Atlas of California Brown Pelican Roost Sites on the Southern California Mainland

U.S. Fish and Wildlife Service
Carlsbad, CA

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Southern California Brown Pelican Atlas Project

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Appendix A

A. Data used in the preparation of this report, including actual counts and references for each date and location.

Appendices B through L

Selected unpublished reports used in the preparation of this Atlas are included in electronic version only.

B. American Trader Trustee Council. 2001. Final restoration plan and environmental assessment for seabirds injured by the American Trader Oil Spill. Report of the American Trader Natural Resource Trustee Council, U.S. Fish and Wildlife Service, California Department of Fish and Game, and National Oceanic and Atmospheric Administration.
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K. Keane Biological Consulting. 2008. Day and night roost monitoring of California brown pelicans (*Pelicanus occidentalis californicus*) at Marina del Rey Harbor, Los Angeles County, Los Angeles, California. Unpublished report prepared for U.S. Army Corps of Engineers Los Angeles District, Long Beach, California.
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M. U.S. Fish and Wildlife Service 1983. A recovery plan for the California Brown Pelican. Portland, OR. 26 pages.
N. Varanus Biological Services. 1999. California Brown Pelican night roost monitoring during maintenance dredging of Marina del Rey Harbor. Unpublished report plus data sheets prepared for Hart Crowser, San Diego, California.

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Project Information

Purpose: This project, **Atlas of California Brown Pelican Roosting Habitat: Southern California Coastal Region** (Atlas) , is included as a selected project in the **Restoration Plan and Environmental Assessment For Seabirds Injured by the *American Trader* Oil Spill** (American Trader Trustee Council, 2001). The purpose of the Atlas is facilitate sound management to protect essential brown pelican non-breeding habitat and identify future restoration project sites. It is anticipated that this project could be (1) expanded to include the offshore islands, central California and northern California, as data and funds permit and (2) updated as additional information on pelican roosts becomes available.

The users of this Atlas may include site managers, permit reviewers, biologists, resource managers, government agencies and the general public. It is hoped that information on pelican roosts will be taken into consideration when considering coastal activities that may affect California Brown Pelican roosting areas. It is hoped that with the knowledge contained in this Atlas, pelicans can co-exist with people in healthy, suitable habitats throughout southern California. The preparation and distribution of this Atlas is intended to ultimately enhance pelican habitat along the southern California coast.

Additionally, many restoration opportunities are identified throughout this Atlas. This provides project planners and resource managers additional tools to consider when developing mitigation plans or habitat conservation plans associated with coastal activities. The implementation of these restoration opportunities will benefit pelican habitat.

Background: The American Trader Trustee Council (Trustees) was established to develop and implement a restoration plan for seabirds injured by the American Trader oil spill. This spill occurred on February 7, 1990, when the single-hull tank vessel *American Trader* ran aground offshore of the Golden West terminal at Huntington Beach, California. The volume of oil released was estimated to be 416,598 gallons of crude oil. Two holes were punctured in the starboard cargo tank by the vessel's own anchor due to a combination of ocean swells and inadequate water depth during the attempted mooring at the sea berth. At the time, the vessel was lightering a cargo of Alaska North Slope crude oil from the *Keystone Canyon,* a very large crude carrier anchored in Long Beach, to several locations along the southern California coast including the Golden West terminal at Huntington Beach.

A number of types of birds were affected by the *American Trader* spill. Over 95% of the oiled birds (dead and alive) were seabirds including sea ducks, pelicans, grebes, gulls, cormorants, loons, alcids (murres, auklets and murrelets) and tubenoses (shearwaters and petrels). California Brown Pelicans are an protected species under federal and state law and thus are of particular concern to the Trustees. The Brown Pelican was severely impacted, with an estimated 185 dead birds. Based on observations at the Long Beach Breakwater, the principal pelican roost in the area, the Trustees estimated that half of the 750 to 1,000 pelicans roosting on the breakwater at the time of the spill were oiled. Additionally, an estimated 425 pelican chicks, at a minimum, were not born or fledged due to the dead or oiled birds. (Because of the longevity of pelicans, which is approximately 20 years, this estimate is extremely conservative.) The spill occurred just before the start of the breeding season as the birds gathered at traditional roosts before moving to breeding islands, therefore making the birds vulnerable to the oil in large numbers.

A study of the survival and behavior of oiled rehabilitated Brown Pelicans was commissioned by the Trustees following the *American Trader* spill (Anderson *et al.* 1996). In this study, radio telemetry techniques and aerial surveys were used to track the fate of radioed rehabilitated pelicans; these birds were compared with a group of non-oiled controls. Most of the rehabilitated pelicans disappeared and were believed to have died within six months. Rehabilitated birds that survived beyond six months were sedentary and showed no signs of breeding activity during the following two breeding seasons. The low survival of these rehabilitated and released birds supports the claim that a large majority of the birds that were cleaned and released during the spill would have died following the spill and those birds that did survive were no longer contributing members of the breeding population.

Brown Pelican Endangered Species Listing History: Due to population declines of brown pelicans by 1970, the U.S. Fish and Wildlife Service listed the species as endangered under the Endangered Species Conservation Act of 1969 (Pub. L. 91-135, 83 Stat. 275). Brown pelicans were included in the List of Threatened and Endangered Foreign Species on June 2, 1970 (35 FR 8495), and included in the United States list of endangered and threatened species on October 13, 1970 (35 FR 16047). The species was subsequently listed under the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.). The listing and de-listing history is as follows:

- February 4, 1985, the U.S. Fish and Wildlife Service delisted the brown pelican in Alabama, Florida, Georgia, South Carolina, North Carolina, and points northward along the Atlantic Coast (50 FR 4938). However, the brown pelican continued to be listed as endangered throughout the remainder of its range, including California, Mississippi, Louisiana, Texas, Mexico, Central and South America, and the West Indies.
- July 5, 1994, the U.S. Fish and Wildlife Service received a petition from Joe L. Herring, Secretary, Department of Wildlife and Fisheries, State of Louisiana, requesting the U.S. Fish and Wildlife Service remove the brown pelican in Louisiana from the Federal List of Threatened and Endangered Wildlife.
- December 14, 2005, the U.S. Fish and Wildlife Service received a petition from Craig Harrison, of the law firm Hutton and Williams, representing the Endangered Species Recovery Council, to remove the California brown pelican, the subspecies of brown pelican occurring along the Pacific Coast of California and Mexico, including the Gulf of California, from the List.
- May 24, 2006 (71 FR 29908), the U.S. Fish and Wildlife Service published a notice announcing our 90-day finding for the petition, concluding that the petition presented substantial scientific or commercial information indicating that the petitioned action may be warranted. The U.S. Fish and Wildlife Service then initiated a 12-month status review of the California brown pelican to determine if delisting under the Act is warranted.
- May 24, 2006, the U.S. Fish and Wildlife Service also published a notice announcing initiation of a 5-year review on the rangewide status of the brown pelican (71 FR 29908). The conclusion of this review, which was based on the best available scientific information, indicates the currently listed brown pelican population does not meet the definition of an endangered or threatened species under the Act (Service 2007a, p. 46).
- February 20, 2008, the U.S. Fish and Wildlife Service published a 12-month finding on the petition to delist the California brown pelican and a proposed rule to delist the brown pelican in its entirety, based on recovery (73 FR 9407).
- As of 2009, listed brown pelican populations occur in primarily coastal marine and estuarine environments along the coast of the Gulf of Mexico from Mississippi to Texas; along the Pacific Coast from British Columbia, Canada, south through Mexico into Central and South America; and in the West Indies (Shields 2002).

Planning Reports and Other Data: Several planning reports were commissioned by Trustees and prepared by Crescent Coastal Research biologists (Jaques and Strong 2002; Jaques and Strong 2003; Strong and Jaques 2003) in support of the development of this Atlas. Information from these contract reports is summarized and excerpted throughout this Atlas. The reports in their entirety are also provided as electronic appendices to this Atlas. Other data were also compiled and summarized in this atlas from any available published or non-published source. In 1992-2002, much additional data on roosting Brown Pelicans on the southern California mainland were gathered by Crescent Coastal Research, Humboldt State University, U.S. Geological Survey, and U.S. Navy for other research and management purposes (Jaques *et al.* 1996; Capitola *et al.* 2002, 2003; Jaques and Strong, unpublished data; Carter, unpublished data). Most of these data were unpublished and may be updated or corrected, as appropriate. Researchers are encouraged to provide pertinent data, updates, comments and recommendations to project managers for consideration in updated editions.

Atlas of California Brown Pelican Roost Sites on the Southern California Mainland

Introduction

The California brown pelican (*Pelecanus occidentalis californicus*) is a common year-round resident of the southern California coastline and Channel Islands. Numbers in the southern California bight increase in summer and fall when post-breeding migrants from Mexico pass through the area (Anderson and Anderson 1976, Briggs *et al.* 1981). The brown pelican is found in estuarine, marine subtidal, and marine pelagic waters along the entire California coast and as far north as British Columbia. In southern California, brown pelicans are common along the coast from June to October, especially within 30 km (19 mi) of shore, but regularly out to 175 km (109 mi) (Briggs *et al.* 1981). They are fairly common the rest of year, with lowest numbers April to May (Garrett and Dunn 1981). In northern California, they are fairly common to common June to November (Anderson and Anderson 1976, Cogswell 1977, McCaskie *et al.* 1979). In southern California, peak numbers occur along the coast following the nesting season, from June through October (Anderson and Anderson 1976, Briggs *et al.* 1981, Jaques *et al.* 1996).

In 1970 and 1971, the California brown pelican was listed both as a federal and California endangered species, respectively, largely due to DDT and PCB pollution that caused widespread reproductive failure during the 1960's and early 1970's (USFWS 1983). Numbers have substantially increased since that time and on February 20, 2008, the U.S. Fish and Wildlife Service published a 12-month finding on the petition to delist the California brown pelican and a proposed rule to delist the brown pelican in its entirety, based on recovery (73 FR 9407). Additional information on the listing and delisting can be found on the Project Information page.

