Exhibit 18

Recovery Plan

Caribbean Roseate Tern

(Sterna dougallii)

U.S. Fish and Wildlife Service

CARIBBEAN ROSEATE TERN RECOVERY PLAN

prepared by

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for

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Approved: ______________________________
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Date: September 24, 1993

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Literature citations should read as follows:

U.S. Fish and Wildlife Service. 1993. Caribbean Roseate Tern Recovery Plan. U.S. Fish and Wildlife Service, Atlanta, Georgia, 40 pp.

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Acknowledgements

Special gratitude is shown to Joanna Burger and Michael Gochfeld who provided the first draft for this recovery plan and most of the background information on roseate terns, as well as the literature review. J. Burger, M. Gochfeld, J. Pierce, and D. A. Shealer have kindly helped review and prepare this document as an unofficial recovery team. Many thanks to all other individuals who have provided valuable information on Caribbean roseate terns, and to those who offered comments on earlier drafts of this document.

EXECUTIVE SUMMARY

Current Status: The roseate tern is listed as threatened in the Caribbean. This species is distributed throughout the Caribbean, with the largest populations occurring in the Lesser Antilles. Total population numbers are not known, but between 3,000 and 6,000 breeding pairs have been estimated for this region.

Habitat Requirements and Limiting Factors: Roseate terns in the Caribbean select sparsely vegetated, rocky offshore islands for nesting. Predation of eggs, and young and adult terns, as well as poaching of eggs and adults for human consumption, are the major threats to this species. Disturbance of nesting roseate terns early in the breeding season and when eggs are pipping may cause nest abandonment or exposure of eggs to extreme temperatures.

Recovery Objective: Delisting.

Recovery Criteria: Existing and new populations and their habitats must be protected (i.e., post and increase law enforcement and vigilance of breeding colonies and wintering areas) and managed (i.e., reduce or eliminate mortality factors through appropriate predator controls and enhancement of breeding grounds) to reduce mortality of eggs, young, and adult roseate terns.

Actions Needed:
1. Protect and manage roseate tern populations and their habitat to prevent further population decline and increase productivity.
2. Continue to gather information on the distribution and abundance of roseate terns in the Caribbean.
3. Conduct studies of the breeding biology and reproductive success of roseate terns in the Caribbean.
4. Determine post-breeding dispersal and wintering grounds.
5. Refine recovery goals.

Total Estimated Cost of Recovery: Recovery costs for roseate terns in the Caribbean have been estimated at $178,500 for the first 3 years. Subsequent expenditures will depend on the results of preliminary studies, and therefore cannot be estimated at this time.

Date of Recovery: Delisting should be initiated in 2020, if recovery criteria have been met.

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PART I. INTRODUCTION

The world distribution and status of the roseate tern, *Sterna dougallii*, have been reviewed by 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 North America, the Palearctic, Indian Ocean, southern Africa, and Australasia. In addition to the North American population, the European and southern African populations are endangered (Randall and Randall 1980).

The decline of the northeastern population of roseate terns in the 1970's has been well documented (Nisbet 1981), and the population there appears to have stabilized. However, the history and status of the Caribbean colonies are little known. Much of our knowledge of the status and distribution of birds in the West Indies was compiled by Bond (1958). Bond and other ornithologists originally misidentified Caribbean roseate terns as common terns (*S. hirundo*) because of the similarity in their bill coloration (Furniss 1983). Failure to distinguish between the two species makes it difficult to reconstruct the history of roseate terns in the Caribbean. Reliable information on the distribution of these two species in the Caribbean has become available only recently (Halewyn and Norton 1984).

On December 30, 1982, the U.S. Fish and Wildlife Service (Service) listed the roseate tern as a category 2 species, its status pending acquisition of additional data (U.S. Fish and Wildlife Service 1982). On September 18, 1985, the status was revised to category 1, adequate information for determination on hand (U.S. Fish and Wildlife Service 1985). Finally, on November 4, 1986, the Service published a proposed rule listing the Caribbean population of the roseate tern as threatened, and the northeastern United States population as endangered (U.S. Fish and Wildlife Service 1986). After a comment period the final rule was published on November 2, 1987, and took effect on December 2, 1987 (U.S. Fish and Wildlife Service 1987).

Description

The roseate tern is a primarily white, slender-winged, long-tailed, typical capped tern (family Laridae, subfamily Sterninae). Its overall length is about 40 centimeters (cm), including tail streamers 15 to 25 cm in length. The wing chord is about 23 cm long and the wing span is about 60 cm. In roseates, the culmen is about 40 millimeters (mm) in length, and the length from the nostril to tip averages 28 mm.

The roseate tern has a black crown, pale grey upper surface and immaculate white underparts. Both the upper and under surfaces are paler than in the very similar common tern. The 3 or 4 outer primaries (wing feathers) are frosted with silver-grey and edged with black. The long tail streamers are pure white, whereas those of common terns are grayish and have a black outer margin. Early in the breeding season there is an evanescent pink or peach bloom on the underparts, visible in some lights. Male and female roseates are essentially identical in size and color. In non-breeding plumage, both common and roseate terns have a dark carpal bar over the bend of the wing, although it is slightly lighter in roseate terns.

Although the Caribbean birds and the northeastern birds are similar in size, there are subtle but apparently consistent differences. The Caribbean birds weigh an average (n=10 incubating adults) of 100 $\pm$ 2 grams (g), consistently lighter than the northeastern birds, and they have a slightly shorter bill and wing. An important difference between the northeastern and Caribbean populations is the bill color. In the northeastern United States and Europe the roseate terns have a primarily black bill, with a faint reddish orange base through much of the breeding season. As the breeding season progresses, the basal orange color gradually extends distally, until it is about one-quarter orange at the time chicks hatch and about half orange when they fledge (Donaldson 1968, Cormans 1976). During the breeding season only the tip of the bill of the Caribbean birds is black; the basal three-quarters is reddish orange, unlike the northeastern roseates. When roseate terns arrive at their colonies near Culebra Island, Puerto Rico, their bill is mostly black, with the basal quarter reddish orange. By the time egg-laying begins, the basal three-fourths the bill is reddish-orange, and this condition remains until after the chicks fledge and the birds leave their breeding colonies (Saliva, pers. obs.). At this time, the red on the bill starts fading and the forehead begins to lose its black color. After the breeding season, most of the adults lose the tail streamers and gain a whitish forehead.

The close similarity between northeastern and Caribbean birds during the non-breeding season may make it impossible to distinguish birds of the two populations in the field outside the breeding season. Therefore, learning the non-breeding distribution of the Caribbean population without the benefit of color-banded birds would be difficult.

Downy young are cryptically colored. They have a "hairy" or grizzled brown and black pattern, and do not have distinct spots. The leg color is purplish at hatching, becoming black by 2 to 3 days of age. The black legs of roseate tern chicks distinguish them from common terns. When fully feathered, the roseate chicks have whitish upper wing surfaces and a distinctive brown and black scalloping on their back and upper wing coverts.

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 a 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.

Breeding

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 proper (e.g., Punta Soldado, Culebra in 1989 and 1991, Saliva, pers. obs.). On Culebra and the Virgin Islands the birds constantly shift locations from year to year, both within the U.S. Virgin Islands (USVI) and apparently 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. 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).

