns and subsequent chick death (Burness and Morris 1993).

Mink have been found preying on tern adults and chicks at The Brothers, Country Island, and Westhaver and Quaker Islands in Mahone Bay (BCAF 2003, 2006). At least eight adult Roseate Terns and many more chicks were found dead on The Brothers in July 2003 due to mink (D'Eon 2003), and again in 2004 about 10-12 adult Roseate Terns and many more Common and Arctic terns were killed (D'Eon 2004). No Roseate Tern chicks were believed to fledge from The Brothers in these two years. Late in the breeding season in 2004 a mink was captured on The Brothers. Since then, no additional mink predation has been noted there (D'Eon 2005-2007). On Country Island, mink predation was noted for the first time in 2007. A large number of Leach's Storm Petrels (*Oceanodroma leucorhoa*) and Common Eider eggs were eaten. Dead adult terns including six Roseate Terns, 26 Common Terns and 71 Arctic Terns (in total, 9.4% of the colony) were found from May 28 until June 14. The mink was eventually trapped on July 17. Despite heavy adult mortality, the colony did not abandon and the terns had a productive breeding season (Toms *et al.* 2008).

The Mahone Bay Tern Restoration Project also trapped mink at Quaker Island in 2005 and 2006 (BCAF 2006). Mink have also been documented recently at U.S. colonies, especially in the Gulf of Maine. For example, in 2005 a mink swam up to 5 km to Outer Green Island where it decimated a colony including up to 42 pairs of Roseate Terns before it was trapped (Hall pers. comm. 2008).

Occasionally young terns are caught in mink traps (D'Eon 2004), so the trapping process itself is a potential threat (although the benefits of catching a mink which is preying on hundreds of terns far outweighs the risk of bycatch). It is important that researchers and stewards at major colony sites continue to watch for mink predation, and respond with quick and efficient trapping. More also needs to be done to determine why mink predation appears to be on the rise at tern colonies.

Productivity at Country Island, the only site where (albeit rough) productivity estimates are available, is nowhere near the 1.1 fledglings/nest seen in the U.S., suggesting that even at this managed site productivity is still limited by predation. Spendelow *et al.* (2002) have documented that site fidelity (in the form of proportion of unmarked, first-time breeders that become residents) is lowest in years when severe nocturnal disturbance, predation and low productivity (due in the specific case of Falkner Island to Black-crowned Night-Herons) are experienced. Indeed, in the last five years, almost 10% of the adult population of Roseate Terns has been killed by mink at two major colony sites (Country Island and The Brothers), and the population has declined from 130 to 100 pairs over this same period (Table 3). It is likely that continued predation by various avian and mammalian predators at Country Island and The Brothers is negatively impacting site fidelity and recruitment in Canada.

Erosion of The Brothers

As noted above under habitat trends, North Brother Island is eroding and tern breeding habitat is being lost (D'Eon 2008). The potential exists for the island and/or its associated tern habitat to be lost rapidly should one or several severe winter storms hit. The level of concern is great enough that the Canadian Wildlife Service has begun to examine potential alternative sites for this tern colony should restoration become necessary (Toms 2007).

Erosion is recognized in the U.S. Roseate Tern Recovery Plan as a threat to the long-term viability of nesting colonies, and has been implicated in the abandonment of 20% of colonies known to have been abandoned between 1920 and 1979 (USFWS 1998). Many islands currently used by Roseate Terns from Maine to Long Island, NY include low areas exposed to some erosion and tidal overwash which reduces the amount of nesting area available and sometimes results in major losses of eggs and young to flooding (USFWS 1998). The U.S. Roseate Tern Recovery Plan (USFWS 1998) recommends that dredged material from approved projects be used to enhance breeding islands currently facing issues of erosion, with any such work limited to the non-nesting portion of the year. In addition, riprap material along the periphery of these islands could help protect them from continued erosion, although permits issued for such projects should include specific conditions regarding fill material, grading, vegetation plantings, and a firm completion date (USFWS 1998). At Great Gull Island, NY, most Roseate Terns nest in rock crevices created when the Island was riprapped for storm damage protection. These nesting sites offer the benefit of protection from most predators (USFWS 1998). At Falkner Island, CT, concerns over erosion leading to instability of the historic lighthouse led to construction of a rock revetment wrapping around a large proportion of the island (Spendelow and Kuter 2001). The construction of the main revetment at Falkner Island has had a negative impact on Roseate Tern productivity due to loss of chicks in the revetment labyrinth (Rogers and Spendelow 2005). The question of whether erosion should be controlled through such measures is clearly a difficult one and impacts on birds cannot always be predicted.

