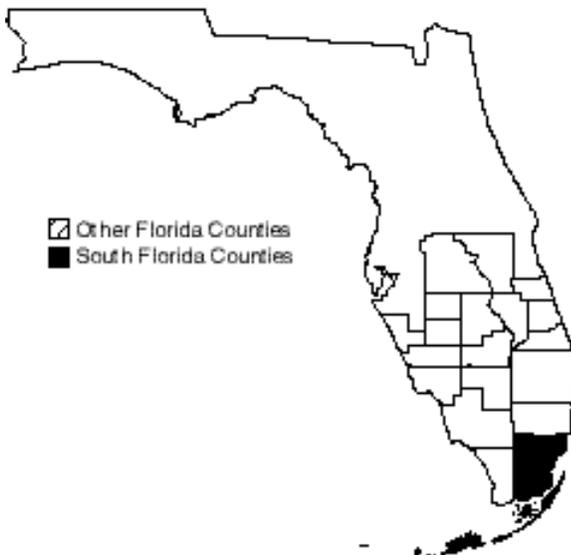

Roseate Tern

Sterna dougallii dougallii

Federal Status:	Threatened (November 2, 1987)
Critical Habitat:	None Designated
Florida Status:	Threatened
Recovery Plan Status:	Contribution (May 1999)
Geographic Coverage:	South Florida

Figure 1. Florida distribution of the roseate tern; this species occurs from the Florida Keys to the Dry Tortugas.



The roseate tern is a medium-sized, colonial-nesting, marine waterbird with a deeply forked tail. This species is distributed worldwide in a variety of coastal habitats. The North American subspecies is divided into two separate breeding populations, one in the northeastern U.S. and Nova Scotia, and one in the southeastern U.S. and Caribbean. Wintering areas are concentrated along the north and northeastern coasts of South America. It is not known if these two populations winter in proximity to each other. The roseate tern was listed as endangered in northeastern North America and threatened in the Caribbean and Florida in 1987 in response to nesting habitat loss, competition from expanding gull populations, and increased predation. Although both populations experienced severe population declines, it is believed that the northeastern breeding population is under greater threat.

This account represents South Florida's contribution to the range-wide recovery plans for the roseate tern (FWS 1989, 1993).

Description

The roseate tern is a slender bird with a body that is approximately 35 to 40 cm in length. Its tail is deeply forked with white streamers, 15 to 25 cm in length. The wing chord averages 23 cm in length; its wingspan is about 60 cm. The culmen is about 40 mm and the length from the nostril to bill tip averages 28 mm. Both the upper and lower body surfaces are paler than that of the common tern (*S. hirundo*), which is similar in appearance. The three or four outer primaries of their wings are frosted with silver-grey and edged with black. The long tail streamers are pure white.

Common terns and Forster's terns (*S. forsteri*) are similar in size, but are more widely distributed, have less pronounced grayish streamers (Forster's tern) or gray with black margins (common tern), and have different amounts of orange coloration on the bill. Arctic terns (*S. paradisaea*) are also similar in appearance to roseate terns, but are only rare

spring migrants in Florida. Roseate terns also have a more rapid wingbeat than these other tern species. Roseates may also be distinguished from these other species by the tail length of a loafing bird, which extends far beyond the wing tips in the roseate (J. Andrew, FWS, personal communication 1996).

Breeding adults are gray above with black caps. The underparts are creamy-white with a blush of pink during the breeding season, the coloration for which this bird was named. The bill is black with varying amounts of the basal portion in orange-red during the breeding season. The amount of red present distinguishes the two breeding populations (Donaldson 1968, Gochfeld 1983, FWS 1989, Nisbet 1989b, Smith 1996). The legs are also red during the breeding season. As with most terns, there is little sexual dimorphism.

In winter, most of the adults lose the tail streamers, the forehead becomes white, the pink blush on the underparts all but disappears, and the legs and bill become black. Both common terns and roseate terns have a dark carpal bar over the bend of the wing in winter plumage, although it is slightly lighter in roseate terns (FWS 1989).

Newly hatched chicks are gray to brown with dark brown or black spots. The legs are purplish at hatching and become black within a few days. Juveniles are brown and gray above with black bill and legs.

