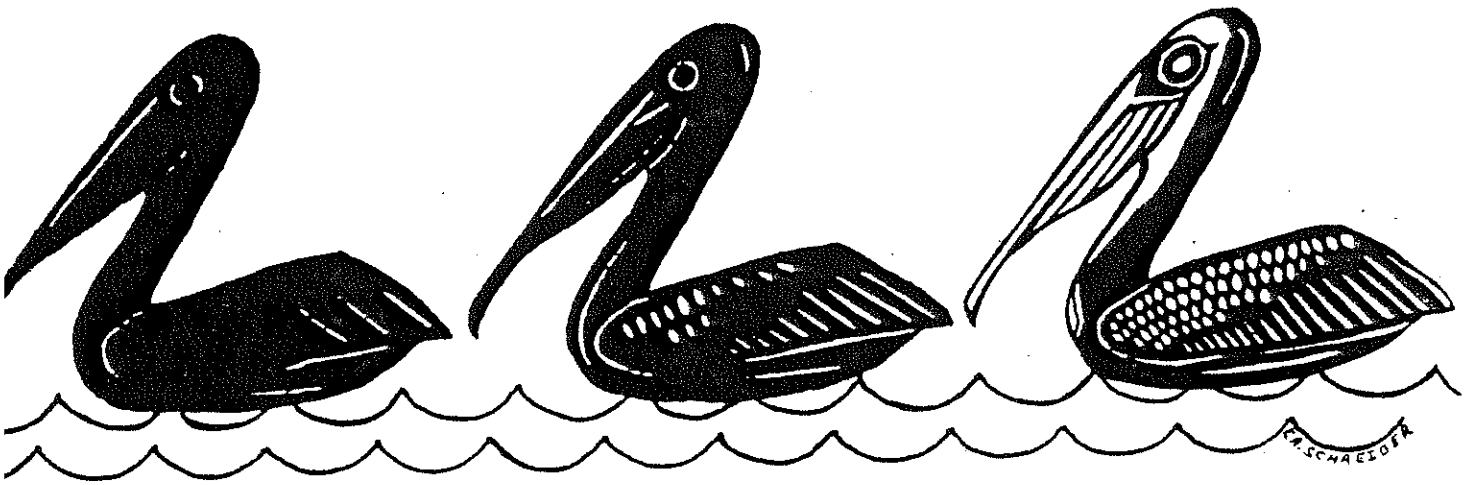
BROWN PELICAN RECOVERY PLAN

PUERTO RICO / U.S. VIRGIN ISLANDS POPULATION



RECOVERY PLAN
FOR THE
BROWN PELICAN, *PELICANUS OCCIDENTALIS OCCIDENTALIS*
IN PUERTO RICO AND THE U.S. VIRGIN ISLANDS

Prepared by

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Approved: _____
Regional Director

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DISCLAIMER

This is the completed Brown Pelican Recovery Plan for the Puerto Rico and U.S. Virgin Islands population. It has been approved by the U.S. Fish and Wildlife Service. It does not necessarily represent the official positions or approvals of cooperating agencies and does not necessarily represent the views of all individuals who played a role in preparing this plan. This plan is subject to modification as dictated by new findings, changes in species status, and completion of tasks described in the plan. Goals and objectives will be attained and funds expended contingent upon appropriations, priorities, and other constraints.

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EXECUTIVE SUMMARY

1. Point or condition when the species can be considered recovered?

The major objectives of the recovery process are to preserve brown pelican nesting, roosting, and feeding habitats, and to prevent loss of pelicans from contaminants and disease.

The decision to delist the U.S. Virgin Islands and Puerto Rico populations should be based on the following criteria: 1) a running 5 year mean population level of 2,300 individuals counted during January censuses throughout the coastal waters of the region, and 2) maintenance of a 5 year running average peak breeding population level of 350 pairs for these populations.

2. What must be done to reach recovery?

From 1980 through 1984, an average of 350 pairs nested and 2,300 individuals wintered in the Puerto Rico-U.S. Virgin Islands region. Maintenance of the population at this level (5 year running mean) must be attained to delist the pelican.

3. What specifically must be done to meet the needs of #2?

Important tasks for delisting the Puerto Rico-U.S. Virgin Islands population are habitat protection, monitoring the effects of contaminants and disease on pelicans, monitoring trends in productivity and abundance, public education, and reduction of human disturbance.

Essential to these recovery goals are the following:

a. Management of important habitat. Prime nesting, feeding, and roosting areas have been identified. Land management agencies should work to prevent destruction of important mangrove and coral reef communities and the discharge of undesirable wastes that may effect important feeding areas. The public should be educated that human disturbance is a major threat to pelican habitat suitability.

b. Monitoring of contaminants and diseases. Several sites with large concentrations of pelicans have been identified as potential problem areas and should be monitored regularly. Other areas should be monitored as needed and prior to delisting.

4. What management/maintenance needs have been identified to keep the species recovered?

Patrolling of important nesting, roosting, and feeding areas should continue. Selected sites should be monitored as needed for the presence of contaminants. Periodic censuses should be conducted to assess the population status of the pelican.

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PART I. INTRODUCTION

A. Background

The Caribbean brown pelican (*Pelecanus occidentalis occidentalis*) is the smallest of three subspecies occurring in the continental United States, Puerto Rico, and the U.S. Virgin Islands (Wetmore, 1945; Blake, 1977). *P. o. occidentalis* is similar to *P. o. carolinensis*, but breeding plumage is usually darker on the undersurface and nonbreeding plumage is usually darker above (Blake, 1977).