In 2008, consideration is being given to the creation of additional Roseate Tern habitat in an area of North Brother Island that has never been used by Roseate Terns by placing tarps covered with gravel and nest shelters prior to the terns' arrival. Similar habitat manipulations were conducted about 10 years ago with great success; the manipulated area has been used by Roseate Terns for breeding in every year since (D'Eon pers. comm. 2008).

Human disturbance

Recreational use of coastal areas in Nova Scotia is increasing and may be responsible for the loss of Roseate Terns breeding in Mahone Bay over the last 30 years. In the past, Roseate Terns were known to breed on Grassy Island and have also been found (albeit in small numbers and with no knowledge of productivity) on Westhaver, Pearl, Mash and Wedge islands (Appendix 1). Since 2003, the Bluenose Coastal Action Foundation (BCAF) has been attempting to create a third managed colony for Roseate Terns on Quaker Island in Mahone Bay as recommended in the Roseate Tern Recovery Strategy (Environment Canada 2006), but without success. Two pairs of Roseate Terns were observed circling and landing on Quaker Island in 2004 and 2005 but they did not nest. The project has used methodologies developed and used successfully elsewhere (Kress and Hall 2004) but efforts have been hampered by poor weather, predators (owls, mink and falcons; BCAF 2003, 2006) and human disturbance. The situation on Quaker Island appears to be representative of how terns are doing throughout Mahone Bay; terns have apparently not nested successfully anywhere in the Bay since BCAF began monitoring terns in 2004. Colonies have been established at various sites but have always been abandoned prior to fledging (BCAF 2004, 2005, 2006). Anecdotal information suggests that human disturbance is the most likely cause for many of these abandonments. People have been observed picnicking, walking dogs and even mowing grass within active colonies in Mahone Bay (BCAF 2006).

Human disturbance at other Nova Scotian Roseate Tern breeding sites is minimal. Country Island is located 5 km offshore, is difficult to land on, and is thus rarely visited by people. The Brothers is easier to access but is carefully watched by a local steward. A potential new source of disturbance has been noted in Pubnico Harbour: the landing and take-off of a float plane several times per week about 1 km from The Brothers. Thus far, no adverse effects on the terns have been documented, but there is no information on the reaction of the birds (D'Eon pers. comm. 2008).

On the Magdalen Islands, human disturbance may be a limiting factor at some sites (Shaffer pers. comm. 2008). At Paquet Island, a cottage on the island, as well as a nearby wharf and marina, attract people to the area, and some people land on the island for swimming and strawberry picking (Shaffer pers. comm. 2008). Chenal Island is close to a large lobster fishing wharf, though activities at the wharf do not appear to disturb the tern colony. Clam diggers may cause some disturbance, but more importantly this island is next to a large shipping lane which occasionally requires dredging. This lane is partially within the 200 m buffer zone established around the

island as critical habitat, but thus far there has been no observed impact to the Roseate Tern colony (Shaffer pers. comm. 2008). Deuxieme Ilet and other colonies occasionally used by Roseate Terns on the Magdalen Islands are all easily accessible by foot as they are surrounded by less than 1 m of water. Kite surfing is a popular activity at many lagoons and is sometimes practised near tern colonies; kite surfers who rest on tern colony islands may disturb the terns (Shaffer pers. comm. 2008).