Roseate terns can be distinguished by their vocalizations which render it possible to pick them out of a noisy crowd of other seabirds (including common terns). They have loud pure “pink” and “pi-vik” notes as well as a very harsh grating “yaaach” note. Superficially, the call notes of the Caribbean birds sound similar to those of the northeastern population.

Taxonomy

This species is in the order Charadriiformes, family Laridae, subfamily Sterninae. The roseate tern was originally described by Montagu in 1813 from specimens found in the Cumbrey Islands in Firth of Clyde, Scotland (AOU 1983).

There are five subspecies of roseate tern recognized. These five subspecies occur on six continents (Gochfeld 1983) with *S. d. dougallii* being the subject of this species account. The five subspecies described in Gochfeld are: *S. d. dougallii*, *S. d. bangsi* (Malayan peninsula eastward including China, the Phillipines, Molluccas, Straits of Malacca, New Guinea, Solomon Islands, and New Caledonia), *S. d. korustes* (India and Ceylon eastward to the Malayan peninsula), *S. d. arideensis* (Seychelles and Madagascar), and *S. d. gracilis* (Australia).

Distribution

The global distribution and status of the roseate tern is summarized in more detail in Nisbet (1980) and Gochfeld (1983). The Caribbean population of the roseate tern breeds from Florida through the West Indies to islands off Central America and northern South America. Roseate terns also breed in the Palearctic, Indian Ocean, southern Africa, and Australia. In addition to the North American population, roseates occur in Europe and southern Africa.

These populations are also endangered (Randall and Randall 1980). The status of the species in Florida has been reviewed by Robertson (1978) and Smith

Roseate tern.

Original photograph courtesy of Mark Robson.



(1996). Approximately 300 pairs currently breed between Marathon and the Dry Tortugas (Figure 1), though none have nested at the Dry Tortugas for over ten years (W.B. Robertson, Jr. former NPS and USGS/BRD biologist, personal communication 1998).

Nisbet's analysis of band returns confirmed that the northeastern roseate terns winter from western Columbia to eastern Brazil between 11 degrees north latitude and 13 degrees south latitude. Most of the Caribbean birds probably winter further to the south; two birds banded in the Virgin Islands were recovered in Guyana (Nisbet 1984).

Habitat

Strictly a coastal species, this bird is usually observed foraging in nearshore surf. In the winter, the roseate tern is pelagic in its habits. Open sandy beaches isolated from human activity are optimal nesting habitat for the roseate tern. A variety of substrates, including pea gravel, open sand, overhanging rocks, and salt marshes are used. In the northeastern U.S., roseates nest on beaches, barrier islands, and offshore islands (FWS 1989). In extreme southern Florida, roseate terns typically nest on isolated islands, rubble islets, dredge-spoil, and rooftops (M. Robson, GFC, personal communication 1994, Smith 1996). Caribbean birds use a variety of substrates, including open sand and coral rubble, rocky cliffs, and low islands. Nesting sites may be densely vegetated or bare (J.Saliva, FWS, personal communication 1997). Varying amounts of debris and vegetation may be present in the nesting area.

Roseate terns sometimes nest on open sand with minimal vegetative cover in much of the tropics, as on the Great Barrier Reef, Australia (Hulsman 1977). They occasionally do this in the northeast, but some cover (*e.g.*, rocks, crevices, vegetation, old tires) seems to be preferred (Spendelow 1982, Burger and Gochfeld 1988a). Artificial structures have been used as well; at least three rooftops in the middle and lower Florida Keys have been exploited by nesting roseates in the past (P. Frank, GFC, personal communication 1996, Smith 1996).

Behavior

Courtship

No information is available on courtship behavior of roseate terns. However, least terns (*S. antillarum*) engage in various pair bonding and courtship activities including: courtship flights, fish flashing and feeding, courtship dances, nest site selection behaviors, and test scraping prior to copulation.

Reproduction

In the Caribbean, roseate terns breed primarily on small offshore islands, or marine rocks, cays, and islets (Burger and Gochfeld 1988b, Norton 1988). Rarely do they breed on large islands (*e.g.*, Punta Soldado, Culebra in 1989 and 1991). On Culebra and the Virgin Islands, the birds constantly shift locations from year to year, both within the U.S. Virgin Islands (USVI) and between the USVI and British Virgin Islands (BVI). The occurrence of large numbers of breeding birds in the USVI has coincided with lower numbers in the BVI and vice-versa, suggesting intermixing between these populations (FWS 1993). Fidelity to a natal colony, or site tenacity to a previously used colony where the birds have reproduced successfully, may be as important as preference for a particular habitat (Spendelow 1989).