In the U.S. , nesting only occurs on Anacapa and Santa Barbara Islands, and occasionally on nearby Scorpion Rock, which are in the Channel Islands National Park (Gress *et al.* 2003) and inland at the Salton Sea (Molina and Strum 2004). Additional nesting occurs on islands along the Pacific coast of Baja, Mexico, and in the Gulf of California, Mexico (USFWS 1983).

Brown pelicans are present at nesting islands from February or March to early August. The nest is a small mound of sticks or debris on rocky, or low, brushy slopes of undisturbed islands (Cogswell 1977); usually on the ground, but less often in bushes (Palmer 1962). Egg laying typically occurs from March to April, but brown pelican nesting is highly asynchronous and can extend over as much as a nine-month period (Anderson and Gress 1983; Gress and Martin 2000). Clutch size is usually 3 eggs, sometimes 2, single-brooded. Incubation lasts about 4 weeks. Young are altricial and tended by both parents; they first fly at 9 weeks of age, and are independent sometime later. Young breed first at about 2 or 3 years of age.

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In 2002, the number of nest attempts and fledglings produced by the southern California nesting population was estimated at 6440 and 3220 individuals, respectively, though the number of nest attempts and fledglings produced is variable by year [range 628 to 6440 and 372 to 6390, respectively, during the past twenty years (1983 to 2002)] (Gress *et al.* 2003). While breeding habitats have received considerable protection, the importance of roosting habitat protection for pelicans has not been widely recognized, especially on the Southern California mainland. Pelicans are not fully waterproof (Rijke 1970, Johnsgard 1993) and must roost on terrestrial habitats to dry, preen, and maintain their plumage (USFWS 1983). Availability of suitable roosting habitats is essential for pelican use of coastal regions (USFWS 1983). Pelicans forage mainly in the early morning or late afternoon, or when tide is rising. They feed almost entirely on fish including anchovies and sardines, caught by diving from 6-12 m (20-40 ft) in the air, and occasionally from up to 20 m (66 ft). Birds may completely, or only partially, submerge and water may be shallow or deep. They occasionally feed on crustacean, carrion, and young of its own species (Palmer 1962). Pelicans usually rest on water or inaccessible rocks (either offshore or on the mainland), but they also use mudflats, sandy beaches, wharfs, and jetties. They do not typically roost overnight on water, but concentrate at a few traditional roosts on mainland or islands (Briggs *et al.* 1981).

Brown pelican colonies of the southern California bight are considered to be a single population unit ("SCB population") because of interchange of breeding birds, population shifts in response to food availability, common influences of the California Current, and utilization of the same stocks of prey species (Anderson *et al.* 1980, 1982; Anderson and Gress 1983, 1984). The southern California bight stretches from Point Conception along the southern California coast south to Cabo San Quintin, Baja California Norte, Mexico.

Breeding Colonies, United States: West Anacapa Island in the Channel Islands National Park, California, is the site of the largest and most consistent brown pelican breeding colony in the United States (USFWS 1983; Gress and Martin 2000). The pelican breeding population on Anacapa was nearly extirpated in the late 1960s and early 1970s; almost total reproductive failure was attributed to excessive eggshell thinning associated with DDT (Gress 1970, Keith *et al.* 1971, Risebrough *et al.* 1971, Risebrough 1972, Anderson *et al.* 1975, 1977; reviewed in USFWS 1983, Gress 1995 and Gress *et al.* 2002). As a result, the California brown pelican was accorded endangered species status by the U.S. Fish and Wildlife Service in 1970 and by the California Fish and Game Commission in 1971. As of 2008, delisting is being considered by both the federal and state governments.

Small, but steady improvements in breeding success were noted as environmental levels of *p,p'*-DDE declined; by the mid-1980s, increased improvement in reproductive performance began leveling off (Gress 1995; Gress *et al.* 2002; see also Sydeman *et al.* 2001 for discussion of possible effects of climate change on brown pelicans during this period).

The only other currently active pelican breeding site in the United States is in southern California, located on Santa Barbara Island, also part of the Channel Islands National Park (see USFWS 1983, Gress and Martin 2000 for Channel Islands breeding records). Historically, Santa Barbara Island was most likely an ephemeral colony site with occasional small nesting efforts.

Breeding Colonies, Mexico: Located in the southern portion of the southern California bight along the northwestern coast of Baja California, Islas Los Coronados and Isla San Martín are currently the only active brown pelican nesting sites outside of the United States.

The Los Coronados colony historically has been a major pelican breeding site, often exceeding the Anacapa colony in size (see Jehl 1973). Like Anacapa, this colony was nearly extirpated because of reproductive failures due to eggshell thinning in the late 1960s. Improved breeding success on Coronados also began in the mid-1970s (Anderson *et al.* 1975). After 1980, however, this colony declined, most likely because of human disturbance from fishing camps located near the pelican colonies (Anderson 1988; Gress *et al.* 1990) and possible fishery overexploitation (Anderson *et al.* 1982). As the Los Coronados colony declined, displaced birds may have been the source of recruitment to the Channel Island colonies in the early 1980s (Anderson and Gress 1983).

Farther south, the pelican colony on Islas Todo Santos has been inactive since the 1920s, and the once major pelican colony on Isla San Martín, until recently, had not been active since 1974 (Everett and Anderson 1990). The demise of these colonies was due largely to human disturbance, tourism, and feral animals (Jehl 1973, 1984; Anderson and Keith 1980). In 1999, about 25 active nests were sighted on San Martín; this number increased to about 300 nests in 2000 (E. Palacios, unpublished data). Although official protection of island and mainland habitats is lacking in northwestern Baja California, natural area protection has been proposed for most islands by 2008.

Description of Diurnal and Night Roost Habitats: Similarities, Differences, and Variations

(Summarized and excerpted from Strong and Jaques 2003; and Jaques and Strong 2003)

The California brown pelican is a coastal seabird that requires terrestrial habitat for communal roosting throughout its range. Roost sites are generally communal (birds are found in groups rather than singly), and the same sites are used consistently over years (USFWS 1983, Jaques 1994). Pelicans rely on a variety of shoreline structures as roost habitat to rest and restore their plumage. Roost habitat is essential habitat for pelicans, as their plumage becomes soaked with prolonged water contact and they need time out of the water to dry (Rijke 1970, Pennycuik 1972, USFWS 1983). Much loss and degradation of mainland pelican roosting habitats has occurred because of intensive coastal development, habitat modification, and human disturbance over the past century. Long-term protection of breeding and roosting habitats is a critical need to maintain large breeding and non-breeding populations of pelicans within the central portion of their historical coastal habitats on the Southern California mainland and in northwestern Baja California (USFWS 1983).

Basic requirements for pelican roosts include:

- terrestrial substrates where pelicans stay dry while resting and preening to maintain their plumage,
- safety buffers from mammalian predators and human disturbances, and
- prey resources within energetically efficient flying distances.

Diurnal or "Day" Roosts

By day, pelicans disperse along the coast and may roost at a variety of habitats. Throughout much of their non-breeding range, their preferred habitat is offshore rocks and islands where there is protection from mammalian predators and human disturbance. On the southern California coast, however, natural roosting habitat is limited due to the eroding cliffs and lack of rocky substrate that is common along the coastline. Therefore, although rocks, beaches, river mouths, and reefs are used, the majority of roosts are found on artificial structures associated with harbors, docks, piers, jetties and breakwaters (Jaques *et al.* 1996).

In southern California, breakwaters and jetties are the most important habitats supporting 42% and 14% of roosting birds, respectively (Strong and Jaques 2003).

Nocturnal or "Night" Roosts

Requirements for night roost habitat are similar to that for day roosts, but more stringent. Suitable night roost habitat is more limited than diurnal habitat as there is increased vulnerability to predators and reduced navigational ability at night (Jaques and Anderson 1987, 1988; Jaques and Strong 2003). Overnight roost sites are restricted to the most secure roosts and have a strong traditional component, thus night roosts tend to be larger and fewer than diurnal ones. Except at a few locations, birds roosting overnight require a water buffer of adequate depth and extent to prevent predator or human access. Night roosting habitat for brown pelicans can be characterized simply as an area of sufficient size to allow communal roosting of a group of pelicans with protection from severe weather and waves, and with a barrier to access by mammalian predators or disturbance. Throughout most of their range, islands and offshore rocks provide this habitat. On the southern California coastline, this type of habitat is limited to breakwaters and a few islets, but the birds will use certain jetties and other structures within harbors if they possess some or all of these important characteristics.

Due to the communal nature of pelican roosts in general, and the limitation of night roost habitat, small night roost groups are rare. There is a strong traditional, or learned, behavioral element to night roost sites which can be seen when pelicans depart day time sites in the evening and fly towards the nearest night roost location. (Jaques and Anderson 1987, 1988).

Protection of roosting areas has become an increasingly important management issue in California, as awareness of the potential adverse impact caused by human disturbance and habitat alteration has grown.

The key factors affecting or limiting use of known night roosts in coastal southern California are:

- Local abundance of pelicans
- Availability and capacity of roost substrate
- Buffer to predators
- Vertical aspect of roost
- Human Disturbance

Seasonal Variation at Roosting Sites

The number of pelicans using a given roost site along the southern California coast varies in a somewhat regular pattern by season. Anderson and Anderson (1976), Briggs *et al.* (1981), and Jaques *et al.* (1996) describe a seasonal low in pelican numbers from December to May along the southern California coast, when most birds are at nesting areas. From June to October, during the annual post-breeding dispersal, there is a higher abundance along the southern California coast as pelicans move from nesting areas to mainly coastal roost sites. The majority of birds eventually move to coastal roost sites in central California, Oregon and Washington (Jaques 1994).