Industrial development

Industrial activities in the coastal zone are intensifying in the Maritimes, and the cumulative effects on Roseate Terns may be difficult to foresee (Environment Canada 2006; Rock *et al.* 2007). An example is the increase in aquaculture sites in coastal Nova Scotia. In Country Harbour, six aquaculture operations (Blue Mussel *Mytilus edulis*, and Sea Scallops *Placopecten magellanicus*) are currently mapped, and in Pubnico Harbour near The Brothers four operations (including Blue Mussel, Rainbow Trout *Oncorhynchus mykiss*, Sea Scallops, Eastern or American Oyster *Crassostrea virginica*, European Oyster *Ostrea edulis*, Bay Quahog *Mercenaria mercenaria*, Bay Scallop *Argopecten irradians*, Atlantic Cod and Atlantic Halibut *Hippoglossus hippoglossus*) are mapped (http://www.gov.ns.ca/fish/aquaculture/aquamap.shtml) though not all are active.

Increasing aquaculture operations may pose a threat if they reduce fish populations or disrupt habitat where terns forage (Environment Canada 2006). In New Brunswick, seabirds (including Common Terns) use oyster aquaculture cages for perches, which leads to fecal contamination of the product (Comeau *et al.* 2006). Bird scaring at aquaculture sites is not currently conducted but if it is implemented it may pose a threat to seabirds breeding nearby. Currently, the aquaculture industry is considering low-cost gear modifications that could effectively deter birds from using the gear without having to resort to bird-scaring devices (Comeau *et al.* 2006).

The Sable Offshore Energy Project (SOEP) laid a natural gas pipeline 5 km from Country Island in 1999, though no ill effects on terns were detected (CEF Consultants Ltd. 2000). Several new development projects for the Country Harbour area are planned in 2008-2010:

- A pipeline will be laid from the Deep Panuke gas field within 5 km of Country Island, with landfall in Country Harbour (next to the SOEP landfall) at a site known to be used by foraging terns (Rock 2005).
- Construction of a large wharf and liquefied natural gas (LNG) receiving terminal at the mouth of Isaac's Harbour, next to the landfall site of the pipelines.
- Construction of a large petrochemical plant in Goldboro, NS that will consist of ethylene, polyethylene, propylene and polypropylene plants as well as a supporting cogeneration plant. Large ships will bring LNG to the plant's receiving terminal.

Roseate, Arctic and Common terns could be impacted by these projects through disruption of foraging (i.e., disturbance to foraging habitat and prey species, displacement from foraging areas) and stochastic events such as spills from rigs/vessels, especially in light of the additional shipping traffic that will result from the LNG receiving terminal at Goldboro. Another LNG receiving terminal near Port Hawkesbury, NS is proposed, which would further increase large shipping traffic in northeastern Nova Scotia, thus increasing the cumulative-effects risk to Roseate Terns and other seabirds in the region. The April 2003 oil spill in Buzzard's Bay, MA, where terns (including hundreds of Roseate Terns) had to be hazed to prevent them from landing on Ram Island until the oil was cleaned up, and at least three adult Roseate Terns were found dead (Buzzard's Bay National Estuary Program 2008), provides strong incentive to minimize risks of shipping accidents in the vicinity of Roseate Tern breeding colonies.

The company constructing the gas pipeline has indicated that it will not conduct construction activities in the vicinity of Country Island from May 1 to June 20, or fly over, disembark on, or approach within 2 km of the island unless an emergency requires it (Kopperson 2006). In addition, the petrochemical and LNG companies will avoid Roseate Tern critical breeding habitat during their activities, and will develop a spill response plan that identifies specific protocols for avoiding and managing exposure of migratory birds (especially Roseate Tern) to spilled substances. However, because critical foraging habitat for Roseate Terns has yet to be identified, it is not known how these development projects might impact the birds. All three companies have contracted biologists to study tern foraging in the Country Harbour area in 2008-2009 to determine if these projects have any impact on terns. The project is also being designed to meet the needs of the Recovery Team to identify critical foraging habitat for Roseate Terns in the Country Harbour area.