In Florida, breeding site location is dependent on the distribution and abundance of islands with open sandy or broken coral substrates (Robertson 1978, Smith 1996). Other important factors include absence of predators and minimal amounts of human disturbance.

Nisbet (1980 and 1989a) reviewed accounts of roseate tern habitat use in the northeast. Although the northeastern roseate terns typically nest under vegetation or other shelter (Spendelow 1982), this is not characteristic of the Caribbean birds. Roseate terns in the Caribbean have been reported nesting near vegetation or jagged limestone rock (Robertson 1978, Voous 1983, Burger and Gochfeld 1988b), on open sandy beaches (Robertson 1978), close to the waterline on narrow ledges of emerging rocks, or among coral rubble (FWS 1993). Although they may nest on slopes with up to a 70 degree angle, they generally seek flat or even back-sloping ledges for their nests. Most of them add little or no material to the nests, but lay their eggs directly on the ground, rock, or vegetation (FWS 1993).

In the northeastern U.S., clutch size ranges from 1.2 to 1.8 with one and two egg clutches most common (Gochfeld 1983). Average clutch sizes for the Caribbean population have been reported between 1.31 to 1.71 (Nisbet 1981, Norton 1988) eggs per nest. Roseate terns in Puerto Rico and the USVI usually lay one or two eggs. Three-egg clutches are a rarity. Voous (1983) reported clutch sizes of one to two with a single nest containing three eggs. Robertson (1978) reported a usual clutch of two eggs in the Dry Tortugas. Hartert (1893) reported a full clutch size of three eggs, but this was probably unusual.

Shelter for chicks may be found near nests (*e.g.*, short vegetation, rocks, crevices); however, most nests are completely exposed. Therefore, eggs and young chicks are vulnerable to predators when the parents are off the nest. On some islands, there is basically no shelter or they are occupied by other tern species (*e.g.*, Cayo Molinos, Culebra), whereas in other islands plenty of cover

is available (*e.g.*, Cayo Turrumote, southwest Puerto Rico). This may account in part for the differences in breeding success and site fidelity among colonies.

In general, roseate terns in the Caribbean begin egg laying in May and have downy chicks in June. In Culebra and the USVI, egg laying usually begins in mid-May and hatching occurs from mid-June through early July. Chicks that hatch in May usually fledge in July. Roseate terns may abandon a nesting area, re-lay on the same island, or move to as many as three different islands in one breeding period. Sometimes laying may be reinitiated as late as mid-July, after the terns have attempted to nest on several islands (FWS 1993). In 1988 and 1989, unsuccessful nesters on Cayo Raton and Cayo Yerba apparently moved to Cayo Molinos late in the season to re-nest. The factors influencing abandonment of a colony site are not well known and need further study. Roseate terns tend to be late nesters for terns; nest initiation usually occurs in the latter part of May or early June (Robertson 1978). Renesting attempts have occurred as late as early to mid July (W.B. Robertson, Jr., former USGS/BRD biologist, personal communication 1996).

Roseate tern eggs are quite variable in color, but are generally brownish with speckles and streaks of blackish brown. The eggs are cryptic on the rocky substrate. Voous (1957) describes them as lighter, more finely spotted, more pointed, and less conical in shape than *S. hirundo* eggs.

Both sexes incubate, brood, and feed their young. In the Puerto Rican colonies, incubation lasts 23 to 25 days (FWS 1993). Wagner and Safina (1989) discuss the role of the male and female in caring for chicks.

Roseate tern chicks grow rather rapidly. In the northeast, they reach a maximum weight of about 100 to 108 g by 22 days, very close to the time at which they fledge. The young birds fledge between 22 and 29 days of age (Nisbet 1981). Chick growth has been considered a useful indicator of food availability. Safina *et al.* (1988) documented prey abundance through the use of sonar and established that roseate tern chicks grew more quickly in a year with greater food availability.