P. o. occidentalis occurs along the Caribbean coast and offshore islands of Central America, and south from Venezuela to northern Brazil at the mouth of the Amazon (Blake, 1977). In the Greater and Lesser Antilles, its range includes Cuba, Jamaica, Haiti, Dominican Republic, Puerto Rico, Virgin Islands, St. Martin, and Barbuda (AOU Checklist, 1957).

B. Distribution and Abundance

The range and population status of *P. o. occidentalis* in the Caribbean is poorly understood (Halewyn and Norton, 1984). The precise location of most colonies is unknown (Palmer, 1962; Voous, 1957) and its status in the Caribbean is essentially unrecorded (Schreiber and Risebrough, 1972). Based on Collazo's 1980 through

1983 study (1985), the population in the Puerto Rico-U.S. Virgin Islands area is estimated at 2,800 individuals and 350 to 400 breeding pairs.

There were no formal brown pelican research efforts in the Puerto Rico-U.S. Virgin Islands region until 1977. Scientific information consisted mostly of incidental observations made during research expeditions (Gundlach, 1878; Danforth, 1931; Biaggi, 1983; Pérez-Rivera, (ed.), 1979; Nichols, 1943; Robertson and Odgen, 1969; Philibosian and Yntema, 1977; and others).

Since the last century, the Caribbean brown pelican has been listed as a resident species in Puerto Rico (Gundlach, 1878; Cory, 1892). Gundlach (1878) reported pelicans breeding from February through September but did not indicate nesting site. Wetmore (1916) found pelicans to be common in the coastal regions of Puerto Rico but not on Mona and Desecheo Islands off Puerto Rico's western coast. Danforth (1931) reported 40 pairs nesting on Cayo Enrique, La Parguera, southwestern Puerto Rico. In the late 1950's, Erdman (1967) found nestlings in a colony on Cayo Frfos in Montalva Bay, east of La Parguera. Another breeding colony, on Cayo Turrumote in the same general area, is mentioned frequently in scientific literature (Pérez-Rivera, 1979). However, mislabeling of cays has been a problem when referring to historical nesting sites (B. S. Neely, USFWS, pers. comm.).

Danforth (1935, 1937) found no evidence of nesting activity on the islands of Culebra and Vieques. Sorrie (1975) reported Kepler's discovery of a nesting colony on Cayo Conejo off the southeastern coast of Vieques, on July 20, 1971. Schreiber, et al. (1981) monitored Vieques pelicans and the Cayo Conejo colony for 8 months in 1978. Pelican numbers on Vieques Island fluctuated from 200 to 250 and the population was considered healthy and reproducing. However, Schreiber recommended a long-term study of pelican ecology in this part of their range.

Puerto Rico's Department of Natural Resources (DNR) administrative report (1973) expressed concern that environmental pollutants were adversely affecting pelican populations on Puerto Rico. The report stated that more intensive studies were needed to properly evaluate the status of pelicans on the island. Pérez-Rivera (1979) recommended delisting it from the Federal Endangered Species List. Raffaele (1983) did not list the species as endangered and reported nesting colonies near La Parguera, Añasco Bay, and Cayo Conejo, Vieques.

Numbers of pelicans counted in Puerto Rico and adjacent islands under its jurisdiction in 10 aerial censuses conducted on a quarterly basis between October 1980 and December 1982 remained generally stable (mean=1,996). Seasonal variation ranged from a low of 1,466 (fall, 1980) to a high of 2,423 (winter, 1980). The timing of major

population fluctuation in Puerto Rico is directly related to the cessation and success of peak breeding populations in Puerto Rico and the U.S. Virgin Islands. Winter populations in Puerto Rico were 25 to 30 percent larger than summer populations. Post-season migratory movements of post-breeding adults and juveniles from the U.S. Virgin Islands were the major cause of observed fluctuations. Juveniles migrate to Puerto Rico and probably remain there until breeding age. There has not been any appreciable increase of the nesting population in Puerto Rico since 1977 (Dr. James W. Wiley, Biologist, USFWS, Palmer, Puerto Rico, personal communication), indicating that most wintering adults probably return to the U.S. Virgin Islands, and perhaps elsewhere, to breed.

Little information is available on pelicans for the U.S. Virgin Islands. Cory (1892) listed the species as resident. Danforth (1930) reported pelicans in every "suitable" locality around the islands but noted that numbers never exceeded 25 at any given locality. Beatty (1930) also reported pelicans as common residents that nested in February and March on St. Croix and Buck Island, St. Croix. In December, Danforth (1935) found no evidence of nesting activity in the St. Thomas-St. John area. Nichols (1943) collected eggs from a nesting colony on Dutch Cap Cay in mid-April 1943. Seaman (1958) reported pelicans nesting on Whistling Key off St. John and suggested that nesting probably also occurred on Mary Point, St. John. Robertson and Ogden (1969) discovered a "thriving" nesting colony off