Nisbet (1980 and 1989) 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 1976, Voous 1983, Burger and Gochfeld 1988b), on open sandy beaches (Robertson 1976), close to the water line on narrow ledges of emerging rocks (Norton and Pierce, pers. obs.), or among coral rubble (Saliva, pers. obs.). Although they may nest on slopes up to 70 degree angle (Norton and Pierce, pers. obs.), 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.

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. In some islands there is basically no shelter or it is occupied by other tern species (e.g., at Cayo Molinos, Culebra), whereas in other islands plenty of cover is available (e.g., at Cayo Turrumote, southwest Puerto Rico). This may account in part for the differences in breeding success and site fidelity among colonies.

Elsewhere in the tropics, roseate terns sometimes nest on open sand with minimal vegetative cover, 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.

In general, roseate terns in the Caribbean begin egg laying in May, and have downy chicks in June. These fledge in July. For example, at Culebra, roseate terns follow a pattern similar to that in the USVI. Laying usually begins in mid-May, and hatching occurs from mid-June through early July. However, they may abandon a nesting area, re-lay on the same island, or move to up to 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 (Saliva, pers. obs.). For example, in 1988 and 1989 unsuccessful nesters on Cayo Ratón and Cayo Yerba apparently moved to Cayo Molinos late in the season to renest. The factors influencing abandonment of a colony site are not well known and need further study.

Roseate terns in Puerto Rico (PR) 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 (1976) 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.

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 pattern rocky substrate. Voous (1957) describes them as lighter, more finely spotted, more pointed, and less conical in shape than *S. hirundo* eggs.

Roseate tern chicks grow rather rapidly. In the northeast they reach an asymptotic weight of about 100 g to 108 g by 22 days, very close to the time at which they fledge, which varies from 22 to 29 days of age (Nisbet 1981). Chick growth has been considered a useful indicator for food availability. Indeed, Safina *et. al*. (1988) documented that roseate tern chicks grew more quickly in a year with greater food availability, as determined independently by sonar.

Both sexes incubate, brood, and feed the young. In the Puerto Rican colonies, incubation lasts 23 to 25 days (Saliva and Shealer, unpub. data). Wagner and Safina (in press) discuss the role of the male and female in caring for chicks.

Burger and Gochfeld (1988a) suggest that breeding roseate terns, which are much less aggressive than common terns, gain anti-predator benefit from associating with more aggressive species. Roseate terns at Culebra approached people closer 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 (Saliva unpub. data). Similarly, Voous (1983) found roseate terns in Aruba quite aggressive, although they did not actually strike humans.

Differences in aggressive behavior may be related to the degree of predation at the different colonies, or the absence of a more aggressive species nesting in the same breeding area.

Factors Affecting Reproduction and Survival

Breeding terns confront a variety of adversities, some of which directly affect the nest, eggs, and young or even the adults, while others affect the ability of the adults to obtain sufficient food to produce a large clutch or to feed their young. Among the direct factors are predation, storms, floods, or prolonged periods of cold wet weather which destroy the nests, eggs, or young.

In the Caribbean, potential predators include magnificent frigatebirds (*Fregata magnificens*), laughing gulls (*Larus atricilla*), red-tailed hawks (*Buteo jamaicensis*), peregrine falcons (*Falco peregrinus*), American kestrels (*Falco sparverius*), short-eared owls (*Asio flammeus*), cattle egrets (*Bubulcus ibis*), night herons (*Nycticorax nycticorax*), ruddy turnstones (*Arenaria interpres*), 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.). One of the most significant and recurrent mortality factors is human interference. Humans take eggs for food or linger on nesting islands and cause fatal disturbance (Pierce and Shealer, pers. comm.).

Pierce (*in litt.*) found egg predation by laughing gulls to be moderately important in the USVI. In 1990, Shealer and Burger (1992) observed at Cayo Ratón, Culebra, several successful attacks on roseate tern chicks by laughing gulls and American kestrels.

Nisbet (1989) 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 major factor threatening many of the Caribbean colonies (Halewyn and Norton 1984, Pierce unpub. data). Human residential, commercial, and recreational activity in proximity to tern colonies is a potentially significant source of disturbance to breeding terns. Although terns can habituate to such activity, it may nonetheless cause chicks to run from nesting ledges or may keep adults off their nests, allowing predators to steal eggs.

Feeding

Nisbet (1981), Duffy (1986), Kirkham and Nisbet (1987), and Safina *et al.* (1988) have described the feeding behavior of the northeastern roseate tern. The species tends to specialize on small schooling marine fish (Bent 1921, Richards and Schew 1989). At the Parguera colonies (southwestern PR), 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 (Shealer, pers. comm.). The terns fly into the wind or hover over the school of fish at heights of 5 to 10 meters, and plunge vertically downward to seize the fish in the bill, sometimes submerging completely. If feeding chicks, the terns return to the colony carrying the single fish in their beaks. Some roseate terns specialize in piracy from other terns (Dunn 1973). Nisbet (1988) noted that roseate terns in the northeast may fly up to 20 kilometers (km) from the colony to fish, yet return with a single fish, usually in the size range of 60 to 100 mm. In a comparison of two years at Cedar Beach, Long Island, 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.

Spring Migration and Arrival to Breeding Colonies

Very little is known about the spring migration and arrival of the roseate terns from and to their Caribbean colonies. They apparently disappear from most of the Caribbean after the breeding season, returning in late April or early May (Table 1). Nisbet (1980) summarized published accounts of the season of residency at breeding colonies.

Table 1. Season of residency of roseate terns at breeding areas in the Caribbean (compiled from reports summarized by Nisbet 1980).

Breeding Area	Months Present	Original Source
Bahamas	May-August	Buden 1979
Puerto Rico	May-September	McCandless 1958
Culebra	May-September	Saliva, unpub.
St. Croix	March-October	Beatty 1930
St.Thomas/St. John	April-October	Nichols 1943
Netherlands, Lesser Antilles	April-November	Voous 1957

Roseate terns tend to return to their colony sites in Puerto Rico in early May (Saliva, pers. obs.). At the Dry Tortugas, birds are in their colonies in mid-May, and there are few records earlier in the breeding cycle (Robertson 1964). Although there has been sporadic banding, few data are available to document migration.

<u>Staging and Migration</u>

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 (Saliva, pers. obs.), and they accompany adults during feeding excursions. However, chicks continue to be fed by the adults for at least a week after fledging. On July 31, 1989, after the breeding season, Saliva observed up to 130 roseate terns near Mary's 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.

The northeastern population stages in large flocks on barrier beaches in August, and most birds depart on their southward migration by mid September (U.S. Fish and Wildlife Service 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. Most recoveries were from October through the winter in Guyana or from November in Brazil.

Nisbet (1984) suggested that Caribbean roseate terns mingle with the northeastern birds in South American waters, and 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. However, "leapfrogging" in migratory birds is well-established, with the more northern populations wintering further south, hence Caribbean roseate terns could 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 yearlings generally do not migrate northward, but remain on wintering areas (Nisbet 1984).