Burger and Gochfeld (1988a) suggest that breeding roseate terns, which are much less aggressive than common terns, gain anti-predator benefits from associating with more aggressive species. However, roseates in the Caribbean often associate with less aggressive species, such as sandwich and sooty terns. Roseate terns at Culebra approached closer to people and made three times as many dives, while twice as many birds dove at intruders compared with roseate terns of the northeastern population at Cedar Beach (Burger and Gochfeld 1988a). This same aggressive behavior towards human intruders has been observed in roseate terns elsewhere in the Caribbean (FWS 1993). Similarly, Voous (1983) found roseate terns in Aruba quite aggressive, although they did not actually strike humans. These differences in aggressive behavior may be related to the presence of potential predators (*e.g.*, frigatebirds), the degree of predation at the different colonies, or the absence of a more aggressive species nesting in the same breeding area.

Foraging

Northeastern roseate terns tend to specialize in small, schooling marine fish (Bent 1921, Richards and Schew 1989). At the Parguera colonies (southwestern Puerto Rico), roseate terns feed on a variety of fish species such

as dwarf herring (*Jenkinsia lamprotaenia*), thread herring (*Opisthonema oglinum*), halfbeak (*Hyporamphus unifasciatus*), young mackerel, and small squid (Nisbet 1981, Duffy 1986, Kirkham and Nisbet 1987, Safina *et al.* 1988, FWS 1993).

Feeding roseates tend to fly into the wind or hover over schools of fish at heights of up to 20 m (FWS 1989). Feeding is accomplished by plunge-diving to seize the fish in the bill, with feeding birds sometimes submerging completely. If feeding chicks, adult terns return to the colony carrying the single fish in their beaks. Nisbet (1989a) noted that roseate terns in the northeast may fly up to 20 km from the colony to fish, returning with a single fish, usually in the size range of 60 to 100 mm. Safina *et al.* (1988) found that roseate terns laid earlier, delivered more fish to the nest, and had better chick survival in a year with greater fish availability. Additionally, some roseate terns specialize in piracy from other terns (Dunn 1973).

Post-breeding

The few observations obtained on the post-breeding activities of the Caribbean roseate terns suggest that their post-breeding behavior is similar to that of roseate terns in the northeast. Chicks move with their parents to offshore cays near their natal colonies (FWS 1993) and accompany adults during feeding excursions. Chicks continue to be fed by the adults for at least a week after fledging. Aggregations of up to 130 post-breeding roseate terns, were observed near Mary Point on the north coast of St. John, USVI, and 40 adult and juvenile roseates at Great Thatch Island, not far from a suspected roseate colony at jost Van Dyke, BVI (FWS 1993).

The northeastern population stages in large flocks on barrier beaches in August with most birds departing on their southward migration by mid-September (FWS 1989). Migrants have been found in the West Indies in September and October. Nisbet (1984) summarized band recoveries of wintering roseate terns in South America. In Guyana, most band recoveries occurred in October through the winter, whereas in Brazil, they occurred in November.

Migration and Wintering Habits

Very little is known about the spring migration and arrival of the roseate terns to their Caribbean colonies. Roseate terns are absent from most of the Caribbean after the breeding season, returning in late April or early May.

They have been identified during migration in several coastal counties in Florida. Cruickshank noted them moving through Brevard County between April 23-June 29 and August 31-October 1 (Stevenson and Anderson 1994).

Nisbet (1984) suggested that Caribbean roseate terns mingle with the northeastern birds in South American waters. The fact that three out of the five recoveries are from Guyana, where many of the northeastern birds apparently winter, is consistent with his suggestion. "Leapfrogging" in migratory birds is well-established, with the more northern populations wintering further south. Hence, Caribbean roseate terns may maintain a discrete wintering area, perhaps in the southern Caribbean. The northeastern birds are known to winter from Colombia to Brazil (Hamilton 1981, Trull 1988). Bands have been recovered from birds trapped at night for food, particularly in Guyana. Immature birds

and most first year birds generally do not migrate northward, but remain on wintering areas (Nisbet 1984).

Saliva reported a flock of about 55 roseate terns and a common tern approximately half a mile off Mary Point, St. John, on October 8, 1992 (FWS 1993). Most roseates in that flock were adults in winter plumage. He also observed a flock of some 65 roseate terns, one common tern, and two black terns (*Chlidonias niger*) feeding about 3 km off the coast of Ponce, Puerto Rico, on October 9, 1992. Roseates in that group were mostly adults in winter plumage, although several had tail streamers and bright orange legs. During January 1993, Saliva observed, on several occasions, roseate terns in a mixed group of roosting sandwich terns (*S. sandvicensis*), brown pelicans (*Pelecanus occidentalis*), snowy egrets (*Egretta thula*), and ruddy turnstones (*Arenaria interpres*) at Mayaguez Bay, Mayaguez, Puerto Rico. These observations suggest that at least some roseate terns remain in the vicinity of the coast of Puerto Rico, rather than traveling to South America.