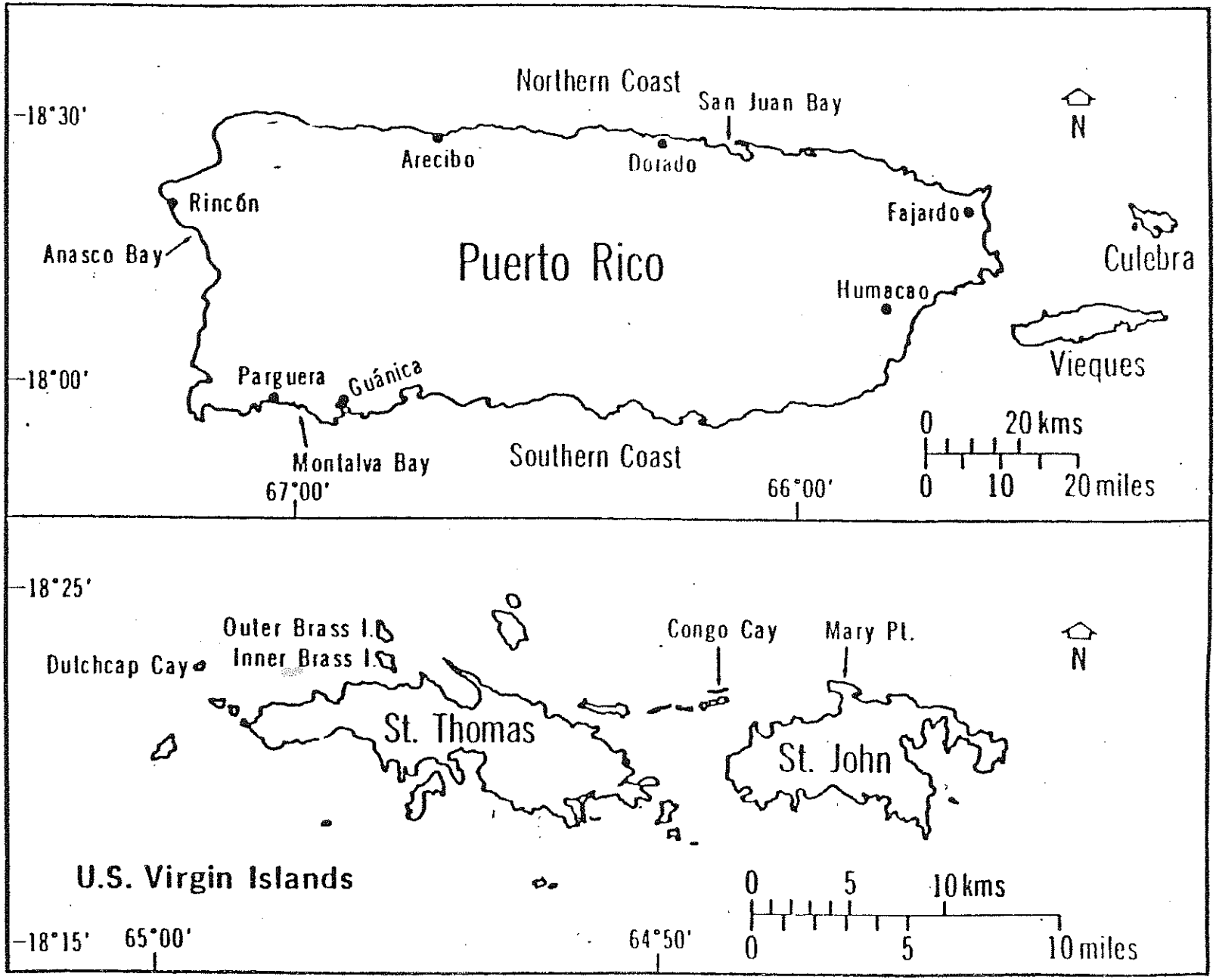
St. John, in September 1969, but did not specify the exact location. The colony (probably Congo Cay) consisted of at least 500 individuals, including juveniles and attending adults. In 1977, the Division of Fish and Wildlife (DFW) of the U.S. Virgin Islands Department of Conservation and Cultural Affairs (DCCA) began a 5-year project to monitor and assess the status of the species in the islands under U.S. jurisdiction (Agardy, 1982).

Philibosian and Yntema (1977) considered the pelican to be endangered. Halewyn and Norton (1984) believe that the U.S. Virgin Islands' pelican population has been stable for the last decade. Raffaele (1983) reported nesting colonies on St. Croix, Buck Island (St. Croix), Congo Cay, Dutch Cap Cay, Whistling Key, and Little Tobago but makes no mention of their status.

In the Puerto Rico-U.S. Virgin Island region, P. o. occidentalis breeds in nine well established sites (Collazo, 1985). Two of these are located in Añasco and Montalva Bays on the western and southwestern coasts of Puerto Rico, respectively (Figure 1). A third colony site in Puerto Rico is Cayo Conejo off the southeastern coast of Vieques Island (Figure 1). Nesting attempts have also occurred at Guánica Bay (1981), Aguadilla (1984), and Guanajibo, Mayaguez (1985).

Major breeding colonies in the U.S. Virgin Islands occur on Dutch Cap Cay off the northwestern coast of St. Thomas and Congo Cay north of

Figure 1. Map of Puerto Rico and the U. S. Virgin Islands showing important feeding and nesting localities.



St. John (Figure 1). Smaller breeding colonies occur on Mary Point, St. John and Whistling Key, about 400 meters to the west (Figure 1). Brown pelicans also nest on Buck Island northeast of St. Croix and on Green Cay (Green Cay National Wildlife Refuge, USFWS).

Productivity rates in the Puerto Rico-U.S. Virgin Islands region from 1980 to 1983 were in close agreement with those collected over long term studies in Florida and believed to come from a stable population (Schreiber, 1979). However, numbers of breeding pairs and young produced declined each year after 1980 (Collazo, 1985).