Wind turbines have been placed near Roseate Tern colonies on three occasions in the last five years. These include the Pubnico Point wind farm, the Sable Island turbine, and a turbine on Machias Seal Island (Gautreau pers. comm. 2008). The 17-turbine wind farm at Pubnico Point opened in 2005 and a bird monitoring program has thus far shown no ill effects on terns (Gautreau pers. comm. 2008). No information is available for the other two sites, although the Sable Island turbine was placed immediately adjacent to a large tern colony and could thus potentially affect Roseate Terns.

Weather

Major storms, such as Hurricane “Bob” which passed through the principal staging area for Roseate Terns in August 1991, can hinder population recovery (Nisbet and Spendelow 1999). “Bob” appeared to be responsible for the crash in the U.S. Roseate Tern population between 1991 and 1992 (Spendelow *et al.* 2002; Lebreton *et al.* 2003; and see Figure 6). Adult survival probability decreased from 0.83 to 0.62 on Falkner Island between 1990 and 1991. Furthermore, it was estimated that only 4% of fledglings from Falkner Island in 1991 (equal to one-quarter of the expected number) survived to breeding (Spendelow *et al.* 2002). Interestingly, both young and adult survival probabilities increased to above pre-hurricane levels on Falkner Island in the two years following Hurricane Bob (Spendelow *et al.* 2002).

In Canada, sites such as those used by terns in Mahone Bay, which are already subject to high levels of human disturbance, may be more likely to be abandoned after severe weather impacts. For example, in 2004 a small number of terns attempted to nest on Quaker Island as a result of the tern restoration activities conducted by BCAF; however, the terns abandoned the site when a severe thunderstorm flooded all nests in June (BCAF 2004).

Biologically limiting factors

Roseate Terns have a low annual adult survival rate for a seabird (average 0.835; Spendelow *et al.* 2008), lay one small clutch per year, and do not generally breed until their third year (Spendelow *et al.* 2002). Survival to breeding (age 3) is relatively low, averaging 32% (Lebreton *et al.* 2003). There is some evidence that there has been a reduction in postfledging survival and recruitment of young Roseate Terns in Buzzard’s Bay, MA since 1999 but a formal analysis has yet to be conducted (Spendelow *et al.* 2008). The median age of breeding adults is 7 years, and median age at first breeding is 3-4 years, suggesting that the median breeding lifetime (number of years of reproduction) of the Roseate Tern is only 3-4 years, which is short for a seabird (Nisbet pers. comm. 2008). First-hatched A chicks generally survive to fledging in the absence of predation, but survival of second-hatched B chicks is more variable and can, in some years, be limited by food supply (Nisbet and Spendelow 1999).

The specialized nature of Roseate Tern foraging habitat may partially explain why this species is both less abundant and less widely-distributed than Common Tern (Safina 1990; Nisbet and Spendelow 1999). Roseate Terns are known to travel long distances (up to 30 km) to their preferred foraging sites (Heinemann 1992). In the U.S., a single foraging site near Bird Island, MA has been used by 20-25% of the Roseate Tern population since 1970 (Heinemann 1992). Furthermore, because Roseate Terns in given colonies prey primarily on only one or two fish species, they are vulnerable to environmental perturbations affecting these fish (Safina *et al.* 1988, 1990; Rock *et al.* 2007). It is therefore extremely important to ensure that essential foraging habitat is identified and protected at major Canadian colony sites.