Saliva (pers. obs.) reported a flock of about 55 roseate terns and a common tern approximately half a mile off Mary's Point, St. John, on October 8, 1992. 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 2 miles 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 (*Sterna sandvicensis*), brown pelicans (*Pelecanus occidentalis*), snowy egrets (*Egretta thula*), and ruddy turnstones at Mayagüez Bay, Mayagüez, Puerto Rico. These observations suggest that at least some roseate terns might 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 1989), and 1,185 bands had been reported. Birds banded before and after 1958 show different patterns of recoveries (Nisbet 1989). 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 non-flying young. 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 was banded in Puerto Rico. Of these, only 16 birds were trapped at Culebra while the rest were from La Parguera. Continued banding of adult and chicks in the northeast and Caribbean regions will increase the likelihood of recoveries of banded birds. This might permit determination of wintering and staging areas, as well as intercolony movement within the Caribbean population.

Population Status

Nisbet (1980) and Gochfeld (1983) have compiled the available information on the worldwide distribution of roseate terns. Data on population trends for North American and European populations (both belonging to subspecies *dougallii*) document well the drastic decline of the species. Data on most tropical populations are less extensive, and it cannot be ascertained whether populations are stable or declining (see Halewyn and Norton 1984).

History

In the Caribbean, there are very few published data on colony sizes and the only long documented history is that of the Dry Tortugas population (Robertson 1964). The history of the northeastern population has been summarized (Nisbet 1980, 1989; 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, egging, and, particularly, the insatiable millinery trade. In the United States, nearly universal bird protection was instituted in 1913 with the passage of the Migratory Bird Treaty Act, significantly curtailing the exploitation of the past century. Following protection, roseate tern populations slowly recovered until the 1950's and 1960's when, somewhat erratically, they began to decline again. In the 1970's 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).

Current Status and Trends

For the purpose of this recovery plan, the following seven areas comprise the Caribbean region:

Florida Keys and Dry Tortugas
Bahamas (including Turks & Caicos)
Greater Antilles and Virgin Islands
Lesser Antilles
Trinidad & Tobago
Southern Caribbean
Central American Coast

Countries included in these areas are shown in Figure 1. The known distribution of roseate terns within these seven areas is described below in Table 2.

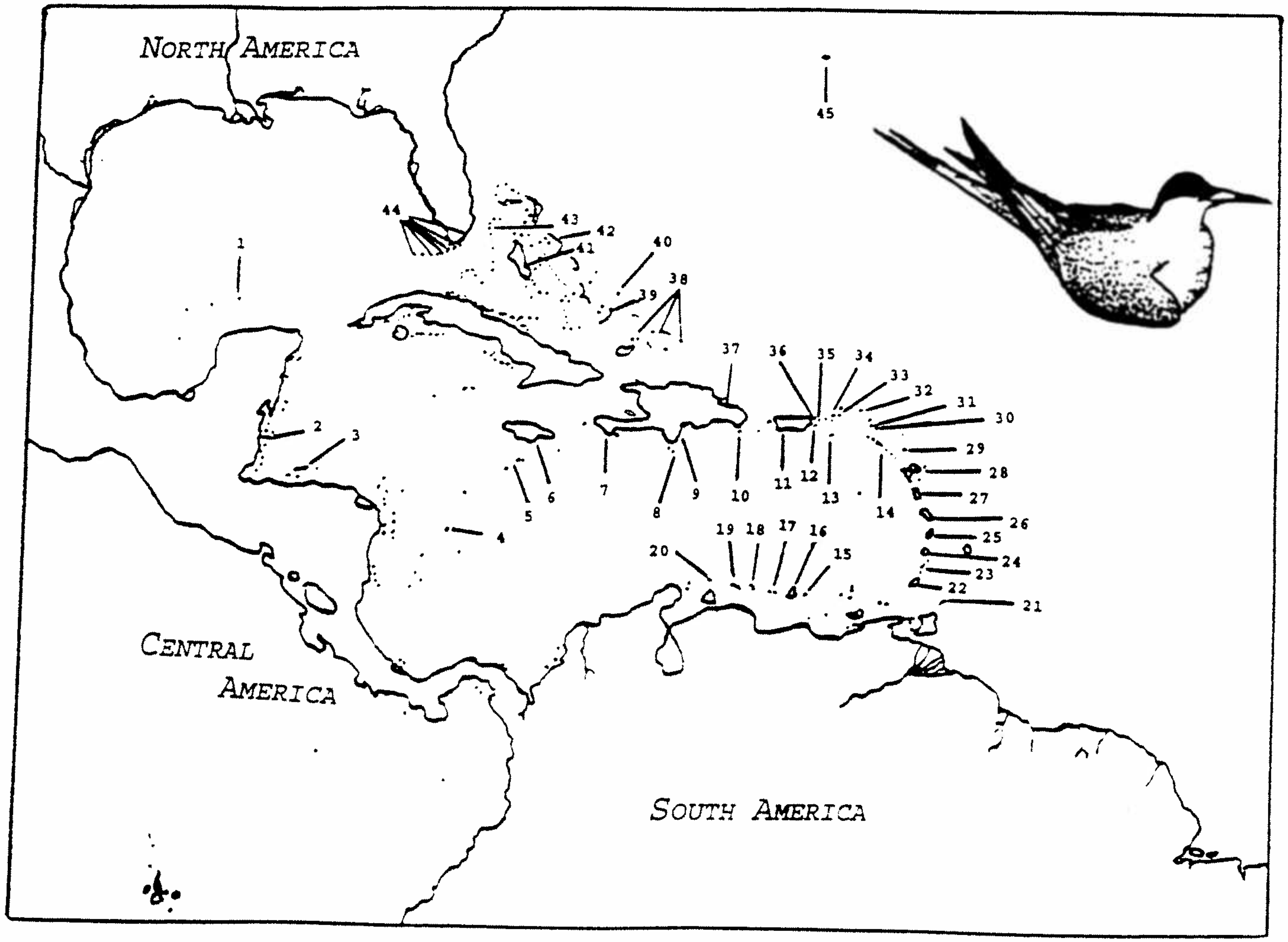
TABLE 2. Estimated roseate tern population in the Neotropics* (after Gochfeld 1983).

Location	Documented pairs	Suspected additional pairs	Probable maximum pairs
Florida	200-300		
Bahamas	------	500-2500[a]	
Greater Antilles	200-500	500[a]	
Virgin Islands	1200-1600	400[a]	
Lesser Antilles and Trinidad	200-300	1000[a]	
Central America	15-50	500[a]	
South America	200-400	600[a]	
Regional Total	2015-3150	3500-5500	8450

* There was formerly a population on Bermuda which was extirpated by poaching in the 1850's, and the birds have not nested since, although they do occur as scarce spring migrants (Wingate 1973).

a= Area is characterized by scattered small colonies; larger colonies (> 100 pairs) are uncommon or undocumented.

Figure 1. Known breeding distribution of the Caribbean population of Roseate Terns, _Sterna dougallii_ (Modified from Halewyn and Norton 1984).*



* Note that these are locations where Roseate Terns have been reported breeding or attempting to nest. Colony size and location may vary from year to year.

Table 3. Key of known breeding locations of Roseate Terns in the Caribbean for Figure 1.