Peaks in abundance in southern California occur either during the post-breeding migration or when prey availability is exceptionally high and localized. During these times, large numbers of pelicans can converge on an area resulting in the use of atypical roost sites. An example of this occurred in June 1992 when over 500 pelicans roosted on Will Rogers State Beach (the beach was closed due to water pollution), and hundreds more were seen on nearby beaches in northern Los Angeles and southern Ventura Counties. Some of these sites never held over 3 birds before or since and, therefore, are not considered traditional roosts.

Annual Variation at Roosting Sites

Annual variation is also common and sometimes unpredictable. During the El Nino event of 1992-93, few pelicans bred successfully in Mexico or on the Channel Islands (Gress *et al.* 1995), and numbers along the mainland shore of southern California were unusually high during both summer and winter. In other years, post-breeding birds may move rapidly through southern California to more northern points, resulting in very low fall abundance in southern California. (These effects cause high variability in roost counts, thus a series of surveys are needed to provide representative information on roost site use.)

Regional and Local Pelican Abundance at Roosts

Pelican distribution and abundance in southern California vary seasonally and annually and are influenced by timing and success of reproduction, migration patterns, ocean conditions, and the patchy and shifting distribution and availability of prey (Anderson and Anderson 1976, Ainley 1976, Briggs *et al.* 1981, Anderson and Gress 1983, Jaques *et al.* 1996). The use of and need for a large capacity night roost within a given region varies along with a broad spectrum of ecological correlates that affect pelican abundance within a given area.

Mugu Lagoon is the only site in southern California where enough data have been collected to illustrate the change in use of a night roost along with seasonal and annual fluctuations in pelican abundance in southern California. Six aerial surveys were conducted along mainland and Channel Islands shorelines to determine number of pelicans in Southern California; Pelican use of an important night roost site in Mugu Lagoon was also monitored. The results:

- Total pelican counts in southern California, including the Channel Islands, ranged from 11,500 (June 1992) to 3,405 (June 1993);
- June 1992 Overnight Mugu Lagoon Roost Use: More than 340 birds on average;
- June 1993 Overnight Mugu Lagoon Roost Use: Less than 50 on average in June 1993; and
- Peak night roost count at Mugu Lagoon of 883 birds occurred in June 1992 during a strong wave of migration along the coast.

Day Roost Characteristics and Limiting Factors

Surveys completed between 1986 and 2000 by Strong and Jaques (2003) found that breakwaters were by far the most important single habitat type used for day roosts. Breakwaters supported more than 42 percent of all roosting pelicans, based on an average of all surveys of the southern California coast. Jetties were a distant second, with approximately 13 percent of day roosting birds, followed by other habitat types, each holding less than 10 percent of the total (see figure (1a) at right).

Although artificial substrates comprised the habitat of 22 of the 60 day roosts that were surveyed, they supported 66 percent of all day roosting pelicans. Offshore rocks were the most common day roost type, but they supported just 7 percent of the total. (Although 15 offshore rock roosts are shown in the figure (1b) (see right), these were grouped into single roosts if they were proximal along the coastline.) The lower frequency of use of natural habitat, when compared with man-made habitat, is largely due to their small size (such as offshore rocks) or higher incidence of disturbance from humans and potential predators.

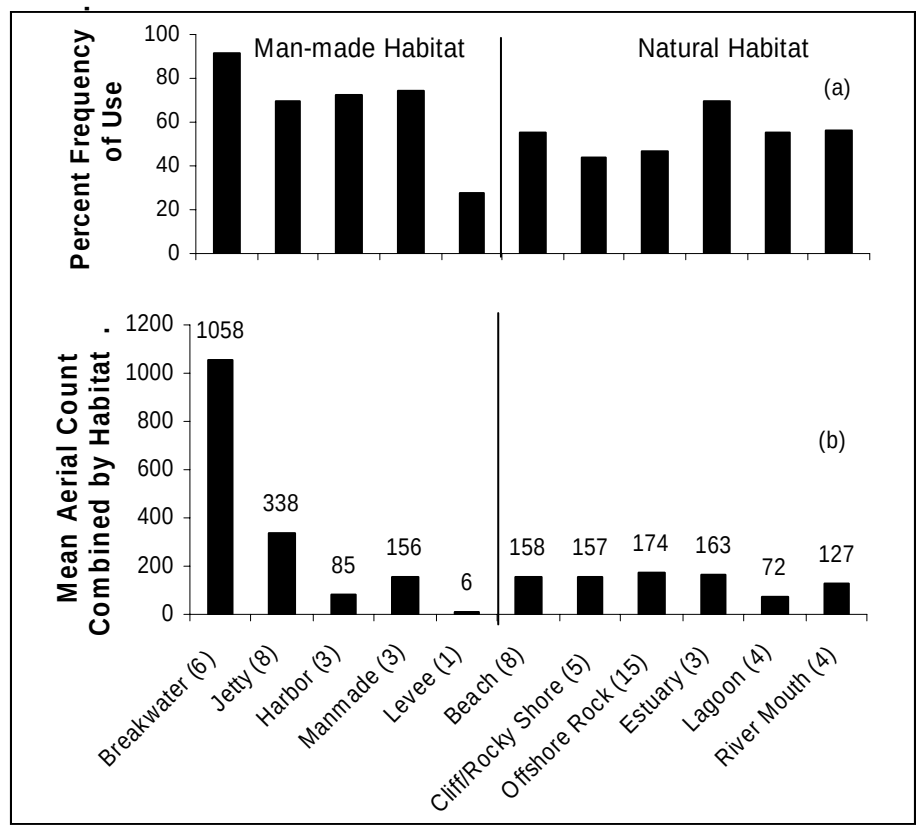

Figure 1. Day Roost: (a) Percent Frequency of Use by Habitat Type; and (b) Mean Number of Pelicans Using Each Habitat Type. From aerial surveys 1986 to 2000. (n) = number of roosts surveyed in each habitat type.

Night Roost Characteristics and Limiting Factors

Availability and Capacity of Roost Substrate

Since pelicans often use artificial structures as prime roost locations, roost availability can change substantively with changes in human activities associated with the artificial roosts. Changes in human access, changes in configuration of floating structures, or other alterations at major night roosts will cause a "ripple" effect throughout the coastal region. Also, the addition or subtraction of a single night roost can affect pelican night roost activities in a relatively large coastal region. Availability of high capacity night roost habitat is limited in some portions of the coastal southern California range of the pelican causing pelicans to expend unnecessary energy to fly between day roosting/foraging areas and distant night roost areas.

Examples:

- *Historic data demonstrate that when attractive mainland night roosts were present in the Santa Barbara Channel region, more pelicans remained in the nearshore environment overnight (rather than flying to the Channel Islands at night). Night roost counts in Santa Barbara County were greatest when two large out-of-commission barges were temporarily moored in the harbor. Up to 1,400 pelicans had been documented on the barges during the day and large numbers are presumed to have remained at night. Presently, only smaller structures are available in Santa Barbara Harbor (a bait barge and a small suction dredge boat). These have held 23-36 birds overnight. These small sites do not and could not support the hundreds of roosting pelicans that once used the barges.*

- *Removal of the night roost site on the Mobil Oil Pier in northern Ventura County has apparently resulted in a loss of suitable night roost habitat between Ventura and Santa Barbara Harbors. Following demolition of the pier, numbers of birds roosting on the seawall at nearby Rincon Island during the day increased and it became a very large and important daytime roost (Strong and Jaques 2003). However, limited data suggest that the seawall has not provided a substitute night roost. A high count of nearly 1,000 pelicans was recorded on Rincon Island during the day in 2001 (Capitolo et al. 2002). If this site is indeed not used as a night roost, then the hundreds of birds that use the seawall by day must be regularly transiting the channel to go to and from nocturnal roosts on the Channel Islands.*

- *The roost at Agua Hedionda Lagoon was the only location in southern California where pelican behavior indicated that the number of birds attempting to roost at the site was greater than what the structures could support at night. Pelican capacity was limited by the number and configuration of floating structures associated with a private mariculture operation. During the day, all of the suitable substrate was used, but at night the area nearest the shrubby eastern shore of the lagoon was left vacant and pelicans sparred for the remaining sites. Some birds departed the site at dusk after unsuccessfully procuring a space. Proximity to potential predators may be the reason that the pieces near the eastern shoreline (which provided cover for predators) were not used at night. Thus, this night roost was limited not only by the available roost substrate, but by the extent of the water buffer between the structures and the vegetated shoreline.*

Buffers to Predation

Successful pelican night roosts also provide protection from predators. Protection is usually provided by open water surrounding an offshore rock or island, or by fencing or restricted human and predator access.

Horizontal distance, or width of buffer, is an important factor in shallow water situations. The combination of adequate water buffers and vertical relief is not available in many southern California estuaries, with the exception of perhaps the man-made seabird nesting islands at Bolsa Chica lagoon.

Examples:

- *Pelicans roost overnight on the very long jetties at Dana Point and King Harbor but not on many shorter jetties in southern California. This suggests that a buffer distance of 1-2 km of rip rap may be required for a jetty connected to land to be adequate security from potential predators and human disturbance at night.*

- *Night roosting sites selected within Mugu Lagoon were areas that appeared to provide the greatest degree of protection from predation and human disturbance. Site selection by night roosting pelicans changed with annual and seasonal changes in wetland configuration and human disturbance factors. The most regularly used site was buffered from predator access by a relatively deep and wide tidal channel. Even so, at night pelicans generally stood as far from vegetated land as possible with their legs in the water.*

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Roost Site Height and Microclimate Options
The vertical aspect of a night roost is important when there is a possibility of inundation by tides or large waves. The breakwaters at *Marina del Rey and Long Beach Harbor* are higher than most in southern California and are above any observed tide or surf impacts. This, and the fact that they are large, true islands surrounded by deep water on all sides, makes them physically ideal night roost substrates. The roosts are also high enough to offer a range of microclimates for temperature regulation. Pelicans can choose between windward and wind-sheltered or sun and shade, by choosing one side of the breakwater wall over the other. In contrast, the breakwaters at Channel Islands Harbor and Ventura Harbor are relatively low and subject to overwash from the surf. This low relief may be the most important factor limiting their use as night roosts.