Skewed sex ratio

A shortage of males may limit the productivity of Roseate Terns at some colonies in northeastern North America (Nisbet and Hatch 1999). The sex-ratio of breeders on Bird Island, MA is 127 females:100 males. Twenty per cent of breeding females do not obtain male mates, and instead pair together to produce supernormal clutches of three to four eggs. Fertilization is achieved through extra-pair copulations. Female-female pairs produce 75% fewer fledglings per female than male-female pairs. As a result, average colony productivity at Bird Island is reduced by at least 20%, compared to the value expected if all females had male mates (Nisbet and Hatch 1999). This sex-ratio bias has been found to be present at hatching at Bird Island in a single season (Szczys *et al.* 2001), but not at Falkner Island across five breeding seasons (Szczys *et al.* 2005b). Research thus far has not been able to differentiate between the possibility of a slight female-biased sex ratio at hatching versus an equal sex ratio with sporadic deviations according to site and year (Szczys *et al.* 2005b). The female-biased sex ratio at breeding is believed to be at least partially caused by sex-specific differences in adult survival rate (Nichols *et al.* 2004), the cause(s) of which remain unknown.

Wintering mortality

The average adult survival rate of Roseate Terns (0.85) is low compared to other species of seabirds in the orders Procellariiformes, Pelecaniformes, and Charadriiformes (Table 3 in Spendelow and Nichols 1989). Because adult mortality is rarely observed at breeding colonies, Roseate Terns are probably dying during migration or at their wintering grounds (Spendelow and Nichols 1989; Spendelow *et al.* 1995). Roseate Terns were trapped intensively between 1968-1981 in Guyana for sale at local markets, but this practice has since reportedly stopped (Nisbet 1984). More information is required to determine the causes of winter mortality (Spendelow *et al.* 1995).

SPECIAL SIGNIFICANCE OF THE SPECIES

Canada represents the northern edge of the Roseate Tern's range in North America. While numbers are low and have probably always been relatively low, the species is still an important component of Canada's avian and marine biodiversity. Recently the Roseate Tern has become an icon for coastal conservation efforts; its image forms the logo of several conservation organizations including Bird Life International, the Association of Field Ornithologists, the Atlantic Canada Conservation Data Centre and the Bluenose Coastal Action Foundation (Environment Canada 2006).

EXISTING PROTECTION OR OTHER STATUS DESIGNATIONS

The Roseate Tern is currently designated as *Endangered* in Canada (COSEWIC 1999) and is protected under the *Species At Risk Act*. The Roseate Tern is a non-game species, and is therefore also protected in Canada under the *Migratory Birds Convention Act* (1994). The Canadian General Status rank for Roseate Tern is At Risk (CESCC 2006). In the United States, the northeastern population of Roseate Tern is listed as *Endangered* and is protected under the U.S. *Endangered Species Act* (1973), and the Caribbean population is listed as *Threatened* (USFWS 1987). It is also *Endangered* as of 2000 under the Nova Scotia *Endangered Species Act* (*Endangered Species Act 1998, c. 11, s. 1.*). In Quebec, the Roseate Tern is presently considered "Likely to be designated as threatened or vulnerable" under the *Loi sur les espèces menaces ou vulnérables du Québec* (Quebec's *Act Respecting Threatened or Vulnerable Species,* Quebec Department of Natural Resources and Wildlife 2008). NatureServe's Global Status for Roseate Tern is G4 (Apparently Secure) and provincial statuses are as follows: New Brunswick (S1B = Extremely rare: may be especially vulnerable to extirpation, with typically 5 or fewer occurrences or very few remaining individuals), Nova Scotia (S1B), Quebec (S1). State rankings are available on NatureServe's website at www.natureserve.org. The Roseate Tern is designated globally by the IUCN (World Conservation Monitoring Centre) as Least Concern.