In an effort to make a comprehensive assessment on the status of the species, DNR, with the cooperation of DFW, embarked on a 3-year study (1980-83) to monitor breeding colonies, numbers, movements, habitat requirements, feeding ecology, and evaluate the presence of environmental contaminants in egg samples (Agardy, 1982; Collazo and Agardy, 1982; Collazo, 1985).

C. Natural History

Breeding Chronology and Nesting Success

Onset and duration of nesting seasons are highly variable depending on colony location. Colonies on the southwestern and western coasts of

Puerto Rico (Guánica, Montalva, and Añasco Bays) are usually active on a well-defined seasonal basis. Breeding activities begin between May and August and last through February. Congo Cay, Cayo Conejo, Whistling Key, Dutch Cap Cay, Buck Island (St. Croix), and Green Cay National Wildlife Refuge colonies are active during most or all of the year. Nesting peaks during September-November, depending on initiation of reproductive activities.

Nesting success in the Puerto Rico-U.S. Virgin Islands region from 1980 to 1983 was highest during 1980-81. The mean number of young produced per nesting attempt was 2.06 at Montalva Bay (n=33), 1.83 at Añasco Bay (n=18), 1.77 at Cayo Conejo (n=9), 1.16 at Congo Cay (n=137), and 1.62 at Dutch Cap Cay (n=53). Nesting success during the following two nesting seasons was lower at all Puerto Rico nesting sites (Collazo, 1985). Success rates ranged from 0.51 at Añasco Bay (n=43) in 1981-82 to 0.86 at Montalva Bay (n=54) in 1982-83. Nesting success rates for 1981-82 and 1982-83 on the U.S. Virgin Islands are not available but monitored nesting attempts suggested a declining trend relative to 1980. Regional nesting populations fluctuated from over 475 nesting pairs during fall in 1980 to approximately 350-400 in 1982. Estimates for 1984 were slightly over 200 nesting pairs at the peak nesting period.

Nesting Habitat

A general description of the environment and habitat of eight nesting colonies follows:

1) Añasco Bay: The colony is located along Tres Hermanos beach in a small tract of Casuarina equisetifolia, Terminalia catappa, and Coccus nicifera, covering about 1,875 sq m. The tract is bordered by coastal beach on the west and a small residential area is located about 0.5 km to the east. Pelicans nest in a row of eight large Casuarina trees (mean height-=28.5m) adjacent to the beach. Mean height of nest structures was 20.6 m above the ground (1980-83).

2) La Parguera: The colony is located on Cayo Frîos, a mangrove islet in Montalva Bay. Comprised of red mangrove, this islet covers an area of approximately 1,120 sq m. The distance to the nearest human habitation is 1.7 km. Other mangrove islets near Cayo Frîos are occasionally used by nesting pelicans. During the 1981-82 season, the breeding colony was located about 0.8 km east of Frîos Cay. This islet is larger in area (2,490 sq m) and closer to human habitation (1.2 km). A chain of mangrove islets lies along the eastern outer limits of Montalva Bay growing on the Romero Reef Barrier. The tenth islet in this chain east of Cayo Frîos was used during 1981-82, 1982-83, and 1984-85. In 1984-85, the adjacent "ninth" islet was used.

3) Guánica Bay: The nesting site is located on a small peninsula covered by fringe mangrove adjacent to a sugar mill pier in the innermost part of the bay. The tract of mangrove vegetation used for nesting covers 150 sq m and is located at the tip of the peninsula. Only three trees were actually used in 1981. Nests (17) were built at an average height of 8.2 m above the ground.

4) Cayo Conejo: Located off the southeastern tip of Vieques Island, this cay is about 1.2 km from Cerro Matías (U.S. Navy Observation Post). There is no easy access from the sea. It covers an area of approximately 38,000 sq m. Coccoloba uvifera is the tallest vegetation used for nesting. Average height of nests was 2.7 m above the ground. Nests built on Pithecellobium unguis-cati and Capparis flexuosa, which grows in a dense mat over the ground, were 1 m above the ground.

5) Dutch Cap Cay: Located 3.6 km northwest of Botany Bay, St. Thomas, this cay covers about 0.6 sq km. The vegetation is comprised of many native and pantropical weed species. Nesting concentrates on guapiratum trees (Guapira fragans) on the northeastern side of the cay. Mean height above the ground is 4.4 m. Each nesting tree supports an average of 2.4 nests. Clumps of Croton rigidus and Pithecellobium unguis-cati on the southeastern slopes of the cay were also used for nesting in 1980 and early 1981. Nests were built

0.5 m above the ground on clumps averaging 2.2 sq m. Introduced domestic goats (Capra hircus) inhabit the cay and significantly affect composition and distribution of the flora. Rats (Rattus rattus) also occur on the cay.

6) Congo Cay: This cay is located 4.8 km west of Mary Point, St. John. It is about 1.2 km long and 0.4 km wide. Vegetation is natural and has probably not been disturbed. Nesting occurs mostly along the northern cliffs. Capparis flexuosa, Guapira fragans, Ficus citrifolia, Coccoloba uvifera, Croton rigidus, and Busera simaruba are used for nesting. The average height of nests was 1.8 m above the ground.

7) Mary Point: The colony is on a mushroom-shaped peninsula located on the northern section of St. John, in a 1,100 sq m stand of forest. Tree species used for nesting include Busera simaruba, Guapira fragans, and Ficus citrifolia.