Examples:

- *Pelicans at Mugu Lagoon roost on a mudflat/islet that is subject to immersion during high tides and heavy freshwater outflow. Pelican night roosting at the lagoon became minimal during extended periods of high water when pelicans could not roost in secure locations without getting their feathers wet (Jaques et al.1996). Although some pelicans remained floating in the water at night during this period, the nearly complete rejection of the area by pelicans during the high water episode seemed to demonstrate that the energetic costs associated with soaked plumage outweighed the costs of relocation to a secure, dry roost.*

Human Disturbance
The same buffers that render night roosts relatively secure from mammalian predators protect them from most forms of human disturbance. Human disturbance has been documented during the day at many southern California night roosts (Jaques and Strong 2002); however, disturbance during the night at most locations seems less likely.

Examples:

- *The jetty roosts at King Harbor and Dana Point are disturbed by fishermen on foot during the day, but at night it is more difficult, and thus less likely, for fishermen to walk the length of the jetty and fish in the dark. Disturbance at dusk and dawn by fishermen, however, has been observed at King Harbor.*

- *The roost at Rincon Island, in contrast, may be equally or more vulnerable to disturbance at night as it is during the day. The primary source of potential disturbance at that site was human access to an observation platform on the seawall where the pelicans roost. Operations associated with the oil industry take place 24 hours a day and the platform is equally accessible to workers at night as it is in the day. Pelican response to human disturbance in darkness at East Sand Island, Oregon, was more severe than during daylight hours (Jaques, unpublished). Another potential disturbance factor at Rincon Island is the presence of feral cats (at least one cat observed on the island in 1999). Cat activity patterns and pelican response to cats may differ at night as opposed to day. Disturbance factors may be preventing the site from being used at night by pelicans.*

Roost Habitat Types

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Offshore Rocks or Islands

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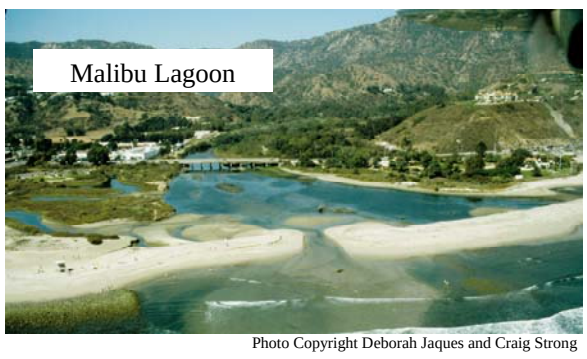
Open Coast, Cliff or Rocky Shorelines



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Open Coast, Beach Sand or Cobble

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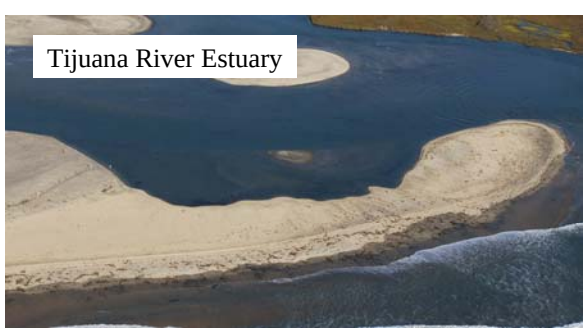
River or Creek Mouths



Estuaries

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Lagoons

Harbors

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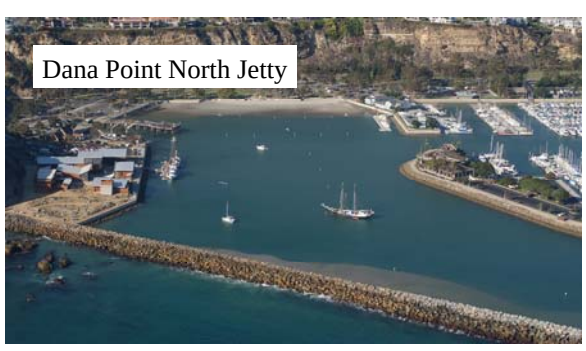
Breakwaters



Jetties

Other Man-made Structures

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Historic and Current Regional Threats to California Brown Pelicans

Human Disturbance

(Summarized and excerpted from Jaques and Strong 2002)

Introduction

Human disturbance causes direct and indirect effects on pelicans in non-breeding habitats that are often difficult to measure. Chronic disturbance to non-breeding birds can affect body condition, metabolic rate, habitat use, and subsequent reproductive success due to reduced lipid reserves (Stahlmaster 1983, Josselyn *et al.* 1989, Culik 1990, Gaston 1991). Long-term effects on bird distribution have been inferred (Batten 1977, Burger 1981, Jaques and Anderson 1986).

Based on the brown pelican's anatomy, roost site selection and behavior, it is evident that conserving energy is an important life history trait for these large migratory birds. Brown pelicans spend much of their daily energy budget resting and maintaining plumage at traditional communal roosts (USFWS 1983, Croll *et al.* 1986). The fewer disturbance events roosting brown pelicans experience, the less unnecessary energy is expended in moving to and from roosts and more energy is conserved for essential activities. The quality of a roost site can be based then, in part, on measurements of disturbance frequency and severity.

Habitat availability, habitat selection, and disturbance to roosting brown pelicans are all interrelated. Brown pelicans prefer to roost communally on dry substrate surrounded by water on all sides, but during the day will select locations that have less of a water buffer, since these areas may be nearer to food or fulfill a variety of other needs (U.S. Fish and Wildlife Service 1983, Jaques and Strong 2002). Roost sites that are not true islands are most vulnerable to disturbance. Since nearshore island habitat is limited in southern California, human disturbance at onshore roosts has been and will continue to be a serious management concern (U.S. Fish and Wildlife Service 1983, Jaques and Anderson 1988, Jaques *et al.* 1996, ATTC 2001, Capitolo *et al.* 2002).

Types and Effects of Human Disturbance

Studies evaluating the types and effects of human disturbance on pelicans at various roost locations and roost habitat types along the California coast determined the following (Jaques and Anderson 1987, Jaques 1994, Jaques and Anderson 1988, Anderson *et al.* 1996, Jaques and Strong 1996, and summarized in Jaques 2002):

- Highest frequency of disturbance observed was caused by one or more people on foot, approaching pelicans at a roost. Pelicans were flushed by walkers that approached within 20-50 meters or closer. This accounted for 32% of all disturbances seen from 1986-2000. In most cases the people were simply walking, but more specific types of activities included jogging and photography;
- Water-based recreational sports, including boating, surfing and fishing also disturb roosting pelicans. Disturbances from watercraft and surfers increased over the period 1986 to 2000. Pelicans flushed from boats that approach within 4 to 30 meters;
- Helicopters can flush pelicans at an average distance of 312 meters, further than other disturbance sources;
- Dogs flush pelicans from roosting sites. Documented disturbances involving dogs decreased from 17% of all disturbances in 1986-93, to 2% in 1999-2000;
- Natural disturbances are rare in southern California and accounted for less than 10% of all disturbances;
- Disturbance of brown pelicans at estuarine roosts is the most detrimental. Greater sensitivity of pelicans to human approach in estuarine settings compared to harbors may relate to (a) less effective water buffers in estuaries since island habitat is usually limited or unavailable and (b) higher likelihood of natural mammalian predation in estuaries making birds more wary to any disturbance (Jaques and Strong 2002);
- Human disturbance in southern California tends to be greater in estuarine habitats than in harbors;
- The "flushing distance" observed in southern California estuaries is lower overall than reported in other regions of the brown pelican range (Jaques, unpublished).
- The severity of disturbance events in harbors tends to be fairly low, even considering the intense level of human activity in the surrounding area. Pelicans displayed habituation to common types of boat traffic in harbors and chose roost sites that were relatively inaccessible to people on foot;
- Artificial structures on the outer coast, other than those associated with harbors, have historically been some of the least disturbed sites, and hence provided high quality habitat, but there were few of these roosts remaining by 2003; and
- Brown pelicans learn, over time, to avoid chronically disturbed locations.

Disturbance Factors
Fishermen
Surfers
Jetskis
Kayaks
Boats
Workers
Dogs
Helicopters
Walkers
Bright Lights
Fishing Boat Operations

Pelican habituated to bait barge in harbor.

Of the disturbance events in which pelican fate could be tracked, 60% of the total relocated to a different area within the same roost, 26% returned to the same site within the roost, and 14% departed the roost entirely (Jaques and Strong 2002).

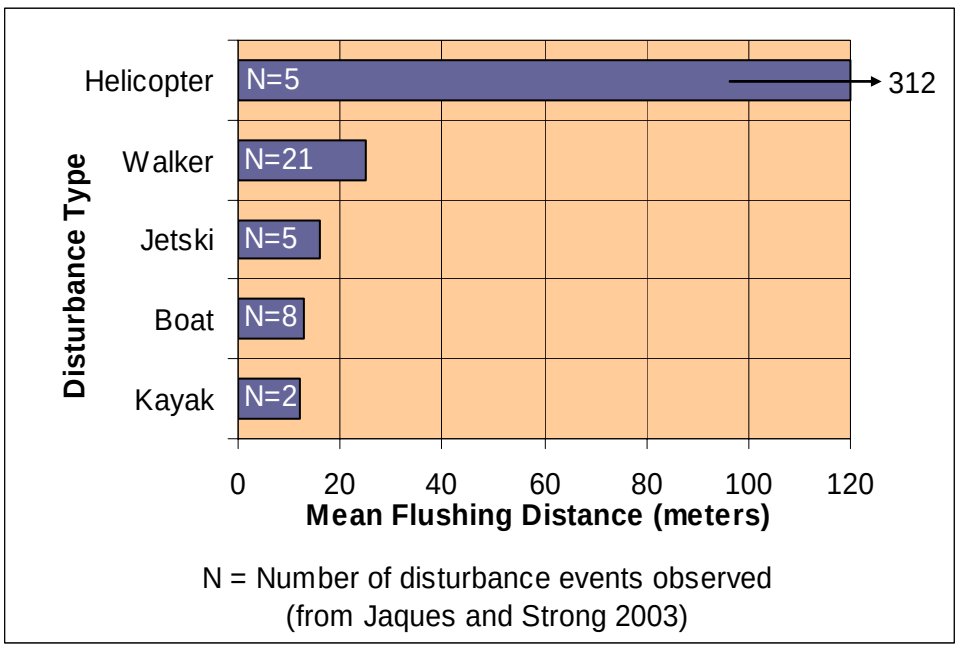

Figure 2. Mean flushing distance for various disturbance types in southern California.