TECHNICAL SUMMARY

Sterna dougallii
Roseate Tern Sterne de Dougall
Range of Occurrence in Canada: QC, NB, NS

Demographic Information

Generation time (average age of parents in the population)	7.8 yrs
Observed percent change in total number of mature individuals over the last 10 years or 3 generations.	stable
Projected or suspected percent change in total number of mature individuals over the next 10 years or 3 generations.	Unknown
Observed, estimated, inferred, or suspected percent change in total number of mature individuals over any 10 or 5 years, or 3 or 2 generations period, over a time period including both the past and the future.	Not applicable
Are the causes of the decline clearly reversible?	Not applicable
Are the causes of the decline understood?	Not applicable
Have the causes of the decline ceased?	Not applicable
Trend in number of populations	Not applicable
Are there extreme fluctuations in number of mature individuals?	No
Are there extreme fluctuations in number of populations?	Not applicable

Extent and Area Information

Estimated extent of occurrence Based on area of polygon joining 4 colonies (The Brothers, Sable Island and 2 colonies on Magdalen Islands) and including three additional colonies (Country Island, Duck Island and Pearl Island) occupied in 2007	98,707 km²
Observed trend in extent of occurrence	Declined from maximum over last three generations of 145,035 km^2 in 1982-85
Are there extreme fluctuations in extent of occurrence?	Not “extreme” but fluctuations have occurred over last three generations: the maximum (above) differs from the current EO by 46,328 km^2 or 32%. However, the non-use of Machias Seal Island is the primary driver of this change.
Index of area of occupancy (IAO) AO calculations are based on the size of the breeding colonies.	Biological AO < 25 km^2 IAO between 20 and 100 km^2
Observed trend in area of occupancy	Decline since 1982-85 (over 3 generations), when 12 colonies were occupied, to 7 colonies in 2007
Are there extreme fluctuations in area of occupancy?	No
Is the total population severely fragmented?	No
Number of current locations	7

Trend in number of locations	Decline from 12 colonies in 1982-85 to 7 in 2007 (but increased to 14 in between)
Are there extreme fluctuations in number of locations?	No
Trend in area and/or quality of habitat	Relatively stable as long as gull control continues at two major colony sites.

Number of mature individuals in each population

Population	N Mature Individuals
Total	200
Number of populations (locations)	1 population (7 colonies in 2007)

Quantitative Analysis

	Not done

Threats (actual or imminent, to populations or habitats)

Predation and displacement by gulls (in the absence of gull control), predation by mink and Great Horned Owls, erosion of at least one major breeding island, human disturbance, and industrial development. The population is also subject to stochastic events (e.g., hurricanes).

Rescue Effect (immigration from an outside source)

Status of outside population(s)? USA: Endangered	
Is immigration known?	Yes, but not extensive
Would immigrants be adapted to survive in Canada?	Yes
Is there sufficient habitat for immigrants in Canada?	Yes
Is rescue from outside populations likely?	Possible but limited by small size of Endangered northeastern population

Current Status

COSEWIC: Endangered (1999, 2009)

Additional Sources of Information: none

Status and Reasons for Designation

Status:	**Alpha-numeric code:**
Endangered	D1

Reasons for designation:
In Canada, this colonial species is part of the northeastern population that breeds on small islands off the Atlantic coast from the Magdalen Islands in the Gulf of St. Lawrence south to Long Island, New York. It winters in South America, from Colombia to eastern Brazil. The most recent (2007) population estimate for Canada was 200 mature individuals occupying 7 locations (approximately 93% are in only 2 locations). The number of mature birds has been fairly stable over the past decade despite recovery efforts. Rescue through immigration of birds from the United States is unlikely since the species is Endangered in New England and the population there is also small (circa 7600 mature individuals in 2007). The primary factors limiting the population are predation of eggs, young and adults, low adult survival rates, and stochastic events (hurricanes).

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Not applicable.
Criterion B (Small Distribution Range and Decline or Fluctuation): Meets Threatened B2ab(i, ii, iii, iv) because area of occupancy is <2000 km^2, breeds at < 10 locations, and there have been observed declines in extent of occurrence, area of occupancy, quality of habitat, and number of locations.
Criterion C (Small and Declining Number of Mature Individuals): Not applicable.
Criterion D (Very Small Population or Restricted Distribution): Meets Endangered D1 (<250 mature individuals)
Criterion E (Quantitative Analysis): Not done.