Figure Number	Location
1	Mexico (Gulf coast)
2	Belize (adjacent islands)
3	Honduras (adjacent islands)
4	Serrana Bank (Colombia)
5	Pedro Cays (Jamaica)
6	Jamaica
7	Haiti
8	Beata and Alto Velo (Dominican Republic)
9	Dominican Republic (Caribbean coast)
10	Saona and Catalinita (Dominican Republic)
11	La Parguera Cays (Puerto Rico)
12	Vieques (Puerto Rico) (adjacent islands)
13	St. Croix (U.S. Virgin Islands)
14	St. Kitts (British Virgin Islands)
15	La Orchilla (Venezuela)
16	Los Roques (Venezuela)
17	Las Aves Island (Venezuela)
18	Bonaire
19	Curaçao
20	Aruba
21	Tobago
22	Barbados
23	Grenada
24	St. Vincent
25	St. Lucia
26	Martinique
27	Dominica
28	Guadalupe
29	Antigua
30	St. Barts (adjacent islands)
31	St. Martin (adjacent islands)
32	Sombrero
33	British Virgin Islands
34	U.S. Virgin Islands
35	Culebra (Puerto Rico) (adjacent islands)
36	Cordillera Cays (Puerto Rico)
37	Bahía Samaná (Dominican Republic)
38	Turks and Caicos
39-43	Bahama Islands
44	Florida Keys and Dry Tortugas
45	Bermuda

Nisbet (1980) resisted speculating on the overall numbers of roseates in the Caribbean. The Virgin Islands population ranged from 750 to 1,500 pairs. Culebra held 325, Florida up to 200, the Exumas up to 200 pairs, and Antigua 50 pairs. Formerly there were colonies in the Grenadines (1902), Grenada (1935), Dominica (1941 to 1951), and Islas Las Aves (1956) which have disappeared. In addition, many potential breeding sites have rarely been visited. The estimated population was 1,500 to 2,000 pairs. Halewyn and Norton (1984) argued that there was no evidence of a decreasing population. They estimated the Puerto Rico-Virgin Islands population alone at 2,500 pairs, but this may be the result of maximum counts for Culebra and for the Virgin Islands in different years. They conclude that the regional population is greater than 2,500 pairs and put the maximum at about 4,000 pairs.

Florida/Dry Tortugas- Halewyn and Norton (1984) give an estimate of 225 pairs for the Tortugas and the Florida Keys. Audubon reported roseate terns nesting in the Florida Keys (e.g., abundant at Indian Key); however, no roseate tern colonies were known in Peninsular Florida or the Keys between the mid-19th century and the 1960's. Nisbet (1980) cited Scott's 1888 account of Florida birdlife in the days prior to the plume trade and Scott reported only one roseate tern record.

In June 1988, a total of 250 to 300 pairs of roseate terns were found nesting on Tank Island off Key West. The entire colony failed for unknown reasons. However, the colony was less than a mile from the Key West sewage outfall, and the few eggs analyzed were found to contain *Escherichia coli*, which has been suggested as a cause of the failure.

The first Dry Tortugas breeding record for roseates was of 100 pairs in June 1917, which Bartsch erroneously assumed were common terns (Robertson 1964, 1976). The counts were remarkably stable between 1917 and 1963, ranging from 75 to 250 pairs in most years (Robertson 1964), although there is a 1936 estimate of 400 pairs. In the mid 1930's, there were about 150 pairs. For most of the time the birds nested in a single colony which shifted location occasionally, but in 1947, Sprunt found 142 nests on three islands. In 1948, there were about 225 nests. In 1962, the colony was wiped out by presumed cattle egret predation. However, through 1963, the population was still stable within the 100 to 250 pair range (Robertson 1964). Nisbet (1980) cites Robertson (pers. comm.) that the numbers have remained stable since then. Saliva did not see roseates on a visit to the Dry Tortugas in mid-May of 1989.

Bahamas - Cory (1891) listed the species as a "regular summer visitant... although by no means abundant." He found a few at Acklins and they were common at Clarence Harbor, Long Island. Sprunt (1984) notes that colonies range from 15 to 100 pairs, and estimates a total population range between 1,000 and 2,000 pairs, concordant with the less precise estimate by Gochfeld (1983) of 500 to 2,500 pairs.

Halewyn and Norton (1984) reported about eight breeding sites in the Bahamas and Turks and Caicos, but gave a documented estimate of about 50 pairs. Sprunt (pers. comm. in Nisbet 1980) did not observe roseate terns in an extensive cruise in the southern Bahamas in 1979, but saw 10 to 15 birds off Crooked Island and several hundreds in the Exumas. He found a colony of 40 pairs on Little Rock near Hawksbill Bay and suspected other colonies near Norman's Key and Guana Key. Bond (1958) cited a report of many "common terns" nesting on Stocking Cay off Great Exuma.

Sprunt (1984) reported confirmed breeding at Fish Cays (Little Bahama Bank), Hawksbill Rock, Little Bell Island, Little San Salvador, and Clarencetown Cays on the Great Bahama Bank. Paterson (cited in Nisbet 1980) did not list roseate terns at all for the Bahamas, but stated that common terns bred in colonies on cays from Abaco to Inagua between April and August. In contrast, Buden (1979) listed the common tern only as a migrant, and listed the roseate tern as a relatively uncommon but regular summer resident, reported from May through August. Buden (1979) listed records from Bird Rock, Crooked Island, Acklins, Great Inagua, Little Inagua, the Caicos (West, Ft. George Cay, Middle), and the Turks (Round, Long, Salt and Big Sand Cays; cited by Nisbet 1980).

Greater Antilles and Virgin Islands

Cuba - Nisbet (1980) found three references to roseate terns in Cuba. Montaña and Garrido (1965) found three nests on Cayuela La Vela in the same area in 1963, which they considered the first nesting record of the species in Cuba. According to Garrido and Montaña (1975), roseates probably nest also on Mono Grande and Los Ballenatos, but the location of these islands remains to be documented. Halewyn and Norton (1984) indicate four probable breeding areas but no population estimate.

Jamaica - Bond (1950) listed the species as breeding on the Pedro Cays south of Jamaica, but the basis of this record is unknown. There is no evidence that roseates have nested there since then (Haynes 1987). It is likely that disturbance and egg collecting contributed to their decline. Regarded as a luxury, seabird eggs are considered to have aphrodisiac properties and command a higher price than chicken eggs (Haynes 1987). Licenses are issued for legalized collecting of eggs, but there is no management, and adult seabirds may be shot for sport or fish bait.

Hispaniola - There are apparently no breeding records from Haiti (Nisbet 1980), although Halewyn and Norton (1984) indicated a possible nesting in southwestern Haiti, as well as nesting at four places in the Dominican Republic. Wetmore and Swales (1931) found about 20 pairs nesting on one of the Cayos de Los Pájaros at the entrance to San Lorenzo Bay on May 11, 1927. About 20 pairs nested on an open rock platform without vegetation (Wetmore and Swales 1931). Wetmore and Swales (1931) found a colony of a dozen pairs on a block of limestone in the lagoon on Beata Island on May 12, 1931. The birds had not begun laying.

Puerto Rico - Wetmore (1927) noted that roseate terns had been recorded from several locations (San Juan, Joyuda, Aguadilla, and Manatí) in Puerto Rico, and reported seeing birds apparently beginning to nest on limestone ledges on the shore north of Manatí in July 1912. The main roseate tern breeding area used to be on cays near Culebra Island, but numbers there had declined dramatically (Wetmore 1927). There are also several roseate tern colonies of about 150 to 200 pairs on cays off La Parguera on the southwestern coast of Puerto Rico, and on small coral islets near Guánica and Guayanilla on the south coast (Saliva, pers. obs.).