Pelicans may habituate to boats and human activities in harbors.
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Immature Birds and Human Disturbance

Observations of the worst cases of chronic disturbance documented in southern California involved immature birds. Young birds seemed to be drawn to naturally attractive shoreline features such as rock promontories (such as Point Loma) and freshwater outlets where they subsequently encounter high rates of human disturbance. Since immature birds are the most likely to be energetically stressed due to lower foraging success than adults (Orians 1969), and have a high mortality rate in the first year, mostly due to starvation (Schreiber and Risebrough 1972, Anderson and Gress 1983), it may be that birds that continually encounter high disturbance levels will have a lower chance of survival, compared to birds that learn to roost in relatively undisturbed habitats (Jaques and Strong 2002).

Loss or Alteration of Historic Roosting Patterns

Estuaries and other coastal wetlands were probably the key mainland roost sites prior to intense development of the southern California shoreline. These habitats serve a variety of functions for brown pelicans, including bathing, pouch-washing, and in some cases, foraging. Mugu Lagoon may be the only estuarine site in southern California that can be considered a regularly used, high quality roost for brown pelicans (Jaques *et al.* 1996, Capitolo *et al.* 2002, Jaques and Strong 2002). Ownership and management by the U.S. Navy have restricted access and limited disturbance at the site, compared to other areas in southern California. In contrast, Malibu Lagoon and the Santa Clara River mouth are managed as State Parks and are subject to intense human recreation. Some of the lagoons in San Diego County are managed for wildlife and are well buffered from human disturbances, but lack roost habitat suitable for brown pelicans.

Changes in Natural Habitats, Harbors and Artificial Roosts

Human disturbance in southern California does appear to be an important factor involved in deterring pelicans from using natural habitats (i.e. estuaries, river mouths, creek mouths, lagoons, rocky shorelines and beaches) and favoring the use of artificial habitats. Data from the analysis of distribution and abundance of brown pelicans in southern California showed that artificial roost sites supported 66% of roosting pelicans along the mainland on average, and that these sites were occupied more consistently than natural sites (Jaques and Strong 2002). In the northern portions of the California brown pelican's non-breeding range, natural habitats along the mainland, including creek mouths, river mouths, other estuarine sites, and some beaches, are used heavily as roost sites (Briggs *et al.* 1983, Jaques 1994) and artificial substrates comprise a relatively small portion of the habitat selected.

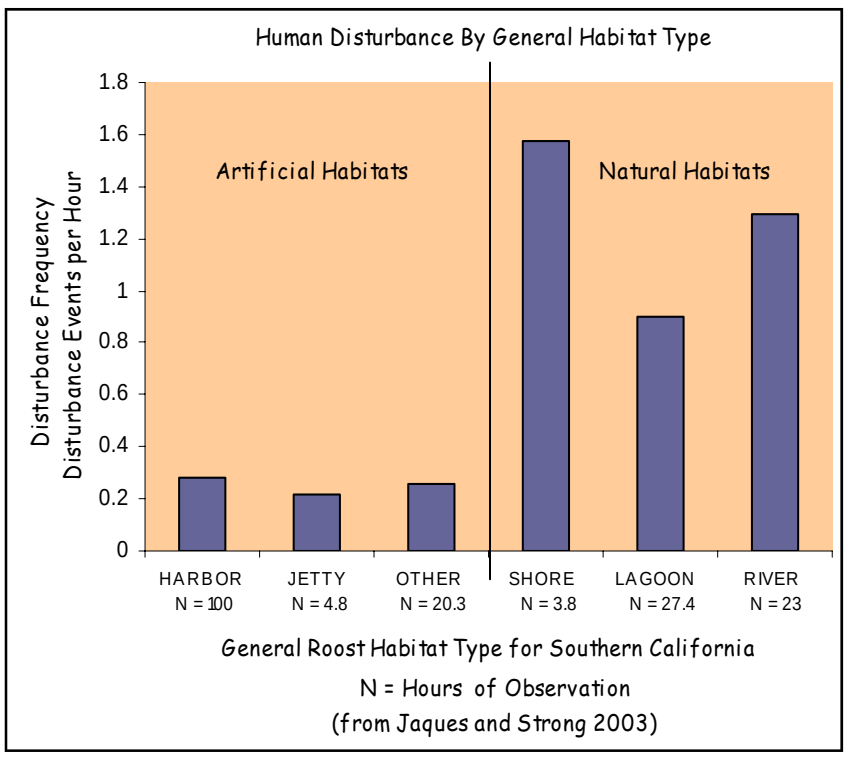


Figure 3. Frequency of human disturbance in six general roost habitats.

Other Threats

Squid Boats and Bright Lights

New disturbance elements have also arisen that may be threatening pelicans both on roosting and nesting sites. In 1999, for the first time, extensive squid fishing occurred at Anacapa and Santa Barbara Islands during the pelican breeding season. Observations of squid vessel operations indicate that the extremely bright lights used at night from dusk to dawn to attract squid may harm nesting success of brown pelicans (Frank Gress, personal communication). More than 50 percent of the pelican nests had been abandoned and that chick mortality was relatively high on Anacapa Island in 1999, an unusual situation in a non-El Niño year. The high nest abandonment coincided with the squid fishery operations occurring close to the breeding colonies. The squid fishery uses extremely bright lights to raise spawning aggregations of squid towards the surface of the water, so that squid can be captured with nets. Lights can be used for periods up to 12 hours (6 PM to 6 AM) while fishing operations are taking place. Satellite data provided by the National Geophysical Data Center allowed tracking of presence or absence of relatively high light levels at various sites in southern California during 1999. Relatively high light levels (proportion positive greater than 30 percent) were evident in the area of Santa Barbara Island in April, May and June 1999 and at Anacapa Island during the months of January through April 1999. In December 1999, in consultation with the USFWS, NPS, and Channel Islands National Marine Sanctuary, the California Department of Fish and Game proposed that the Fish and Game Commission adopt a regulation intended to avoid disturbance of pelican colonies by the squid fleet.

Jetty Fishing on Pelican Roosting Habitat, Oceanside, California.

"Panhandlers" in Harbors and Entanglement in Fishing Gear

Although they are not managed as wildlife habitat, the many artificial structures and harbors along the southern California coast are a critical component of non-breeding habitat for brown pelicans. The presence of large aggregations of pelicans in harbors, however, can have negative impacts as well. Pelicans using harbors to roost are more likely to encounter oil and other contaminants, are more likely to become entangled in monofilament, and may become regular scavengers or 'pan-handlers.' Pelicans frequenting harbors are also more likely to be involved in negative interactions with humans such as interfering with sport and commercial fishing, causing private property damage, becoming a public nuisance, or being maimed or killed by malicious persons.

Entanglement in fishing gear results in injury and death for pelicans each year. Most pelicans are hooked accidentally, some intentionally (personal observation). Hook may tear hole in gular pouch, impairing ability to capture fish, resulting in starvation; monofilament line may entangle wings or legs, making flight difficult or impossible or wrap tightly around limbs, causing necrosis and infection. Trailing line may entangle in vegetation or structures or may ensnare other birds. (U.S. Fish and Wildlife Service 1983)

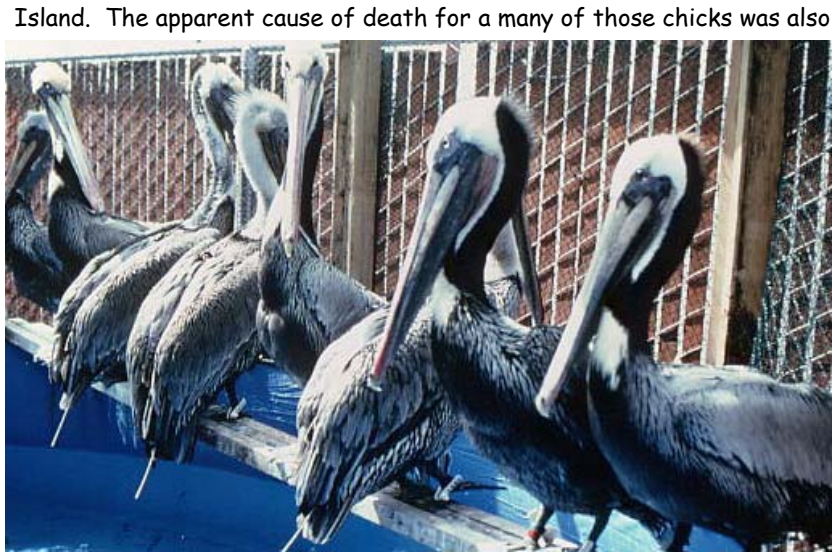
Disease

Pelicans in the southern California bight have been adversely affected by the bacterium *Erysipelothrix rhusiopathiae* which causes an infection and sometimes death due to ingestion of fish scraps discarded by restaurants and commercial fishing industry. No reports of mortality due to this bacterium are known since late 1980s (Shields 2002).

Pelican deaths also have been attributed to domoic acid poisoning resulting from pelicans feeding on fish that ingested toxin producing diatoms. In 1991, unusually high mortality reported in brown pelicans and Brandt's cormorants (*Phalacrocorax penicillatus*) in Santa Cruz, California, was attributed to domoic acid, a neurotoxin produced by blooms of a pennate diatom (*Pseudonitzschia* spp.)(Work *et al.* 1993a and 1993b). In that study, high levels of domoic acid were found in northern anchovies (*Engraulis mordax*), the principle prey item of brown pelicans (Anderson *et al.* 1980, 1982; Gress *et al.* 1980, U.S. Fish and Wildlife Service 1983), which acted as a vector for the toxin.