Bent (1921) reported that roseate terns winter in the Caribbean and in northern South America, based on the distribution of collected specimens. Through the end of 1978, more than 94,000 roseate terns had been banded in North America, mostly as chicks (Nisbet 1989a), and 1,185 bands had been reported. Birds banded before and after 1958 show different patterns of recoveries (Nisbet 1989a). A total of 358 roseate terns have been reported in the Caribbean or South America, 51 in the Greater Antilles (most before 1957), 12 in the Lesser Antilles (most after 1946), and 295 in South America (60 percent in Guyana from 1967 to 1976). By contrast, only 1,678 roseate terns have been banded in the Caribbean, all but one were chicks of various ages. Of these, only five have been recovered, and for one of these taken at sea there is no locality data. In 1991, a total of 287 roseate terns were banded in Puerto Rico, 16 at Culebra and the rest at La Parguera. Continued banding of adults and chicks in the northeast and Caribbean regions will increase the likelihood of recoveries of banded birds. This might permit determination of migratory pathways, staging areas, and wintering areas as well as intercolony movement within the Caribbean population (FWS 1993).

Relationship to Other Species

As a colonial nester, roseate terns have been observed nesting among least terns at Truman Annex in Key West (A. Scheutz, USN, personal communication 1994) and on roofs in Marathon (P. Frank, GFC, personal communication 1996). Nesting roseates in the northeast most often nest in association with common terns (Nisbet 1981, 1989b; FWS 1989). Caribbean birds are known to nest in association with sooty or bridled terns (*S. fuscata* and *S. anaethetus*) (Robertson 1978, Nisbet 1981 and 1989b). In southern Asia, roseates occur in mixed colonies of swift and black-naped terns (*S. bergi* and *S. sumatrana*). In East Africa, roseates nest in colonies dominated by sooty, bridled, and white-cheeked terns (*S. repressa*). Britain's roseate terns nest with other terns or black-headed gulls (*Larus ridibundus*); Australian birds are known to nest with Australian fairy terns (*S. nereis*) and black-naped terns.

Status and Trends

Nisbet (1980) and Gochfeld (1983) have compiled the available information on the worldwide distribution and status of roseate terns, however, no recent compilation of status has been made. Data on population trends for North American and European populations (both belonging to subspecies *dougallii*) clearly document the drastic decline of the species. Some of these data are quantitative in nature; some inconsistency with the level of decline may be due to sampling techniques (Gochfeld 1983). Data on most tropical populations are less extensive; it cannot be ascertained whether populations are stable or declining (Halewyn and Norton 1984).

In the Caribbean, there are few published data on colony sizes and the only long-term history is that recorded for the Dry Tortugas population (Robertson 1964). The history of the northeastern population has been summarized (Nisbet 1980; 1989a, Gochfeld 1983, Kirkham and Nettleship 1987). These accounts document the dramatic reduction of all species of terns in the late 19th century due to market hunting, eggging, and harvest for the millinery trade. In the U.S., nearly universal bird protection was instituted in 1918 with the passage of the Migratory Bird Treaty Act, which significantly curtailed exploitation. Following protection, roseate tern populations slowly recovered until the 1950s and 1960s when a somewhat erratic decline began. In the 1970s, the decline became alarming, particularly in the face of a general increase in the population of common terns with which the roseates nest (Buckley and Buckley 1981).

Although historical estimates for the Caribbean population of the roseate tern have been poorly documented, Nisbet (1980) estimated the total West Indies breeding population at greater than 2,000 pairs in 1976 and less than 1,500 pairs in 1979. Robertson (1978) estimated the Florida breeding population at 250 to 300 breeding pairs. Kushlan and White (1985) censused three sites in the Florida Keys in 1976 and found 370 nests. Robertson and Wolfenden (1992), estimated the number of breeding pairs in Florida at 350. Robson and Kalla reported counts ranging from 137 pairs in 1991 to 278 pairs in 1992 at Pelican Shoal off Key West; Ricardo Zambrano reported 317 pairs at Pelican Shoal in 1998 (GFC, personal communication 1998).