Roseate terns have been reported near La Cordillera, the chain of approximately 100 small islands stretching across 16 km of water from Fajardo to Culebra (Saliva, pers. obs.), but breeding has not been confirmed there. Kepler and Kepler (1978) reported 250 pairs of terns nesting on Cayo Molinos and 75 pairs on Cayo Ratón, near Culebra. Based on bill color they assumed these were common terns. In the early 1980's, Cayo Molinos was the only occupied colony with an estimated 200 pairs in June 1981, 242 nests in June 1982, (Furniss 1983), and 172 nests and an estimated 250 pairs in 1983 (Burger and Gochfeld, unpub. data). From 1987 through 1989, there was a decline to fewer than 70 pairs. Roseate terns on Culebra sometimes show little colony-site fidelity, some years moving up to four times to different cays in a single breeding season (Saliva, pers. obs.). At Cayo Molinos, late in the 1989 and 1991 breeding seasons, Saliva estimated over 200 and 130 pairs of terns, respectively, many of which were nesting and may have been failed breeders at some unknown colony.

Personnel from the University of Puerto Rico Department of Marine Sciences at La Parguera have reported roseate terns nesting on cays off La Parguera since at least 1985 (pers. comm. to Saliva). On these cays, they always nest in mixed colonies with sandwich terns. The number of pairs between 1989 and 1991 has remained relatively stable at about 200 to 300 pairs in two or three colonies (cays).

Virgin Islands - Philibosian and Yntema (1977) summarized the occurrence of the roseate tern in the West Indies as breeding in St. Thomas (where common terns also nest), St. John, occurring in

Anegada, and the BVI without evidence of breeding, and as accidental in St. Croix. Halewyn and Norton (1984) show about 2,000 pairs of roseates in 3 to 6 colony sites for 1981 in the USVI, plus 40 pairs in the BVI. However, the numbers have been less than 1,500 pairs in recent years.

Roseate terns nest in several colonies in the USVI and BVI, and Nisbet (1980) considered this area the stronghold of the Caribbean roseate terns. Beatty (cited by Nisbet 1980) reported breeding at Bank Island, St. Croix, and colonies of 200 birds on cliffs at Bivoni Bay and at Little Saba Cay, St. Thomas, from 1939 to 1940.

Nichols (cited by Nisbet 1980) recorded roseates from 17 small islets of St. Thomas and St. John, but he reported only one definite colony of 200 pairs on Cas Cay, and 15 pairs of common terns on Little Flat Cay. According to R. A. Dewey (*in litt.* to Nisbet 1980) roseate terns also nested on Shark, Saba, Dog, and Flat Cays in 1956, and on Saba in 1971.

Nisbet (1980) reported on roseate terns studied by R. Dewey from 1976 to 1979. During that time, no common terns were found in the Virgin Islands. Estimates of breeding population on eight known colonies were summarized by Nisbet (1980), suggesting a decrease from about 1,500 pairs in 1976 to 750 pairs in 1979.

There is very little published information on seabirds of the BVI. Nisbet (1980) notes that the 1976 Cambridge Ornithological Expedition reported up to 200 roseate terns feeding, but the only breeding colonies noted were 30 pairs on Guana Island, 20 pairs on Cooper Island and perhaps 10 pairs on Cockroach Island. Dewey (Nisbet 1980) reported that fishermen from the USVI had told him that roseates used to nest in large numbers in BVI, but have been reduced by egging which is legal in the BVI.

In 1980, over 1,000 roseate terns were observed on Leduck Cay, St. John, and some nests were found (Norton 1980). In 1987, about 50 pairs of Roseates were nesting on a small cay off Middle Caicos (Norton 1987). Roseate terns were found nesting at additional sites in the BVI at Round Rock, Watson Rock (near Great Tobago) and off the west point of Jost Van Dyke, and probably also near Ballast Bay, St. Kitts (Norton 1987).

In late July 1991, adult and young roseate terns were observed roosting and feeding near Mary Point, Water Lemon Cay, and Great Thatch Island on the north coast of St. John (USVI). These were probably birds dispersing from their breeding colonies in either the USVI or BVI.

Lesser Antilles - Halewyn and Norton (1984) showed roseates nesting on 9 or 10 islands in this group with a maximum of 50 pairs on Antigua and a total of less than 100 pairs known.

However, they failed to give specific values for Sombrero Cay, which may contain almost half of the Lesser Antillean birds.

Located at the northern extreme of the Lesser Antilles, Sombrero Cay supported a phosphate mining industry. Its seabird colonies were severely impacted by human and cat predation. Recently, Ogden *et al.* (1985) reported a total of about 30 to 40 pairs of roseate terns from the quarry, nesting in a grassy area and on "tailings." At St. Barthelemy, Pinchón (1963) stated that there was a colony of roseate terns on the islet of LeBoeuf.

Voous (1983) cites two breeding records, a colony of 10 pairs on Castle Rock, Baie de l'Embouchure (June 1973) and a colony of 14+ pairs on rocky islets near Green Key, north of Castle Rock (June 1974) in St. Maarten. There are no more recent breeding records and very few sight records, of which one is a recovery of a Massachusetts breeding bird.

Holland and Williams (1978) did not find roseate terns on Great Bird Island, but found about 50 pairs breeding in May at York Island, at the eastern end of Antigua in each year from 1973 to 1977. Danforth (1936) reported on several observations of roseate terns including July 25, 1933, and August 12, 1931, at Basseterre, St. Kitts, and at Friar's Bay and Salt Pond, on June 25, 1933. There were records from Nevis on June 29, 1935, and early August 1931, but there was no specific mention of breeding.

Noble (1916) stated that roseate terns were common on outlying islands near Guadeloupe, and were reported by the natives to breed on Les Saintes to the south, and on Tete Anglais to the north of Guadeloupe. Pinchón (cited by Nisbet 1980), did not list the species for these islands. Bond (1941) reported a small colony of roseate terns on a little island off the east coast of Dominica. He also reported a fairly large colony of "common terns" on a promontory at Grand Bay, but these were later shown to be roseates (Nisbet 1980). In 1987, about 50 roseates were counted in Pague Bay but it was not clear if they were nesting (Norton 1987).

Prys-Jones (1982) provided a detailed history of the status of roseate terns on Dominica. He noted that 19th century records attributed to Ober may have been erroneous for Ober saw roseates on Guadeloupe, but not definitely on Dominica. The earliest 20th century records are attributed to Verrill (in Bond 1941), who found them to occur not uncommonly along the leeward coast between May and August 1904, with breeding pairs depositing their eggs in rocky crevices. They were subsequently found nesting in May 1934 on an islet off the windward coast by Agar (Bond 1941). Agar also collected a specimen in July 1949 in Grand Bay (Bond 1950).

Pinchón (cited in Nisbet 1980) reported a small colony of roseate terns nesting each year on the islets Poirier and Touaou in the Baie des Anglais in Martinique, and in Saint Lucia, a juvenile (young of the year) and several adult roseate terns were seen fishing on the Castries harbor in August 1991, suggesting a possible breeding site nearby (Saliva and Pierce, pers. obs.).

Wells (cited in Nisbet 1980) stated that roseate terns formerly bred in large numbers at Jacka-dan Island (Isle Jacques Adams) near Hillsborough, Carriacou, in the Grenadines but had recently moved to Frigate Island and Rose Rock. He also reported that roseate terns were numerous on Grenada frequenting all the bays around the coast. He found nests at Lee Rocks in May. Devas (1942) considered them common breeders but provided no details.