8) Whistling Key: Nesting occurs on the north side of this small island located about 400 m west of Mary Point. Nesting occurs on similar vegetation present on Mary Point.

Roosting Habitat

The following roosting habitats are consistently used by pelicans in the Greater Puerto Rican Bank region:

1) Mangrove: Brown pelicans in Puerto Rico use fringe mangrove, mostly red mangrove (Rhizophora mangle), bordering protected bays and coves along the coastline and overwash stands on islets. Mangrove forests in estuarine areas are also used.

2) Australian beefwood trees: Casuarina equisetifolia trees are used as roosting sites at Añasco Bay on the western coast, Hatillo, Arecibo Bay, Dorado, and San Juan Bay on the northern coast.

3) Rocky shores: Rocky shores surrounding many offshore cays in this region are used for loafing and roosting. Cays that are consistently used are Dutch Cap, Inner and Outer Brass, and Congo. In Puerto Rico, Cayo Molino (Culebra) is also used frequently. Coral rubble is used in localities such as La Parguera and Punta Petrona, along the southern coast.

4) Sandy beaches: Roosting and loafing occurs on sandy beaches along the western coast of Puerto Rico at the mouth of the Río Grande de Añasco and on the banks of West Shore Key within San Juan Bay. In the U.S. Virgin Islands, pelicans consistently use the northern beach of Lovango Cay, south of Congo Cay.

5) Artificial structures: These structures include boat houses, piers, pilings, docks, and harbor markers. Most are associated with the maritime traffic at Torrecillas Lagoon, San Juan Bay, Jobos Bay, Yabucoa Bay, Guánica Bay, Guayanilla Bay, Arecibo Bay, La Parguera, Mayaguez (CODREMAR [Corporation for the Development of Marine Resources]) and the "crash boats" beach area in Aguadilla.

6) Littoral and deciduous woodland: These habitat types occur on Dutch Cap and Congo Cays and vary in extension and plant species composition. Plant species found in this habitat type and used by pelicans include Ficus citrifolia, Bursera simaruba, Guapira fragans, Capparis flexuosa, Croton rigidus, Coccoloba uvifera, and Pithecellobium unguis-cati. Pelicans also roost on evergreen littoral vegetation associated with exposed rock (cliffs, rock boulders, and outcrops).

Food and Feeding Habits

In general, the diet of pelicans is rather uniform throughout Puerto Rico and the U.S. Virgin Islands (Collazo, 1985). Pelicans feed primarily on blue fry (Jenkinsia lamprotaenia), sharkmouth fry (Anchoa lyolepis), sprat (Harengula sp.), whalebone anchovy (Cetengraulis edentulus), and Tilapia mossambica. With the possible exception of Tilapia, adult and juvenile pelicans appear to feed on fish of similar size as those being fed to nestlings. Overall, blue and sharkmouth fry accounted for about 60 percent of the sampled biomass.

Pelicans feed opportunistically along the coastal waters of Puerto Rico and the U.S. Virgin Islands, regardless of calmness or depth. Preferred feeding areas occur around root systems of fringe and overwash mangroves, water protected by coral reef barriers, and bays, estuaries, and lagoons.

The relative importance of feeding areas was determined by frequency and numbers of pelicans observed (Collazo, 1985). Areas were classified as 1) important (50 or more pelicans nearly always present roosting, nesting, or feeding), 2) moderately important (few to many pelicans often present but fluctuating seasonally or irregularly), and 3) occasionally important (few to many pelicans present, depending on occurrence of large schools of fish). Appendix A lists and describes "moderately important" and "occasionally important" feeding areas.

Important Feeding Areas

1) San Juan Bay: This harbor handles the majority of Puerto Rico's maritime traffic and has about 739 ha of open water. Feeding pelicans

concentrate in Bay View, the southwest section of the bay which accounts for 9 percent of the Bay's water surface area. Food fish are available year-round. Pelicans feed in lower numbers throughout the rest of the bay, particularly near roosting areas at the Coast Guard Headquarters and Martin Peña canal.

2) Dorado Lagoons: Pelicans concentrated on Mata Redonda Lagoon at Dorado Beach Hotel and on two artificial ponds on the Cerromar Hotel grounds. Water levels are controlled by pumps. The lagoon and ponds are stocked with Tilapia mossambica and Lepomis sp.

3) Humacao Lagoons: These lagoons are located on an alluvial plain in southeastern Puerto Rico. The lagoons were once drained for agricultural purposes but are now re-flooded due to the elimination of water pumping. Feeding pelicans concentrate on Santa Teresa Lagoon (76.6 ha open water) and on Mandri Lagoons (191.9 ha open water). Depths in these lagoons range from 0.5 to 1.5 m.

4) U.S. Virgin Islands: Collectively, the U.S. Virgin Islands support the largest breeding population of pelicans in the Puerto Rico-U.S. Virgin Islands region. Specific feeding areas are selected opportunistically. Fish schools are consistently present at or near Congo, Inner and Outer Brass Cays.

5) La Parguera: This area contains the broadest shelf zone found in Puerto Rico, extending seaward as far as 10 km in some sections (Morelock et al., 1977). Over 50 cays and islets are found within this area, most supporting mangrove stands (Martínez et al., 1979). Depths range from 15 to 18 m between the shore and the edge of the shelf (Martínez et al., 1979). Feeding pelicans concentrate along the root systems of fringe and overwash mangroves, and around coraline formations in the area.