The decline in roseate tern during the 1970s led to its listing in 1987 for both the northeastern and Caribbean populations (54 FR 2068). The final rule for this listing identifies the loss of nesting sites, competition from other colonial nesters, and predation as threats to the species.

Breeding terns confront a variety of adversities, some of which directly affect adult birds, nests, eggs, and young. Others affect the ability of the adults to obtain sufficient food to produce a large clutch or to feed their young. Among the direct impacts are predation, storms, tidal inundation, flooding, or prolonged periods of cold wet weather which destroy the nests, eggs, or young. In addition, habitat alteration or destruction is a major factor affecting roseate terns in Florida.

In the Caribbean, potential predators include magnificent frigatebirds (*Fregata magnificent*), laughing gulls (*L. atricilla*), red-tailed hawks (*Buteo jamaicensis*), peregrine falcons (*Falco peregrinus*), American kestrels (*F. sparverius*), short-eared owls (*Asio flammeus*), cattle egrets (*Bubulcus ibis*), night herons (*Nycticorax nycticorax* and *N. violaceus*), ruddy turnstones,

American oystercatchers (*Haematopus palliatus*), mockingbirds (*Mimus gilvus*), hermit crabs (*Coenobita clypeatus*), land crabs (*Geocarcinus ruricola*), marine or sally lightfoot crabs (*Grapsus grapsus*), feral cats, rats, and snakes (*Alsophis* spp.) (FWS 1989). Shealer and Burger (1992) observed at Cayo Raton, Culebra, several successful attacks on roseate tern chicks by laughing gulls and American kestrels. In addition, Saliva (FWS, personal communication 1997) observed an oystercatcher feeding repeatedly on roseate tern eggs in 1995.

One of the most significant and recurrent mortality factors is human interference during nesting. Humans may take eggs for food or linger on nesting islands during critical phases of the nesting cycle (FWS 1993). Human-related disturbance, such as camping, has been a problem at Pelican Shoal (P. Frank, GFC, personal communication 1996, H. Smith, DEP, personal communication 1989).

Nisbet (1989a) reported that roseate terns tend to shift colonies quickly in response to predation or reproductive failure. The number of potential predators found in or near some of the Caribbean roseate tern colonies may be an important factor explaining the poor colony-site fidelity, aggressive behavior, and lower reproductive success of this species in some of those areas.

Egging, the collecting of eggs for food or sale, is perhaps the greatest factor threatening many of the Caribbean colonies (Halewyn and Norton 1984, FWS 1993). Human residential, commercial, and recreational activity in proximity to tern colonies is a potentially significant source of disturbance to breeding terns. Although terns can acclimate to such activity, it may nonetheless cause chicks to run from nesting ledges or may keep adults off their nests, thus increasing the likelihood of egg predation or exposure of the eggs to heat or cold. Human presence in proximity to nesting colonies may also increase the number of human-associated predators, such as black rats and feral cats.

Management

In South Florida, the GFC, DEP, and National Audubon Society have worked cooperatively to designate Pelican Shoal as a Critical Wildlife Area under GFC rule-making authority. This designation, in July 1990, affords the site the maximum protection available under Chapter 39 of the Florida Administrative Code.

Staff at Everglades NP have instituted a rat control program on Bush Key. Though this on-going effort has benefitted brown noddies (*Anous stolidus*) and possibly sooty terns, roseate terns have not nested. Historically, this site was the primary nesting location for roseate terns in South Florida. Continuing this management action may eventually restore Bush Key as a safe alternate nesting site for roseate terns.

The FWS, DOT, and DEP are developing plans to establish a roseate tern nesting colony on a section of the abandoned U.S. 1 bridge near Pigeon Key just west of Marathon, Florida.

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Recovery for the Roseate Tern

Sterna dougallii dougallii

Recovery Objective: DELIST the species once recovery criteria are met.

South Florida Contribution: MAINTAIN and increase the South Florida population.