Danforth (1936) found a large colony of roseate terns nesting with laughing gulls on Glover's Island on July 31, 1935. Devas (1942) reported breeding roseate terns on Green Island.

Trinidad and Tobago - Bond (1970) reported that a colony of roseates was discovered at Tobago in 1966 on a rocky slope opposite the St. Giles Islets. Dinsmore (1972) saw 30 to 40 roseate terns on April 22 on the north side of Little Tobago, and in late May 1966, he located their nesting colony on the northeast tip of Tobago. About 200 adults were present. The colony was still active in 1967 (Dinsmore 1972). In mid-April 1978, French (*in litt.*) found 40 roseates in southwestern Tobago looking as if breeding was imminent. He estimated the population for the Tobago coast at 500 to 1,000 birds, but Halewyn and Norton (1984) give a value of 200 pairs.

Southern Caribbean - In the Southern Caribbean, roseate terns are known to nest on the Venezuelan Islands and on the Netherlands Antilles. Halewyn and Norton (1984) estimated about 140 pairs on Aruba, Curacao, Bonaire, and two Venezuelan island groups. Phelps and Phelps (1955) found roseate terns nesting on five islands in this archipelago (Noronqui, Buchiyaco, islet northeast of Nordisqui, Los Canquises, and Sarqui) between 1954 and 1958. LeCroy (1976) spent 6 weeks on Los Roques in 1973 studying nesting terns. She heard a pair of roseate terns daily on Fransisqui but never found their nest. She surmised from their bill color that these might have completed nesting.

Van de Werf *et al.* (1958) saw large numbers of roseates on Ave de Sotavento and Isla de Sterna on May 20-21, 1956, and found three nests on Isla de Bubí on May 18, 1956.

Voous (1983) reported that the roseates are summer visitors to the Netherland Antilles from mid-April to early August. The first breeding record was by Hartert in 1892, with no subsequent record until 1961 when roseates nested in the same place. At present they nest at one locality in Aruba (reef islands off

San Nicolas Harbor), two locations in Curacao (Jan Thiel, Spaanse Water) and two locations in Bonaire (Pekelmeer area, Goto). Voous (1983) remarked that the roseate tern "probably nests in the islands... each year, but because of similarity with Common Tern [it is] often overlooked." They nest there with sandwich and common terns, and the largest colony was 20 to 40 pairs at Jan Thiel. Voous (1957) reported that between 1951 and 1961, roseates had nested on Aruba (one locality), Curacao (2 places), and Bonaire (2 places). The largest colony was 40 pairs in Curacao in 1955.

Halewyn (1987) summarized the nesting populations of common and roseate terns reported from St. Nicolas Cay, Aruba, and noted that both species were present in most years. He reported ghost crabs, hermit crabs, and ants potentially damaging tern eggs.

Central American Coast - Udvardy (1973) reported a roseate tern colony in 1970 and 1971 at Sandy Cay, west-southwest of Utila Island, about 34 km off the north coast of Honduras. There were 10 nests and about a dozen chicks fledged. The birds were reported to have nested there for many years. The colony was egged annually. This represents the first published middle American breeding record in over 100 years when terns were found nesting off the coast of Belize (Salvin 1864).

However, unknown to Udvardy, Pelzl (1969) found two roseate tern colonies off Belize near West Snake Cay and Wild Cane Cay, and found 21 and 13 nests, respectively, with an additional 24 and 17 fledglings. The birds nested on coral rubble and among the grasses. Salvin (cited by Nisbet 1980) had observed three to five roseate terns on Grassy Cay in the Turneffe Islands off Belize around 1866, and concluded they were preparing to lay.

Yucatán - Paynter (1955) had no definite records of roseate terns for the Yucatán Peninsula, although he had seen some unidentified medium-sized terns. Fosberg (cited by Nisbet 1980) saw small terns with black bills nesting with royal terns on East Desterrada Islet, Arrecife Alacrán on July 5, 1961. He thought they were common terns, but they were more likely roseate terns.

Reasons for the Suspected Decline in Numbers

In the Caribbean, only the colonies in Puerto Rico (Culebra and La Parguera) and the USVI have been monitored throughout the entire breeding season to get an idea of reproductive success. However, even within these relatively close colonies there exists great variability in reproductive success. In Culebra, the number of fledglings per nest appears to be very low (less than 10 percent for the past 6 years), compared to over 45 percent for the Parguera colonies within the last 2 years (Saliva and

Shealer, unpub. data). As mentioned previously, behavioral differences are found between these two major nesting areas, namely within-season intercolony movement.

Although the cause remains unknown, it seems as if predation may be an important factor determining the differences in behavior and reproductive success. At Culebra, roseate terns confront 14 potential predators (Saliva and Burger 1989, Shealer and Burger 1992). Since fewer sheltered places for chicks are found at Culebra, they are more vulnerable to predators. The cays of La Parguera provide plenty of sheltered places for chicks to hide. Also, the major predators (hawks, laughing gulls, land crabs, and hermit crabs) are infrequent or absent from some of these cays. Halewyn and Norton (1984) mention egging, human disturbance, rat predation, and netting of adults in Guyana as the main factors affecting the Caribbean roseate terns.

Human Disturbance - Human disturbance poses a major threat to seabird colonies. Types of human disturbance include trampling of nests, flushing of adults and chicks, and collecting of eggs. In the Caribbean, egging has a long history and continues to be a major problem not only for roseate terns, but also for other seabirds (Ogden *et al*. 1985). Eggers have eliminated large colonies in the Virgin Islands (Philibosian in litt.). Egging is an annual event on the Central American coast as well (Udvardy 1973). Haynes (1987) provided an elaborate account of egging of Jamaica's terns. Halewyn (1987) noted that Aruba's terns were subject to egging even though it was illegal, and over 200 eggs were confiscated by police in 1977. Sprunt (1984) noted that although commercial egging has been stopped in the Bahamas, eggs and nestlings were still taken for food.

In Culebra, egging had been a tradition until the U.S. Navy transferred their land (including seabird nesting grounds) in Culebra to the Service. Since then, egging has diminished and people are more reluctant to collect eggs, fearing to be arrested by Service agents. Nevertheless, roseate tern colony site abandonment suggests that egging may still be occurring at Culebra.

Egging may be the greatest threat to nesting terns, and it is critical to document the extent of egging, particularly in colonies under United States jurisdiction. In some jurisdictions egging is legal. Such poaching should be either eliminated or regulated. Chicks and breeding adults are also captured for food (Ogden 1985), but the impact of this appears less impressive than the taking of eggs.

Predation - Predation is one of the major natural forces with which colonial nesting seabirds must contend. Predators can be placed into four major categories: crabs, ants, birds, and mammals.

Crabs: Land crabs (*Geocarcinus* spp.), hermit crabs, and sally lightfoot crabs are numerous on the cays around Culebra. In 1983, Burger and Gochfeld (pers. comm.) noted sally lightfoot crabs climbing up onto Molinos to retrieve dead chicks near the water line. Burger and Gochfeld (unpub. data) noted nine instances of *Geocarcinus* predation on roseate tern chicks on Cayo Ratón, Culebra, and they attributed the disappearance of most roseate tern chicks to this crab species. Hermit crabs also prey on nestling doves (Burger, unpub. obs.) and on sooty tern chicks (Saliva, unpub. obs.) on islands were roseate terns also nest; therefore, they may opportunistically prey on roseate chicks as well. Crab control on traditional nesting islands should be studied as a possible management strategy.