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BIOGRAPHICAL SUMMARY OF REPORT WRITER

Becky Whittam obtained her B.Sc. in Biology from Queen's University and her M.Sc. in Biology from Dalhousie University, where she completed a Master's thesis on the effects of predation on Roseate, Arctic and Common terns on Country Island, Nova Scotia. Whittam has worked for Bird Studies Canada since 1998, first as Volunteer Projects Coordinator in Port Rowan, Ontario, and currently as the Atlantic Canada Program Manager in Sackville, New Brunswick. She has extensive experience studying Canadian Species At Risk, including Hooded Warbler and Barn Owl in Ontario, and Roseate Tern and Bicknell's Thrush in Atlantic Canada.

COLLECTIONS EXAMINED

No physical collections were examined; however, the following data sets were reviewed as needed:

Nova Scotia Tern Survey database (provided by B. Toms and A. Boyne, Canadian Wildlife Service, with data collected by NS Department of Natural Resources and Canadian Wildlife Service). Cited as Boyne unpublished data in text.

Nova Scotia and New Brunswick gull survey summarized data (provided by A. Boyne, Canadian Wildlife Service). Cited as Boyne unpublished data in text.

Magdalen Island tern and gull survey summaries (provided by F. Shaffer, Canadian Wildlife Service). Cited as Shaffer unpublished data in text.

A summary of element occurrences of Roseate Tern (1930-2001; provided by S. Gerriets, Atlantic Canada Conservation Data Centre).

Summary of number of pairs and productivity of Roseate Terns at all colony sites in the northeastern U.S. and Canada (provided by C. Mostello, U.S. Roseate Tern Recovery Team). Cited as U.S. Roseate Tern Recovery Team unpublished data in text.

Atlantic Canada Waterbird Colony Database (provided by J. Chardine, Canadian Wildlife Service). Cited as Chardine unpublished data in text.

Appendix 1. Site number, name, location and numbers of Roseate Tern pairs present per year from 1982-2007.

P = Roseate Tern(s) present but number of pairs unknown (and breeding questionable). P,NB = present but confirmed non-breeding. Blank cells indicate years in which surveys were not done at particular sites.

		Year																						
#	Site Name	82-85	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	Refs[C]
	QUEBEC																							
1	Pointe de l'Est								0	0	0					0			0	0	0	1	1	1
2	Île du Chenal		1		1	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1
3	Deuxième Îlet					0				1	1	0	1	1	1	1	1	1	0	0	1	0	0	1
4	Île Paquet			3	1	1-2	1	1	2-3	0	1	1-2	1-2	1	1	1-2	1	0	1	0	0	0	0	1
5	Îlot du Nord-Ouest (Havre aux Basques)	1				0			0	0	0		0			0		0	0	0	0	0	0	1
6	Île de Travers										0								0	1	0	0	0	1
	NEW BRUNSWICK																							
7	Machias Seal Island	1		1				0	7	1	2	2	2-3		P,NB	P,NB	1	1	P,NB	P	0	P,NB	0	2-10
	NOVA SCOTIA																							
8	Peter Island	1		1							1	0	0		2				0				0	2-3 10,11
9	Holmes Island						1		1	0	0	0	0	0	0				0		0		0	13-19, 12
10	Tusket Island[A]	6									0		0						0	0	0		0	2, 11, 18, 19
11	Mud Island	2					0									0					0			2,11,12,13, 19, 20
12	The Brothers	55-60					20	23	30	34	33	48	54	59	61	86	70	90	86	76	68	67	68	21
13	Chesapeake Island										0	2	0	0	0	0			0				0	11, 12 17, 18, 20, 22,
14	Salmon Island	0									0				16				0				0	11, 12
15	McNutt's Island	0									0				1-2				0				0	11,12
16	Hughes Island	0									0				5 - 10				0				0	11,12
17	Westhaver Island	8									0				P				0	0	0	0	0	11, 12, 23, 24
18	Mash Island	0									0				10-20				0	0		0	0	11, 12, 24
19	Grassy Island	0							20	20	30		12		0				0			0	0	3, 11, 12, 24
20	Pearl Island					0		P					0	0	P	P	P					0	P	25, 26, 24, 27
21	Wedge Island	6									0				5-10				0				0	11, 12
22	Neil's Island										0				3-6				0				0	12
23	Macdonald Point	0									0				3-6				0				0	11,12
24	Sambro Island	3									0				0				0				0	11, 12
25	Fisherman's Beach	P									0				0				0				0	11, 12
26	Duck Island																						1	12
27	Beaver Island		P								0				0				0				0	12, 28
28	Lobster Island	0									0				0				1				0	11, 12
29	Western Bird Island		P										P											12
30	Thrumcap Island	P									0				0				0					11, 12