In mid-April until the end of June 2002, U.S. Fish and Wildlife Service biologists and wildlife rehabilitators reported mortality of brown pelicans on the southern California coast. Personnel from Wild Rescue in Malibu, California reported the recovery of 131 dead and 32 live brown pelicans and small numbers of other fish-eating seabirds along the coast from Santa Barbara to San Diego. This avian mortality event coincided with significant mortality in seals, sea otters and dolphins along the same stretch of coast. The suspected etiologic agent for marine mammal and fish-eating bird mortalities was domoic acid, a naturally occurring toxin produced by plankton that is ingested and concentrated by small marine fish and crustaceans.

Also in 2002, over 3,700 chicks died in the nesting colony on Anacapa Island. The apparent cause of death for a many of those chicks was also



Pelicans in rehabilitation center after American Trader oil spill, 1990.

domoic acid toxicity based on the timing of the mortality and presence of domoic acid in 12 adult brown pelican carcasses (F. Van Dolah, NOAA personal communication, Gress *et al.* 2003). Researchers speculate that nestlings were fed prey items harboring domoic acid and succumbed to the toxin (Gress *et al.* 2003).

Newcastle's Disease and Avian Influenza have not been detected in pelicans but greater effort is needed to monitor pelican health for emerging disease problems (Mendenhall 2006).

Contamination

Oil Pollution

Oil spills pose potential threats to pelicans on the southern California coast. Two of three major marine shipping lanes in southern California are within 25 kilometers of California brown pelican nesting colonies. More than 30 offshore oil platforms occur near and in foraging habitats for pelicans. Oil spills can come from tankers, offshore platforms, pipelines, cleaning of bilge tanks at sea, shipping accidents and other causes (Carter 2003, McCrary *et al.* 2003). Oil spills not only directly impact pelicans due to oiling, chronic disease and mortality, but also from adversely affecting prey populations. Naturally occurring oil seeps in the Santa Barbara Channel may also contribute to oiling of birds and mortality (U.S. Fish and Wildlife Service 1983).

Eggshell Thinning and DDT/DDE

During the late 1940s to 1970, DDTs and PCBs were dumped and discharged into coastal and marine waters off the coast of Los Angeles. Ocean dumping, wastewater discharge, storm drain run-off, non-point run-off and aerial transport represent the main mechanisms that introduced DDTs and PCBs into the southern California bight. Direct discharge of DDT wastes into the ocean from the primary source (Montrose Chemical Company) ceased in 1970.

Numerous studies have documented the impacts to natural resources resulting from the DDTs and PCBs releases. These contaminants are slow to break down and bio-concentrate up the food web resulting in reproductive impairment of higher trophic level organisms. Pelicans and other birds fed on pelagic fish that were contaminated with DDE/DDT and PCB residues. As a result, brown pelicans and other birds experienced significant reproductive failure and population declines during the 1960s and 1970s.

Reproductive impairment was primarily due to eggshell thinning. DDE, a metabolite of DDT adversely affects eggshell thickness. Eventually, after ongoing chronic exposure to DDT/DDE, eggshells are so thin that they break during incubation. For pelicans, this resulted in a long-term population decline beginning in the 1950s and almost a complete lack of reproductive success in 1969 and 1970 (Gress 1995, Anderson and Anderson 1976).

Although DDT/DDE and PCB contamination has declined significantly since the early 1970s, DDT/DDE and PCB contamination continue to exist in the environment of the southern California bight. Even so, recovery of brown pelicans in the southern California bight continued into the early 1980s and populations remain relatively stable or increasing since then (Gress *et al.* 2003).

Food Resources

Small, surface-schooling fish make up the bulk of a pelican's diet including northern anchovy and pacific sardine. After breeding habitat availability, food availability is the most important limiting factor influencing pelican productivity (Anderson *et al.* 1980, 1982; Anderson and Gress 1983, 1984). Annual reproductive success in the southern California bight is specifically correlated with anchovy abundance unless factors such as disease or contamination are present. In years when anchovies are scarce, many adults may abandon their nests and nestlings starve (Anderson *et al.* 1982).

Food availability can be affected by a variety of things including competition; habitat changes (for example, El Niño); commercial fisheries; and natural variation .

Competition for Prey Species

Northern anchovy are preyed upon during all life stages. Juveniles and adults are important forage for a variety of fish, bird, and marine mammal species (Pacific Fisheries Management Council 1998).

Habitat Changes and Prey Species Availability

The El Niño phase of the Southern Oscillation increased in frequency with every couple of decades of the 1900s. What was once an unusual climatic pattern became familiar in the last two decades of the century, with major events in 1982/1983, 1986/1987, 1991/1992, 1994 and 1997/1998. During El Niño, the normally wet western Pacific region dries out and the eastern Pacific — including the west coast of the Americas — experiences wet, stormy weather. In addition, the warm ocean waters that have moved into the eastern Pacific hold the cooler water below the surface, eliminating the upwelling process which affects the distribution of schooling fish (Glantz 1996). For example, the 1997/1998 El Niño decreased the availability of sardines, anchovies, and herrings. The lack of adequate food greatly hampered the pelican's breeding season. In March and April 1997, researchers found only 280 nests in one brown pelican colony. No nests were found during May of that year. In a normal year, the colony would contain an estimated 10,000 to 20,000 nests (Gress 2000).

Although both northern anchovy and Pacific sardine populations fluctuate widely, in approximately 60 year cycles (Baumgartner *et al.* 1992), anchovy abundance was high during much of the recent period of low sardine abundance along the U.S. west coast. During most of the last two decades, the warm-water Pacific sardine has increased and the cooler-water northern anchovy has decreased in numbers, perhaps in part as a result of increased surface temperatures in California waters (Smith *et al.* 1992, Smith 1995, Bograd *et al.* 2000).

Commercial Fisheries and Prey Species Availability

According to the California Department of Fish and Game, there are many informational voids concerning seabird ecology, especially winter ecology, which makes it difficult to determine if a particular fishery is having a negative effect on a seabird population. Information concerning fishery interactions is, for the most part, anecdotal and difficult to quantify. Food habit data and the relationship to changes in key prey species are not well known. This lack of information makes an analysis of whether fishery management practices are having a potentially significant adverse impact on seabirds difficult. However, since pelicans feed on only one or two major prey species, they are more susceptible to potential impacts than many other generalist-feeding seabirds (Anderson *et al.* 1982).

The regional availability of anchovy and sardine has affected both the fishery and the pelican food supply. The U.S. sardine fishery collapsed in the 1950s and commercial fishing ceased altogether in the 1960s. The anchovy fishery on the central subpopulation was small-scale until the mid 1940's when the decline of Pacific sardines shifted the focus to anchovies (Frey 1971). However, since the 1970s, the Pacific sardine has rebounded, and currently is abundance and has a high growth rate. California fisheries managers consider the resource recovered, although managers note that the developing sardine fishery must be carefully regulated to avoid any impact on the ongoing expansion of the population. In 2001, the National Marine Fishery Service listed Pacific sardines as "not overfished" and "with no overfishing occurring" throughout California. Levels of anchovies harvest fluctuated through the 1980's, declined during the early 1990's, and then increased again by 1995 (see Figure 4).

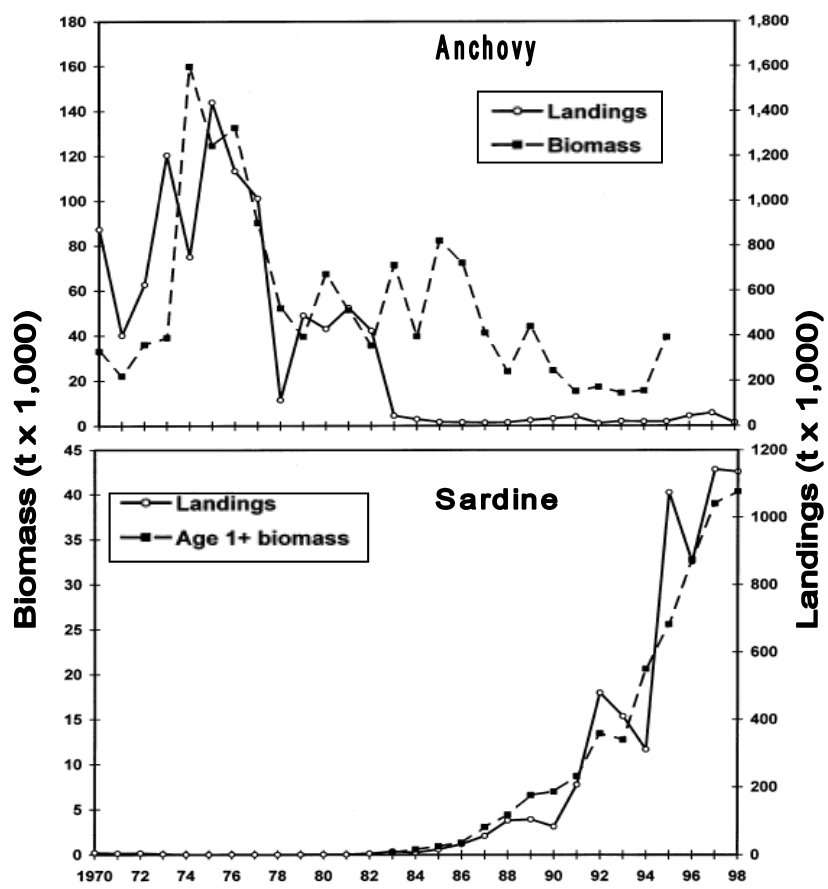


Figure 4. Anchovy and Sardines: Annual landings and estimated biomass for Pacific sardine and northern anchovy in California. Data from Pacific Fisheries Management Council 1998 and 2007, Hill et al. 2006, and Bar-aff and Loughlin 2000.