Ants: Fire ants (*Solenopsis* spp.) may enter a pipping egg and bite the hatching chick sufficiently to kill it (Spendelow 1982). Large infestations may result in death of chicks as well. Norton (1986) documented such attacks by ants on pipping gull-billed terns in Anegada. Since the time from pipping to hatching is 24 hours, it would be possible for ants to completely eliminate successful hatching. Ant control on traditional nesting islands should be studied as a possible management strategy.

Birds: Avian predation is potentially important in reducing roseate tern productivity. Predators can take eggs or young, or even adults. Frigatebirds, cattle egrets, laughing gulls, ruddy turnstones, and red-tailed hawks are the major avian predators on terns in the Caribbean (Robertson 1964, Norton 1986, Saliva and Burger 1989). Migrating peregrine falcons can be important predators on adults, since a single peregrine that remains near a tern colony for an extended time may kill a substantial number of birds, or cause nest abandonment.

Mammals: The main mammalian predator of roseate terns in the Caribbean is the rat (probably *Rattus rattus*). The introduced mongoose (*Herpestes auropunctatus*) is a major predator on ground-nesting birds in many Caribbean islands, and would certainly restrict terns to mongoose-free islands (Ogden *et al.* 1985). Similarly, feral cats and dogs would be important and should be eliminated from any nesting island. Cat predation on seabirds was known more than a century ago (Ogden *et al.* 1985). Saliva (pers. obs.) has noted extensive cat predation on young and adult sooty terns (*S. fuscata*) at Culebra Island. Domestic ungulates could interfere with nesting seabirds, either by trampling nests, destroying vegetation, or even eating eggs or chicks (pigs and goats).

Habitat Modification - Nesting seabirds require appropriate nesting substrate and vegetation, proximity to food, absence of predators and lack of human disturbance. Habitat change can be wrought by natural conditions such as erosion of sandy islets or overgrowth of vegetation. Some islands, such as in southwestern

Puerto Rico, can be severely affected and changed by high tides or strong waves. Human impact on the habitat of roseate terns has been considerable, like at Key West, Florida. In some other parts, such as the Dry Tortugas and Culebra, military ownership of the cays can provide some protection. On the other hand, military ownership can be detrimental to nesting terns when their habitat is used for military practices (Kepler and Kepler 1978).

Pollution - Hays and Risebrough (1972) suggested that congenital defects in roseate terns were related to organochlorine contamination, yet Custer *et al.* (1983) found low levels of organochlorines in roseate tern eggs in 1981. We have no data on the role of pollution in the Caribbean population. Data from feathers of 10 adult roseate terns from Culebra in 1989 had mercury levels of 700 to 3000 parts per billion (Burger and Gochfeld, unpub. data). These levels are lower than those associated with disease or birth defects on terns, but it would be important to document pollutant levels, particularly for pesticides which are widely used in the Caribbean Islands.

Oil spills and slicks might potentially affect roseate terns. Several seabird species in oiled condition are reported in Puerto Rico and the USVI, and some roseate terns with varying degrees of oiling have been observed (Shealer, pers. comm.).

PART II. RECOVERY

A. Recovery Objective

The objective of this recovery plan is to provide guidance for reversing the decline of populations of the Caribbean roseate tern, *Sterna dougallii*, and restoring the species to a stable, secure, and self-sustaining status, thereby permitting it to be removed from the Federal list of threatened and endangered species.

The Caribbean roseate tern may be considered for delisting when:

1. Conservation programs to maintain, protect, and enhance populations of this species have been implemented in coordination with countries in the Caribbean where roseate tern populations occur.

2. Populations of roseate terns in the Caribbean remain stable (i.e., without significant decrease in number of breeding birds) or increasing for at least 5 consecutive years.

B. Narrative Outline

1. Protect and manage roseate tern populations and their habitat to prevent further population decline and increase productivity. A stable population of roseate terns can only be obtained when breeding colonies are appropriately protected, and the habitat is enhanced for maximum breeding success.

   1.1 Protect breeding sites. The protection of currently known breeding areas should be given the highest priority.

      1.11 Develop protection programs at existing breeding areas. Conservation programs should be developed to encourage the protection of roseate tern colonies. Posting of breeding areas, regular patrolling of these areas during the breeding season, limiting recreational use, and techniques for predator control are examples of programs necessary to achieve protection of breeding terns. At present, programs to protect and manage roseate tern colonies in the Caribbean, other than those under the jurisdiction of the United States, are not known. The recovery of this species will depend on the development of these programs, coordinating efforts with all the different countries involved.

      1.12 Determine ownership of nesting areas. Ownership of sites used by roseate terns should be determined to effect protective measures. Landowners in these areas should be appraised of the importance of their land for breeding terns, and appropriate guidance should be provided to them as to how to avoid disturbance to nesting terns.

      1.13 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 general conservation values as well as on the importance of protecting this species and adhering to Federal or local regulations. One step could be the preparation of an illustrated brochure to be distributed to local groups, schools, and organizations. Permitting and funding agencies should be made aware of the threatened status of Caribbean roseate terns, the pertinent laws involving this species, and the responsibilities of those agencies to avoid affecting it.

1.2 Implement management strategies at breeding colonies. Management of breeding habitat may be necessary to increase tern reproductive success, particularly when coupled with predator control programs.

1.21 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 vegetation cover. However, the terns seem to like some type of shelter near the nests. Therefore, vegetation encroachment in nesting areas should be controlled by removing excessive vegetation cover.

1.22 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) should be provided were 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.

1.23 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.

1.24 Predator control. 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 to prevent or deter predators should be implemented.

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

1.242 Control mammalian predators. Remoteness of roseate tern nesting colonies provides protection to the terns against mammals. However, some cases have been reported of roseate terns nesting on the mainland in areas where rats, cats, or dogs may reach them. Trapping, removal, and poisoning of these animals are some of the protective measures necessary to prevent loss of terns to these predators.

1.243 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.

1.244 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 incidence of these insects may be necessary.

1.245 Prevent human disturbance and predation. Poaching of eggs is the most important human factor affecting roseate terns. In some areas egging is legal, but there is no control on the number of eggs collected. The effect of this disturbance on the terns' reproductive success is not known. In other areas egging is illegal, but the governments do not have the facilities or manpower to patrol the tern colonies. Patrolling during the early stages of incubation, coupled with education of nearby commmunities may be the best tools to handle this problem.

2. Continue to gather information on the distribution and abundance of roseate terns in the Caribbean. Additional information concerning the distribution and abundance of the species will affect future management decisions and the establishment of recovery priorities.

2.1 Continue to search for new populations. Given the intercolony movement reported for some roseate tern populations in the Caribbean, it is possible that new colonies may be formed each year.

2.11 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 population sites should be identified and searched to determine their suitability for future recovery actions. Coordination with agencies, individuals, and organizations would be necessary to achieve this goal.