Recovery Actions

In 1970, the brown pelican (Pelecanus occidentalis) was listed as endangered under the Endangered Species Conservation Act of 1969. This Act was replaced in 1973 by the Endangered Species Act, increasing federal protection for listed species. Pelicans are also protected by the U.S. Migratory Bird Treaty Act. The Caribbean brown pelican was included in the list of protected species by the Commonwealth of Puerto Rico in 1973. The taking and harassment of pelicans is prohibited by Law 70 of 1976 and the Regulations to Govern the Management of Threatened and Endangered species of the Commonwealth of Puerto Rico of 1985 in Puerto Rico and Title 12 of the U.S. Virgin Islands Code in the U.S. Virgin Islands.

D. Potential Threats

Although research and conservation efforts in the continental United States were extensive, little attention was given to Caribbean populations (Schreiber and Risebrough, 1972). Concerned about the possibility that environmental contaminants were affecting Caribbean populations, the Department of Natural Resources of Puerto Rico listed the pelican as an endangered species (Department of Natural Resources Report, 1973).

It was not known whether factors similar to those affecting continental populations affected pelicans in Puerto Rico and the U.S. Virgin Islands. Chlorinated pesticides, particularly DDE and other DDT metabolites, were determined to be the major cause of endangerment for continental populations (Anderson and Hickey, 1970; Blus et al., 1971; Schreiber and Risebrough, 1972; Blus et al, 1974). Other factors found to adversely affect reproductive success of continental brown pelicans were frequency of human disturbance, disease, inclement weather, heavy infestation of ticks, and unpredictable food availability (Blus, 1970; King and Blankenship, 1977a and 1977b; Schreiber, 1979; Anderson et al., 1982; Anderson and Gress, 1983). None of these latter factors, though, equaled the devastating effects of organochlorine pesticides which lowered continental populations to precariously low levels in many areas of its northern range, except in Florida, where the population has been stable for the last 30 years (Schreiber, 1980).

Halweyn and Norton (1984) suggested that the following activities adversely impact pelicans in the Caribbean:

1) poaching of eggs, young, and adults;
2) pelicans deliberately caught on fishing hooks or incidentally entangled in fishing gear;
3) pelicans easily disturbed by human intruders approaching colonies on land or by water;
4) loss or degredation of habitat (i.e., mangrove forests); and,
5) possibly, pesticides.

Available information on pesticides suggested that organochlorine contaminant levels in biological samples were not high enough to be considered hazardous to pelicans in Puerto Rico and the U.S. Virgin Islands (Reimold, 1975). However, unusual pelican die-offs occurred at Dorado and Humacao Lagoons in 1982 killing seven percent of that year's mean population count in Puerto Rico.

Part II. RECOVERY

A. Recovery Objective

The general recovery objective for the brown pelican in the Puerto Rico-U.S. Virgin Islands region is to maintain a healthy population that would lead to its delisting from the endangered species list. A

minimum viable population level for this species can not be estimated with existing data. Data requirements include estimates of genetic variance and population dynamics parameters (e.g., survival and mortality rates) (Franklin, 1980; Henny, 1972; Reed et al., 1986; Shaffer, 1981; Soulé, 1980). In most cases, estimates are heuristic (Soulé, 1980). A population of 500 individuals has been suggested as one capable of maintaining genetic heterozygocity (Franklin, 1980). Brown pelicans in this region far exceed this minimum population level.

From 1980 to 1983, the brown pelican population in this region was well within the proposed levels necessary to maintain a viable population (Anderson and Gress, 1983; Collazo, 1985; Schreiber, 1979). Monitoring for at least 6-8 years is necessary to adequately assess the status of this species (Schreiber and Schreiber, 1983). The criteria to delist the species in this region are that the brown pelican population maintain a long-term (5 years) observed mean level of: 1) 2,300 individuals during winter, and 2) 350 breeding pairs at the peak of the breeding season. These levels were maintained during the years 1980 through 1984 (Collazo, 1985). A 5 year running mean was selected to assess long-term data because: 1) it is simple, 2) it "smooths" the sharp fluctuations expected for pelican populations in a tropical environment (Collazo and Klaas, in preparation), and 3) it will provide at least 6 running mean data points to assess the long-term trend of the population. Overall population trend and local

trends (i.e., Puerto Rico vs. U.S. Virgin Islands or between breeding colonies) will be assessed following procedures suggested by Geissler (1984).

B. Step-down Outline

1. Monitor population numbers and reproductive performance
    11. Conduct annual population surveys
    12. Monitor reproductive performance
2. Monitor harmful environmental conditions
    21. Monitor effects of hurricanes on breeding population
    22. Monitor presence of contaminants and disease
        221. Assess environmental contaminants present in egg samples
        222. Detect presence of oil on eggs
        223. Monitor key areas having large pelican aggregations for possible die-offs from disease or environmental contaminants.
3. Protect and enhance population
    31. Place educational signs at all known breeding and traditional roosting sites
    32. Monitor and reduce human disturbance and encroachment
        321. Monitor frequency of human disturbance at nesting sites
        322. Assess pelican habitat availability and structural suitability in areas proposed for development.