Predation

Predation on adult pelicans is rare. Gull and corvids (ravens and crows) are the most frequent nest predators (eggs and nestlings). They typically target nests left unattended by parents. Such predation may be facilitated by human disturbance at the nest site that flushes adults from nests (Schreiber and Risebrough 1972, Anderson and Keith 1980). Raptors flying overhead occasionally flush roosting birds (Jaques 1994). Flushed pelicans typically circle overhead and return to nest or roost site, or lands on water nearby (Schreiber 1979). Natural flushing events at colonies also can result in nest predation.

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Restoration—Enhancing Pelican Roost Habitat

(Summarized and excerpted from Jaques and Strong 2002, 2003; Strong and Jaques 2003)

Restoration efforts related to brown pelican non-breeding habitat enhancement are primarily aimed at creating or improving night roost habitat. Night roost habitat in southern California is limited, while day roost habitat remains reasonably abundant. Night roosts also tend to be the highest quality day roosts, therefore, creating or enhancing night roosts will also benefit day roosts (Jaques and Strong 2002).

It is recommended that the following criteria be considered when selecting night roost enhancement or creation projects:

Need and Location. Target geographical gaps in night roost availability. The Santa Barbara coast has the lowest night roost capacity (birds travel to the Channel Islands at night), and large night roosts in San Diego County and Orange County are marginal due to changes in management (Agua Hedionda), overwash by tide or wind waves (Zuniga Point) and human disturbance (Dana Point Harbor).

Predator buffer. Provide permanent open water buffer around roost sites.

Vertical relief. Ensure dry habitat that

(a) is free from overwash by waves and
(b) provides microhabitat options including shade and wind protection.

Capacity. Provide space for 100 birds or more.

Human disturbance. Establish management tools to prevent or limit human disturbance.

Viewshed. Maintain an open view of potential foraging areas and predator approaches.

Substrate. Use substrates commonly used by pelicans.

Data gaps that need to be addressed to implement certain restoration actions include the following:

(a) Determination of the height of existing Marina Del Rey breakwater to provide guidance on the appropriate breakwater height above high water;
(b) Determination of the width and depth of water buffers at Agua Hedionda Lagoon to provide guidance on the appropriate sizing of buffers; and
(c) Determination of roosting pelican capacity per meter of breakwater at Long Beach and Marina Del Rey to provide guidance on capacity of high quality roosts.

Potential Restoration Projects

Recommendations for potential restoration projects are listed in Table 1. As of 2008, efforts were underway to implement some of these projects. In late 2004, a roosting barge was anchored at the South San Diego Bay National Wildlife Refuge as a pilot project to attract pelicans to a safe night roost habitat. Although the platform was monitored monthly for evidence of night roosting throughout 2005 (U.S. Fish and Wildlife Service, unpublished data), none was observed. By 2008, however, pelicans were photographed using the platform during the day. Available levee habitat, although perilous due to predator accessibility, continues to be used (D. Brubaker, pers. communication).

In fall 2005, remnants of the Sandpiper Pier were removed and four new roosting and nesting structures were installed. Small numbers of pelicans roosted on the new structures even prior to construction of the final structure in early December 2005 (M. Fluharty, personal communication). From 1997-2005, Brandt's Cormorants nested at the original pier (McChesney *et al.* 1998, Capitolo *et al.* 2008). In 2006, Brandt's Cormorants nested on all four structures, but no pelicans were present during aerial surveys in April-June (Capitolo *et al.* 2008). When nesting cormorants are present, little space apparently is available for other roosting birds. As of 2008, plans were being made to document use of the new roost structures for pelican roosting in fall and winter.

Table 1. Habitat enhancement: Specific recommendations to improve night roost habitat

Treatment Type	Roost Site	Priority	Project Description
Create New Island Habitat	San Diego Bay National Wildlife Refuge	High	Modify existing earthen levees to create islands, or create floating islands surrounded by an open water buffer, implemented in part, additional efforts needed
	Batiquitos Lagoon	High	Create earthen islands or create floating islands surrounded by an open water buffer
	Outer Santa Barbara Harbor or other location along Santa Barbara County coast	High	Create floating islands surrounded by an open water buffer
Improve Existing Structure to Enhance Habitat Quality of Existing Night Roost	Zuniga Point Jetty	Moderate	Add riprap to increase height of jetty to eliminate overwash by wind waves or high tides
	Ventura Harbor Breakwater	Moderate	Add riprap to increase height of jetty to eliminate overwash by wind waves or high tides
	Channel Islands Harbor Breakwater	Moderate	Add riprap to increase height of jetty to eliminate overwash by wind waves or high tides
	Sandpiper Pier	Moderate	Replace artificial structure to increase capacity and structural heterogeneity/microhabitat features (As of 2008 this project was already implemented)

Restoration—Reducing Disturbance to Roosting Pelicans

(Summarized and excerpted from Strong and Jaques 2003)

Restoration actions geared towards reducing human disturbance at existing roosts in southern California should prioritize natural areas. It may be more difficult to achieve the goal in natural habitats; however, the long-term ecological benefits to pelicans and other waterbird species are likely to be greater (Jaques and Strong 2002). Some harbor structures or man-made structures on the outer coast remain very good candidates for enhancement.

The most heavily disturbed traditional roost sites in Southern California were Malibu Lagoon, the Santa Clara River mouth, and Tijuana Slough. Each of these sites had disturbance frequencies exceeding one flushing event per hour. The harbors with the greatest disturbance problems in southern California appeared to be King Harbor and Dana Point. The primary roost sites at each of these harbors were attached jetties, rather than detached breakwaters.

Efforts to reduce human disturbance in southern California needs to target different user groups, primarily different types of recreationists, according to general roost site habitat. The key user groups in harbors that need to change behaviors to reduce disturbance include boaters and fishermen, whereas the primary users in estuaries would be people walking on the beach. The increase in disturbance due to small watercraft and surfers in recent years likely reflects an increase in the popularity of these water sports and is of concern (Jaques and Strong 2002).

Recommendations are split into projects in harbors, including jetties and breakwaters; and projects in estuaries and lagoons.

Harbors and Coastline: Recommendations to Reduce Human Disturbance

Table 2. Habitat enhancement: Specific recommendations to reduce human disturbance in harbors and along coastlines

Target User Group	Project Description	Pros	Cons	Locations
People on Foot	Installation of fences on long jetties to block access	Decrease disturbance and displacement of pelicans from jetty roosts May develop some day roosts to night roosts May reduce pelican use of boats, piers, buildings and other private property in harbors	May restrict rights of public users May increase pelican use of harbors overall, resulting in increased negative human-pelican interactions	The longest jetties at: Dana Point King Harbor Oceanside Anaheim Bay and potentially others
Motorized and Non-Motorized Watercraft	Placement of signs informing boaters that landing on breakwaters and similar structures is not permissible	Decrease disturbance, flushing and displacement of pelicans by boaters landing on or near roosting sites	Limited enforcement needed	Breakwaters at: Marina del Rey Ventura Harbor Channel Islands Harbor and potentially others
	Placement of buoys around breakwaters to create a 20 m to 30 m buffer zone between boats and pelicans	Decrease disturbance and flushing of roosting pelicans from near approaches by boats	May restrict activities of large, well-informed tour boats, but not some small boats such as kayaks and jet skis. (Small boat operators were observed to cause the most disturbance) Enforcement important yet difficult Buoys may cause navigation hazard	

Recommendations to improve habitat in harbors include installation of fences on jetties to prevent disturbance from people walking out to the tips since both pelicans and fishermen appear to prefer the tips of jetties (Jaques and Strong 2002). Precluding fishermen from tips of jetties would probably be very effective in reducing disturbance, including the indirect disturbances that pelicans encounter when they move to less preferred habitats within the same harbor after a disturbance. This might lead to greater numbers of pelicans using those jetties where fencing was installed and possibly create some night roosts.

However, the value of allowing more pelicans to rest undisturbed on jetties needs to be weighed against the negative implications of greater pelican use of harbors. This action would also likely be perceived as restriction of the rights of shore fishermen, a group that directly caused only 6% of all disturbances documented in southern California (Jaques and Strong 2002). Vandalism, an increase in negative perceptions of pelicans, and increased potential of intentional killing or maiming of pelicans by fishermen could result from this action at popular fishing locations. In contrast, jetties that are not associated with intensive public use and that can be restricted for other reasons may be good candidates for fencing.

Placement of buoys around breakwaters to create a buffer zone between boats and pelicans may effectively prevent some disturbances, such as from tour boats, but the buffer is likely to be violated by the users of small water raft such as jet skis or kayaks. These smaller vessels caused the most disturbance (Jaques and Strong 2002). Enforcement of a buffer zone would be necessary since the overall positive benefits to pelicans are likely to be fairly negligible if there is no enforcement. Problems associated with the buoys causing hazards to navigation in some fairly narrow channels also need to be considered.

Where possible, a buffer of 30 meters would preclude all boat-based disturbance, and a 20 meter buffer would eliminate 75% of disturbances (based on observed flushing distances in Jaques and Strong 2002). The distance at which most boats pass *without* causing disturbance, and the distance required for boats to safely pass through a given area should be also be evaluated and considered.

The most severe disturbance scenario for harbors is having boats land on important breakwater roost sites. Although access on breakwaters it is not allowed (U.S. Army Corps of Engineers), there is no obvious source of public information on this. The placement of education signs on the breakwaters and at boat access points, informing people that the structures are not available for public use may be effective.