2.12 Conduct annual surveys of colony sites to determine the number of nesting roseate terns. A single reporting scheme would be desirable to monitor the overall population trends for the Caribbean basin. Particularly important is to maintain all estimates as similar as possible. Surveys should include estimates of nests or nesting pairs, and estimates of adult and young terns present at the colony. At minimum, a single coordinated survey of all breeding colonies should be repeated every 5 to 10 years.

2.2 Continue current color banding efforts, and initiate color banding programs where absent. Color banding would help assess intercolony movement of adult and young roseate terns within a breeding season, or from year to year. Not only would it help determine intercolony movement, but possibly the identification of wintering areas as well. Coordination with agencies and individuals involved in this activity would be necessary.

3. Conduct studies of the breeding biology and reproductive success of roseate terns in the Caribbean. A subgroup of roseate tern colonies under United States jurisdiction should be selected for more intensive studies including food availability, hatching success, fledging success, causes of

mortality, interspecific interactions, and impacts of contaminants on breeding terns.

3.1 Determine food availability. Where possible, food used 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. Where roseate terns are feeding over shoals of fish, it would be desirable to collect samples of fish. A study of fish availability in the vicinity of colonies using an echo-sounder would be useful.

3.2 Determine hatching and fledging success. Clutch size should be determined to assess hatching and fledging success. The number of eggs hatched, as well as the number of chicks surviving to the fledging stage, should be monitored throughout the breeding season.

3.3 Determine causes of mortality. For each colony, the causes of reproductive failure should be documented. After determination of the causes of mortality, colonies which can be protected should be identified, and a colony-specific plan should be drawn up to develop protective measures which can be implemented effectively.

3.4 Evaluate interspecific interactions. There is basically no information on possible competition for nest space between roseate terns and other seabirds that use the same breeding areas. Particularly important is to determine the order of species arrival at the breeding areas, at what point roseate tern nesting habitat may be usurped, and which habitat characteristics the intruder species select that may affect subsequent utilization by roseate terns.

3.5 Evaluate impact of contaminants on roseate terns. Determination of toxicant levels in abandoned eggs, dying chicks, feather samples, and fish samples would be useful to evaluate the contribution of chemical contaminants to reproductive failure.

4. Determine post-breeding dispersal and wintering grounds.

4.1 Assess post-breeding dispersal of adult and young roseate terns. A Caribbean-wide survey of non-breeding roseate terns will be useful to supplement anecdotal reports in the literature. Where terns are sighted, species identification should be ascertained, and whenever possible, bill coloration and color band combinations, if present, should be documented.

4.2 Determine wintering areas used by roseate terns. Currently, wintering areas used by Caribbean roseate terns are not known. Possibly they join roseates from the northeastern population and move to areas near northern South America or other parts of the Caribbean, perhaps even staying at sea. There are no reports of roseate terns wintering near Puerto Rico or the USVI. Given that mortality at the wintering areas may be a significant factor causing the decline of this species, it is of prime importance that the wintering areas be determined. Cooperation and coordination among the different countries where roseate terns winter is crucial for the establishment of management techniques to reduce or eliminate risks to this species during the winter migration.

5. 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.

5.1 Determine number of individuals and populations necessary to ensure species' stability, security, and self-perpetuation. Reproductive studies, together with the relative success of population protection measures, will allow more precise and realistic recovery goals to be established and met.

5.2 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.

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PART III. IMPLEMENTATION SCHEDULE

Priorities in Column 1 of the following Implementation Schedule are assigned as follows:

Priority 1 - An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

Priority 2 - An action that must be taken to prevent a significant decline in the species population/habitat quality or some other significant negative impact short of extinction.

Priority 3 - All other actions necessary to provide for full recovery of the species.

IMPLEMENTATION SCHEDULE

Priority #	Task #	Task Description	Task Duration (Yrs)	Responsible Party: FWS Region	Responsible Party: FWS Division	Responsible Party: Other	Cost Estimates ($K): FY 1	FY 2	FY 3	Comments
1	1.11	Develop protection programs.	continuous	4	TE CINWR LE	PRDNR DPNR	3			
1	1.22	Provide nest sites where needed.	2-4	4	TE CINWR	PRDNR DPNR	2	1	1	
1	1.24	Predator control	annual	4	TE CINWR	PRDNR DPNR NBS	2	2	1	
1	2.12	Conduct surveys of colony sites.	annual	4	TE CINWR	PRDNR DPNR FAS	5	4	4	
1	2.2	Continue current and initiate color banding programs.	annual	4	TE CINWR	PRDNR DPNR FAS NBS	5.5	4.5	4.5	
1	3.2	Determine hatching and fledging success.	3-4	4	TE	NBS	1	2	2	Only at some colonies.
1	3.3	Determine causes of mortality.	3-4	4	TE	NBS	1	2	2	Only at some colonies.

IMPLEMENTATION SCHEDULE

Priority #	Task #	Task Description	Task Duration (Yrs)	Responsible Party			Cost Estimates ($K)			Comments
				FWS Region	FWS Division	Other	FY 1	FY 2	FY 3	
1	4.2	Determine wintering grounds.	4-6	4	TE	GOV NBS	12	10	10	
2	1.12	Determine ownership of nesting areas.	2-4	4	TE	GOV NBS	2	1		
2	1.21	Manipulation of vegetation.	annual	4	TE CINWR	PRDNR DPNR NBS	2	2	2	
2	2.11	Identify and evaluate potential breeding colony sites.	2-4	4	TE CINWR	PRDNR DPNR NBS	4	3	3	
2	3.4	Evaluate interspecific interactions.	3-5	4	TE	NBS	3	3	3	
2	3.5	Evaluate impact of contaminants.	annual	4	TE TS	PRDNR DPNR	4	4	4	
2	4.1	Assess post-breeding dispersal of adult and young.	3-4	4	FWE	NBS	10	10	10	

IMPLEMENTATION SCHEDULE

Priority #	Task #	Task Description	Task Duration (Yrs)	Responsible Party			Cost Estimates ($K)			Comments
				FWS Region	FWS Division	Other	FY 1	FY 2	FY 3	
2	5.1	Determine number of individuals and populations necessary to ensure species' stability, security and self-perpetuation.	ongoing	4	TE					
2	5.2	Determine what additional actions are needed to achieve recovery objectives.	ongoing	4	TE					
3	1.23	Promote nesting at former colony sites.	2-3	4	TE CINWR	NBS	4	4	4	
3	3.1	Determine food availability.	3-4	4	TE	NBS	5	5	5	

LIST OF ABBREVIATIONS

TE - U.S. Fish and Wildlife Service, Endangered Species Division
CINWR - U.S. Fish and Wildlife Service, Caribbean Islands National Wildlife Refuges
TS - U.S. Fish and Wildlife Service, Technical Services Division
LE - U.S. Fish and Wildlife Service, Law Enforcement Division

IMPLEMENTATION SCHEDULE

Prior-ity #	Task #	Task Description	Task Duration (Yrs)	Responsible Party			Cost Estimates ($K)			Comments
				FWS Region	FWS Division	Other	FY 1	FY 2	FY 3	

LIST OF ABBREVIATIONS, Continued

PRDNR - Puerto Rico Department of Natural Resources
DPNR - U.S. Virgin Islands Department of Planning and Natural Resources
FAS - Florida Audubon Society
GOV - Government agencies outside the U.S. with jurisdiction on roseate tern colonies
NBS - National Biological Survey

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