Recovery Criteria

The current population estimate for the roseate tern in Florida is 300 breeding pairs. The objective of this recovery plan is to maintain or increase this number. This objective will be achieved when: the four major colony sites (Pelican Shoal, Vaca Rock, Truman Annex, and the Marathon Governmental Center) are protected from existing threats; these colony sites are managed to reduce losses of eggs, young, and adult roseate terns, and increase colony productivity; potential nesting habitat is restored or rehabilitated to provide additional colony sites for the roseate tern; conservation programs to maintain, protect, and enhance these and additional colony sites are implemented; and studies of the breeding biology and reproductive success of roseate terns in Florida indicate the population has sustained a rate of increase (r) equal-to or greater-than 0.0 as a 2-year running average for five consecutive years.

Species-level Recovery Actions

- S1. Search for colony sites. Given the intercolony movement reported for some roseate terns in the Caribbean, it is possible that other colony sites may be used.**
- S1.1. Identify and evaluate potential colony sites.** Based on characterization of the preferred habitat type, and on an evaluation of areas that have not been thoroughly surveyed, potential colony sites should be identified and surveyed to determine their level of use and value as alternate sites.
 - S1.2. Resurvey historical colony sites throughout South Florida.** Conduct surveys during the nesting season throughout the Florida Keys and the Marquesas Keys and continue annual surveys in the Dry Tortugas.
- S2. Protect and enhance roseate terns in South Florida.**
- S2.1. Control predators.** The presence of predators at roseate tern colonies may result in nest abandonment or direct predation on eggs, young, or adult terns. Therefore, the effect of potential predators on breeding roseate terns should be evaluated and appropriate management techniques implemented to prevent or deter predators.
 - S2.1.1. Control avian predators.** Individual avian predators may specialize in preying on terns, and may regularly visit tern nesting areas to feed. Whenever possible, these nuisance birds should be scared off or trapped and relocated away from tern colonies. If these measures prove unsuitable,

shooting or poisoning of the nuisance bird may be considered. Federal and State permits are required to remove these birds.

- S2.1.2. Control mammalian predators.** The remoteness of roseate tern nesting colonies provides protection to the terns against mammals. However, in the Florida Keys, raccoons and rats may be able to swim out to colony sites. Also, rats may be a factor in most South Florida colonies except the Outer Tortugas, Keys, and probably Pelican Shoal. Trapping, removal, and poisoning of these animals are some of the protective measures necessary to prevent loss of terns to these predators.
- S2.1.3. Control crabs. Hermit and land crabs prey upon hatchlings and very young terns.** However, it seems as if chicks are vulnerable to these predators only when the adult terns are absent from the nest area. Otherwise, adults usually prevent crabs from getting close to the nests. In cases where crabs are too abundant, or when other disturbances keep adult terns away from the nests, trapping and relocation of crabs may be desirable.
- S2.1.4. Control ants.** Some species of ants (e.g., *Solenopsis invicta*) may kill young terns when eggs are pipping or soon after hatching. The use of ant poisons or traps in areas of high densities of these insects may be necessary.
- S2.1.5. Prevent human disturbance of tern nesting colonies.** Providing law enforcement personnel prior to, and during, the nesting season should be combined with education of Florida Keys residents and tourists to prevent human disturbance on important sites.

S3. Conduct research on the biology and life history of the roseate tern in Florida.

- S3.1. Develop a color banding program.** Color banding would help assess the relationship between the roseate terns found in Florida and those found in the Caribbean. Localized movements and site fidelity would also be identified.
- S3.2. Conduct studies of the breeding biology and reproductive success of roseate terns in Florida.** More intensive studies including food availability, hatching success, fledging success, causes of mortality, interspecific interactions, and impacts of contaminants on breeding terns should be included in these studies.
- S3.3. Determine food availability.** Where possible, prey species favored by roseate terns should be ascertained. This may involve direct observations of feeding birds, observations at the nesting colony, fish brought to chicks or dropped at nests, or regurgitation samples.
- S3.4. Determine hatching and fledging success.** Clutch size, and hatching and fledging success should be determined. The number of eggs hatched, as well as the number of chicks surviving to the fledging stage, should be monitored throughout the breeding season.
- S3.5. Determine causes of mortality and colony failure.** For each colony, the causes of reproductive failure should be documented. After determination of the causes of mortality, the best method to protect the site should be identified, and a plan drawn up which can be implemented effectively.