323. Zone or regulate human developments at important feeding areas

4. Environmental public education

41. Present public talks to coastline communities

42. Prepare information pamphlets and posters

C. Narrative

Brown pelicans are a long-lived species. Meaningful data on population and reproductive performance trends are obtained by collecting data continuously for a period of at least 8 years. Baseline data for the Puerto Rico-U.S. Virgin Islands region is available for 3 years (1980-1983). Monitoring efforts conducted from 1986 until 1990 will provide desired cumulative data.

1. Monitor population numbers and reproductive performance

11. Conduct annual population surveys

Surveys conducted in January will yield counts reflecting direction and intensity of the reproductive output of peak breeding periods in the region and trend data on population numbers for Puerto Rico and the U.S. Virgin Islands.

12. Monitor reproductive performance

In the Greater Puerto Rican Bank region, breeding peaks occur during the fall. A regional index to reproductive output of peak breeding efforts can be obtained by monitoring changes in

age ratios from August through January at San Juan Bay coupled with knowledge of the number of nesting attempts throughout the region. San Juan Bay harbors the majority of juveniles, non-breeding and/or post-breeding adults in the Greater Puerto Rican Bank region. A regional index to breeding efforts can be estimated by visiting nesting colonies on a quarterly basis and counting active nests. Fall visits to all nesting colonies should be conducted monthly during September, October, and November, when nesting effort is usually at its peak.

2. Monitor harmful environmental conditions

21. Monitor effects of hurricanes on breeding populations

Brown pelican breeding activities in the Puerto Rico-U.S. Virgin Islands region peak during the hurricane season (July 1-November 30). Regional breeding efforts can be significantly disrupted by successive hurricanes in a season or consecutive years. An appropriate status assessment must take into consideration the detrimental effects of these natural disturbances which could lower long-term recruitment rates.

22. Monitor presence of contaminants and disease

Contaminants and disease were the probable cause of death of 7 percent of the 1982 mean population in Puerto Rico. Monitoring is required in order to formulate appropriate corrective measures to eliminate or reduce the impact of these factors on the population.

221. Assess environmental contaminants present in egg samples

Although the mean residue levels of pesticides known to adversely affect brown pelicans were low from 1980 to 1983, samples collected in southwestern Puerto Rico had the most elevated levels of the region. Collection of a sample of 10 eggs (live and/or addled) from each colony is recommended in 1988 to assess contaminant levels before delisting is considered. Collection prior to this date should be considered only if there is evidence of widespread reproductive failure.

222. Detect presence of oil on eggs

Oil has embryotoxic effects on brown pelicans. Evidence of oiled eggs should be noted when checking nest contents at colony sites. Monitoring should be intensified if major oil spills occur during peak breeding activities.

223. Monitor key areas having large pelican aggregations for possible die-offs from disease or environmental contaminants. Presently, the key areas are Dorado and Humacao Lagoons where die-offs occurred in 1982. San Juan Bay should also be included because of the large number of pelicans present year-round and the potential for a major die-off occurring. Efforts should be made to monitor these localities regularly to detect die-offs in their initial stages. Probable cause of mortality should be ascertained as quickly as possible in order to

implement corrective measures. Biological sampling guidelines to insure sample quality should be prescribed. Pathological and toxicological evaluation of suitable biological samples must be coordinated through the Fish and Wildlife Service's Ecological Services and other appropriate agencies.

3. Protect and enhance population

31. Place educational signs at all known breeding and traditional roosting sites

Rapid human encroachment into coastline and offshore habitats and human disturbance pose the major threats to the pelican's continued habitat availability and suitability. Signs in English and Spanish that educate the public on the status of the pelican and the laws that protect them, and asking them not to disturb or trespass, should be placed at all known nesting and traditional roosting sites.

32. Monitor and reduce human disturbance and encroachment

321. Monitor frequency of human disturbance at nesting sites

Human disturbance is likely to affect brown pelicans in this region, particularly in Puerto Rico. An index of its magnitude is obtained by patrolling nesting sites every two weeks from a distance of at least 500 feet. If human disturbance is detected, patrolling by law enforcement personnel must be conducted on a weekly

basis during breeding peaks to discourage such activities.

322. Assess pelican habitat availability and suitability in areas proposed for development

Breeding and roosting in the U.S. Virgin Islands occurs on currently protected sites or on remote inaccessible cays where the chances of human encroachment are small. In Puerto Rico, however, almost all major breeding and roosting sites are potentially subject to further human encroachment. During 1980-83, 93 percent of all roosting and breeding occurred on mangroves. A classification rule based on structural variables is available to assist in reaching a decision concerning the structural suitability of mangrove sites. Brown pelicans are traditional in that roosting and breeding sites used in the past tend to be re-used. Historical information about a given site must be taken into consideration when making habitat suitability assessments. Consistent aggregation of pelicans in one area increases the likelihood of establishment of a roost or nesting site.

323. Zone or regulate human developments in important feeding areas

The U.S. Virgin Islands supports the majority of breeding brown pelicans in this region while Puerto Rico

is used primarily by juveniles and post-breeding and non-breeding adults. Efforts should be made to maintain the quality of important feeding areas by avoiding undesirable discharges of sewage and industrial wastes in the water and the elimination of mangrove tracts and coraline communities. Undesired substances will stress the marine community and ultimately the food base of pelicans.

4. Environmental education

41. Present public talks

Emphasis must be given to coastal communities located in the general vicinity of all nesting and important roosting sites.

42. Prepare general information pamphlets and posters

Information pamphlets and posters could be distributed to the general public during scheduled talks. General information pamphlets and posters should also be available at the Office of Information and Education of the Department of Natural Resources and Regional Offices throughout Puerto Rico, at the Department of Conservation and Cultural Affairs and Office of Information of the U.S. Virgin Islands, and at pertinent federal agencies in the region.