#	Site Name	Year																					Refs[C]
		82-85	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	
31	Fisherman's Harbour										0		5		0				0				0	29, 12
32	Country Island	0	25								30	45	1	3	16	53	1	41	43	40	41	29	25	3, 30
33	Charlos Cove, unnamed I.												4											29
34	Berry Head		1																					28
35	Cole Harbour		1																					28
36	Gravel bar E of Cook's I. (off Port Felix)		P																					28
37	Dort's Island													P										12
38	Hog Island		P																					28
39	Sable Island Main Station																							31
40	Sable I. - Lake Wallace																							28
41	Sable I - unnamed colony																							28
42	Sable I. - Green Plains																							28
43	Sable Island East Light																							32
	Sable Island (General)[B]	10-20				1			4	3	2	1				2	1	0				2	4	12, 28, 31, 32

A. There are many islands in the Tusket Island system and it is not known which of these Roseate Terns were found on in 1982-85. Kirkham and Nettleship reference C. Allen, a reputable birder (now deceased), for 6 pairs present on Tusket Island in 1983 but do not specify which island. They also mistakenly reference Nova Scotia Birds 1984 (Vol 26 no 1) for "15-20 pairs on N. Twin I., Tusket Is." which upon checking the original reference is actually just The Brothers (aka Twin Islands). After 1983, all records of "0" Roseate Terns in this row are for Little Half Bald Tusket Island made by Ted D'Eon. In the calculation of Area of Occupancy for 1982, the location for Roseate Tern breeding was assumed to be Outer Bald Island based on Bird Society records indicating Roseate Terns present at this site prior to the 1980s.

B. At least 5 locations on Sable Island have been known to have Roseate Terns since 1982 (sites 39-43). Details for which sites were used in what years are incomplete, however, so data on numbers of birds seen per year are lumped under the category "Sable Island (General)".

C. References for Appendix:

1- Shaffer unpublished data
2- Kirkham and Nettleship 1985
3- Whittam 1999
4- Bernard *et al.* 1999
5- Bernard *et al.* 2000
6- Devlin and Diamond 2001
7- Devlin *et al.* 2003
8- Charette *et al.* 2004
9- Bond *et al.* 2006
10- Bond *et al.* 2007
11- Leonard *et al*. 2004
12- Boyne unpublished data
13- D'Eon 1991
14- Boates *et al.* 1993
15- D'Eon 1994
16- D'Eon 1995
17- D'Eon 1996
18- D'Eon 1997
19- D'Eon 2005
20- D'Eon 2000
21- D'Eon 2007
22- D'Eon 1998
23- BCAF 2005
24- BCAF 2006
25- Mills pers. comm. 2008
26- Kress and Duley 1992
27- Rodenhizer pers. comm. 2008
28- Erskine 1992
29- Whittam 1997
30- Toms *et al.* 2008
31- Dillon pers. comm. 2008
32- Toms *et al.* 2006
33- Stevens pers. comm. 2008