- S3.6. Determine post-breeding dispersal.** To date we have no information on this important aspect of roseate tern life history.
- S3.7. Assess post-breeding dispersal of adult and young roseate terns.** A survey of non-breeding roseate terns will be useful in determining important post-breeding sites. Where roseate terns are sighted, species identification should be confirmed, and whenever possible, bill coloration and color band combinations, if present, should be documented.
- S4. Conduct annual surveys and monitor colony sites to determine the number of nesting roseate terns.** The monitoring protocol should be compatible with that for the Caribbean basin. Surveys should include estimates of nests or nesting pairs, and estimates of adult and young terns present at the colony.
- S5. Educate the general public on roseate terns.** The public, especially locals need to be informed of the need to avoid roseate tern colony sites during the nesting season. Pelican Shoal is particularly subject to this disturbance. An educational program should be developed to target Lower Keys residents on the duration of the roseate tern nesting season, and the need for cooperation in eliminating human disturbance from this site.
- S6. Refine recovery goals.** As additional information on the biology, ecology, and management of roseate terns is gathered, it will be necessary to better define, and possibly modify, recovery goals.
- S6.1. Determine the importance of Florida's colonies to the Caribbean population and adjust recovery goals accordingly.**
- S6.2. Determine what additional actions, if any, are required to achieve recovery objectives.** If there are any actions not included in this recovery plan which, during the recovery process become recognized species' needs, they must be incorporated into the plan.

Habitat-level Recovery Actions

- H1. Protect and manage roseate tern nesting sites to prevent population decline and increase productivity.** A stable population of roseate terns can only be obtained when breeding colonies are appropriately protected. The protection of currently known breeding areas should be given the highest priority.
- H1.1. Develop protection programs for known colony sites.** A conservation program should be developed for the protection of Florida's roseate tern colony sites. Posting, regular patrolling during the breeding season, limiting recreational use, and techniques for predator control are examples of programs necessary to achieve protection of breeding terns.
- H1.2. Educate the public on protection and conservation of roseate terns and their habitat, and regulations pertaining to this species' survival.** Governments and agencies with jurisdiction over roseate tern colonies should become involved in the education of the public on the importance of protecting this species and adhering to Federal or local regulations. This could involve the preparation of an illustrated brochure to be distributed to local groups, schools, and organizations.
- H1.3. Implement management strategies at breeding colonies, if necessary.** Management of breeding habitat may be necessary to increase tern reproductive success, particularly when coupled with predator control programs.

- H1.3.1. Manipulate vegetation.** Based on the available information on roseate tern habitat selection in Caribbean colonies, it appears as if the preferred nesting areas have little or no vegetative cover. Therefore, vegetative encroachment in nesting areas should be controlled by removing excessive vegetative cover.
- H1.3.2. Provide chick shelters, if appropriate.** Chick shelters may be important at some colony sites to afford the chicks an opportunity to avoid heat stress and predators. They may be constructed of 4 inch diameter PVC pipe, Spanish roofing tiles, or scrap wood.
- H2. Provide suitable nest sites where necessary.** In otherwise suitable areas where roseate terns breed, sometimes nearby shelters such as rocks, boulders, or logs are not available. This situation renders eggs and younger chicks vulnerable to predators. Artificial shelters (e.g., nest boxes, tires, logs, coral crevices, ceramic roof tiles) should be provided where natural shelters are scarce. Roseate terns usually select areas where a depression can be excavated (soft terrain), or where a natural cavity exists. In cases where these are not available, artificial shelters can be provided.
- H2.1. Promote nesting at former colony sites.** Areas known to have harbored roseate tern colonies should be evaluated to determine what management techniques may be necessary to bring the habitat to its former state, or to conditions suitable for nesting roseate terns. Once this is achieved, roseate tern decoys may be placed in these areas prior to the arrival of breeding terns to attract them to nest at these locations.
- H2.2. Identify and evaluate potential colony sites.** Based on characterization of the preferred habitat type and on an evaluation of areas that have not been thoroughly surveyed, potential colony sites should be identified and surveyed to determine their level of use and value as alternate sites.
- H2.3. Continue to create additional colony sites. Roseate terns may use artificial colony sites.** A trial project using a raft capped with nesting substrate placed in a borrow pit is underway in the Florida Keys. These structures would also provide nesting opportunities to least terns, a state-listed threatened species in Florida.
- H3. Research habitat preferences in Florida.** Compare the habitat preferences of Florida's colonies with those of Caribbean colonies.