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PART III. IMPLEMENTATION SCHEDULE

Priorities in Column 4 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 forseeable future.

Priority 2 - An action that must be taken to prevent a significant decline in 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.

GENERAL CATEGORIES FOR IMPLEMENTATION SCHEDULE

Information Gathering - I or R (research)

1. Population status
2. Habitat status
3. Habitat requirements
4. Management techniques
5. Taxonomic studies
6. Demographic studies
7. Propagation
8. Migration
9. Predation
10. Competition
11. Disease
12. Environmental contaminant
13. Reintroduction
14. Other information

Management - M

1. Propagation
2. Reintroduction
3. Habitat maintenance and manipulation
4. Predator and competitor control
5. Depredation control
6. Disease control
7. Other management

Acquisition - A

1. Lease
2. Easement
3. Management agreement
4. Exchange
5. Withdrawal
6. Fee title
7. Other

Other - O

1. Information and education
2. Law enforcement
3. Regulations
4. Administration

Implementation Schedule

Brown Pelican

General Category	Plan Task	Task Number	Priority	Task Duration	Responsible Agency			Estimated Fiscal Year Costs			Comments/Notes
					FWS						
					Region	Division	Other	FY 1	FY 2	FY 3	
I-1	Conduct annual population survey	11	2	5 yrs	4	SE	DNR, DFW	5K	5K	5K	
I-7	Monitor reproductive performance	12	2	5 yrs	4	SE	DNR, DFW	5K	5K	5K	
I-14	Monitor effects of hurricanes on breeding populations	21	3	5 yrs	4	SE	DNR, DFW				
I-11, 12	Monitor presence of contamination and disease	22	2	5 yrs	4	SE/TS		2K	2K	2K	
O-2	Place educational warning signs at breeding and traditional roosting sites	31	2	1 yr	4		DNR DFW	5K			
I-14	Monitor frequency of human disturbance	321	3	Continuous	4	SE	DNR, DFW	5K	5K	5K	
I-14	Assess areas proposed for development	322	2	Ongoing	4	SE	DNR DFW				
O-3	Zone or regulate development at important pelican feeding areas	323	2	Ongoing	4		DNR DFW				

Implementation Schedule

Brown Pelican

General Category	Plan Task	Task Number	Priority	Task Duration	Responsible Agency			Estimated Fiscal Year Costs			Comments/Notes
					FWS						
					Region	Division	Other	FY 1	FY 2	FY 3	
O-1	Present public talks to coastline communities	41	3	Continuous	4	SE	DNR, DFW				
O-1	Prepare information pamphlets and posters	42	3	1 yr	4	SE	DNR, DFW	5K			

DNR = Puerto Rico Department of Natural Resources
SE = US Fish and Wildlife Service, Endangered Species
TS = US Fish and Wildlife Service, Technical Services
DFW = Division of Fish and Wildlife, U.S. Virgin Islands

IV. APPENDICES

Appendix A

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Appendix B

Feeding Areas

Moderately Important Areas:

1) Jobos Bay: The bay and surrounding vegetation cover about 11,000 ha. It is Puerto Rico's second largest estuarine area (Laboy, 1983). Water depth averages 3.8 m. Feeding pelicans are scattered throughout the bay.

2) Guánica Bay: The bay has about 12.5 ha of fringe mangrove along its northern and northwestern edge (Martínez et al., 1979). Feeding pelicans concentrate along the inner sections of the bay where the bottom is a thick organic muck. Water depth averages 4.5 m.

3) Torrecillas Lagoon Complex: These brackish lagoons are part of the most extensive mangrove forest remaining in Puerto Rico and are typical of a northern coastal wetland area. Average water depths at Torrecillas and Piñones Lagoons are 2.4 m and 0.8 m and cover areas of approximately 246 ha a 103 ha, respectively. Feeding pelicans concentrate mainly in the general area of Punta Larga and Punta Mosquito near the eastern end of Luis Muñoz Marín International Airport.

4) Culebra Island: Feeding occurs mostly in Puerto Manglar on the southeastern coast and along the northwestern coastline of the island. Mean water depth is 3.8 m.

5) Vieques Island: Large feeding aggregations are most often seen along the western and northwestern portions of the island. The northwestern coast is protected by the extensive U.S. Navy built pier facility a few kilometers to the east. Pelicans consistently use shallow waters near the pier. Other areas used by pelicans are Puerto Mosquito, Puerto Ferro, Bahía Tapón, and Ensenada Honda.

6) Other Feeding Areas: In Puerto Rico, feeding pelicans consistently use Guayanilla Bay, Puerto Real, Boquerón, and Salinas (Cabo Rojo). These areas share similar physical characteristics such as reef barriers, overwash mangrove islets, fringe mangroves, protected coves, shallow and heterogeneous bottoms consisting of a mix of sand, coral reefs, and Thalassia beds.

Occasionally Important Areas

These localities are occasionally used by numerous pelicans and other seabirds that feed on large schools of fish. This activity lasts up to several days, after which the birds disperse from the area. Arecibo Bay, Caja de Muertos Island, Berberia Cay, and Aguadilla are examples of such areas. Such nomadic feeding aggregations are common during winter months when fish schools potentially occur anywhere along the coastal zone of Puerto Rico or the U.S. Virgin Islands.