Estuaries, Lagoons and Coast: Recommendations to Reduce Human Disturbance

Table 3. Habitat enhancement: Specific recommendations to reduce human disturbance in estuaries, lagoons and coastal areas

Target User Group	Project Description	Pros	Cons	Locations
All User Groups Including Walkers, Fishermen, Surfers, Kayakers, Dogs	Develop education materials targeted to instill an awareness and ethic about protecting pelicans and other seabirds from disturbance	Decrease disturbance of roosting pelicans	Interpretive displays may be subject to vandalism	Malibu Lagoon Santa Clara River Mouth Tijuana River Mouth La Jolla Caves
		Increase use of coastal wetland habitats by pelicans and associated waterbirds	Success depends on voluntary changes in human behavior	
	Restrict human access within 25 m to 30 m by modifying trail patterns (may be temporary or permanent) and/or Create temporary closures to foot traffic or boats		Need for onsite management personnel to implement changes in trails and/or maintain experimental closures	
		Creates or increases regulatory buffer distance between pelicans and people	May require regulatory enforcement	
	Create island roost habitat within wetlands using natural or artificial substrates and/or Alternatives include earthen islands, artificial floating structures or pile-supported structures.	Increase habitat availability and decrease human disturbance by providing dry substrate surrounded by water buffer	Permitting may be difficult	Mugu Lagoon Bolsa Chica Lagoon Agua Hedionda Lagoon San Elijo Lagoon Batiquitos Lagoon South San Diego Bay
		Does not restrict recreational opportunities or rely on voluntary changes in human behavior	Costs for earthen islands may be relatively high, artificial structures may need to be maintained	
	Enhancement of roost sites by increasing elevation of existing islets	Same as above Increased habitat during high water	Permitting may be difficult	
	Provide artificial roosting substrate such as driftwood	Same as above Relatively easy to implement and natural in appearance	Limited available space for pelicans on driftwood, may require annual replacement	

Education projects may be the most effective means of reducing disturbance at sensitive estuaries and lagoons such as Malibu Lagoon and the Santa Clara River mouth. Education efforts include the development of interpretive materials to help instill an awareness and ethic about the negative impacts caused by disturbing pelicans and other waterbirds.

Additionally, restriction in foot traffic in sensitive wetlands may be appropriate at times when pelicans are vulnerable. For example, review of the human traffic patterns and trails at Malibu Lagoon may reveal some specific options for modifying human access patterns to reduce disturbance to the wetland area. When the lagoons are closed (cut off from the ocean), pelicans are likely to be on the outer beach where they are susceptible to disturbance from people walking the beach at high tide. Temporary closures around beach berm or sand spit roost sites may be appropriate. These could be set up using cones, ropes or signs. State Parks exclosures to prevent Snowy Plover and Least Tern disturbance are believed to be effective and may serve as a model for protecting pelican roosts. A minimum buffer zone of 25-30 meters between human traffic and pelicans would be required (Jaques and Strong 2002). A buffer distance of 30 m or more to protect wetland birds was recommended by Josselyn *et al.* (1989).

Changing the distribution of the pelicans by modifying habitat may be more effective in reducing disturbance than trying to alter the behavior of people. Enhancement of natural islets within the estuaries to raise the elevation of roost sites above the high water level or provision of additional natural substrate such as driftwood would be an effective means to provide a water buffer between humans and pelicans. though habitat manipulation is accepted at wetlands managed for wildlife, the support for these projects may not be likely in dynamic coastal wetlands managed by the California Department of Parks and Recreation. Placement of woody debris in coastal estuaries has taken place as part of salmon enhancement efforts in northern California. While the woody debris option would provide substrate for fewer pelicans, it may be more likely to be permitted.

Creation or enhancement of island roost habitat would be effective at many coastal wetlands that have restricted or limited public use, including Mugu Lagoon, Bolsa Chica, Agua Hedionda, San Elijo, Batiquitos, and South San Diego Bay. Artificial floating or piling-supported structures would probably be the most cost effective measures. Formation of artificial or earthen islands surrounded by adequate permanent water buffers would result in reduced disturbance to pelicans without restricting recreational opportunities or relying on voluntary changes in human behavior.

Provision, enhancement, or retention of artificial structures outside of harbors on the outer coast remains a justifiable restoration objective. These sites may provide pelicans with the least disturbed environment and greatest benefits relative to foraging opportunities.

Restoration — Habitat Modifications
Site-Specific Recommendations

(Summarized and excerpted from Jaques and Strong 2002; Strong and Jaques 2003; and Jaques and Strong 2003)

These site-specific recommendations are ideas that were developed for the American Trader Trustee Council and resource managers to consider when looking for opportunities to enhance Brown Pelican day and night roosting and habitat protection throughout their southern California range (Jaques and Strong 2002; Strong and Jaques 2003; and Jaques and Strong 2003). These ideas require additional development and consideration prior to implementation.

The atlas maps in this document (starting page 16) have specific locations associated with these recommendations and additional restoration ideas for resource managers to consider in the "Restoration Check List" box on each atlas map page. These ideas are presented for future mitigation and other opportunities for Brown Pelican conservation.

San Diego County

South San Diego Bay, SD 2.0 - High Priority
There is potential for development of large, high quality roost habitat at this site with collaboration from USFWS San Diego NWR. Although currently, the existing levees are used extensively for day and night roosting, the birds remain vulnerable to predator access. Restoration activity would target island habitat creation by alteration of existing levees, building islands, or installing floating structures. Protected, predator free, "island" type roosts would enhance day and night roosting here. A floating structure was established at this site in 2004 and monitored monthly for night use throughout 2005. Although no night roosting pelicans were observed in 2005, by 2008 day roosting pelicans had been observed. Additional night monitoring is being considered by the American Trader Trustee Council as of 2009.

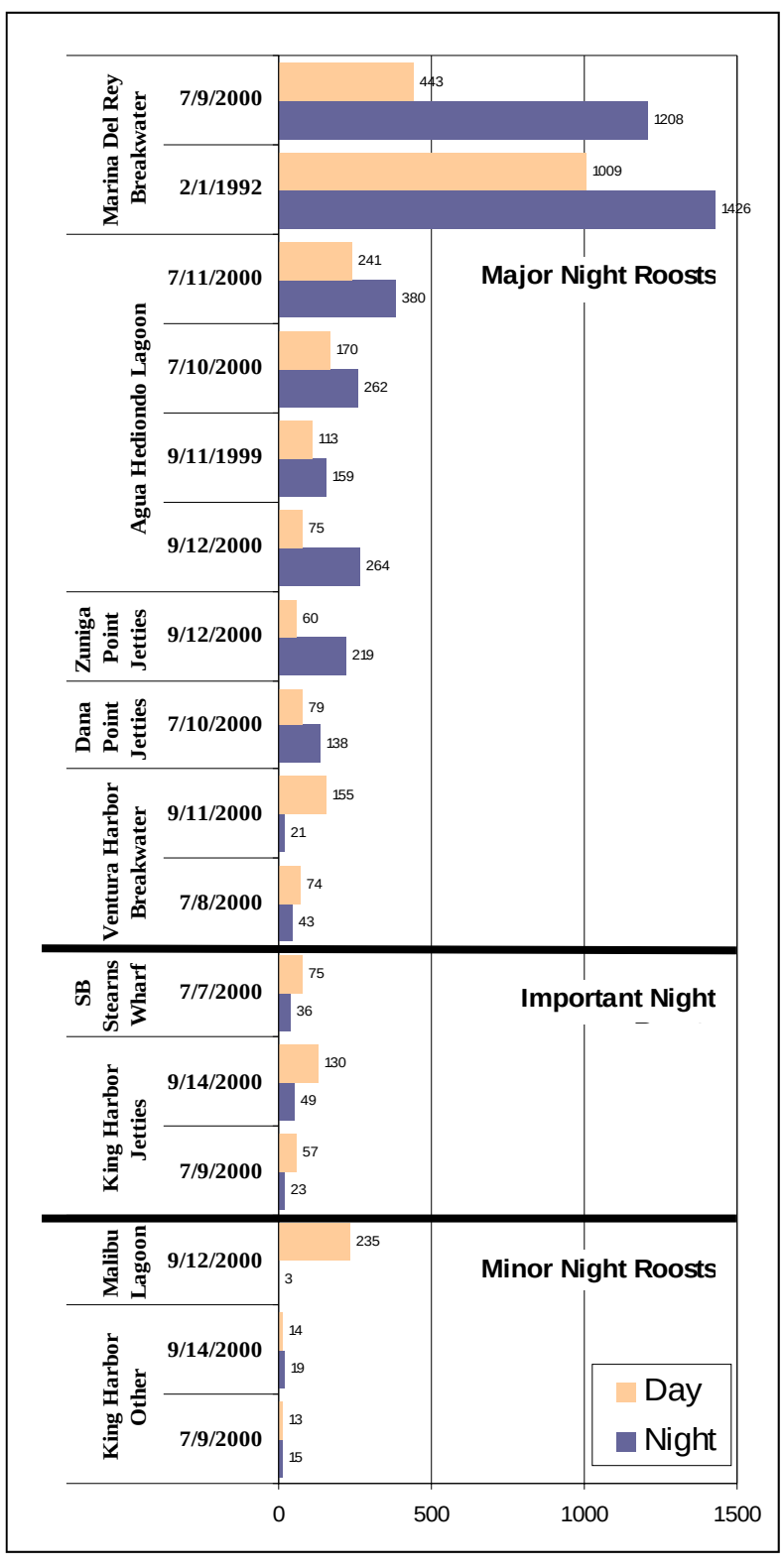

Figure 5. A comparison of day versus night roost numbers at selected roost sites. Daytime counts are the average numbers seen on the day before or after a given night roost count. All counts are from ground-based surveys.

Zuniga Point Jetty, SD 5.0 - Moderate Priority
Restoration activities here would involve supplementing the breakwater above high water with rip-rap to create a larger and higher quality night roost. Restoration actions would benefit both day and night roosts.

La Jolla Cove, SD 13 - Moderate Priority
La Jolla Cove fencing and signs could be improved to decrease the opportunities for people to flush or interact with pelicans. This would provide better day roost habitat.

Batiquitos Lagoon, SD 14 - High Priority
Development of high quality day and night roost habitat at Batiquitos Lagoon would be accomplished with collaboration from the CDFG at the Ecological Reserve. A floating structure or island that is buffered by open water at all tide stages is recommended. Restoration actions would benefit both day and night roosts.

Oceanside Harbor Jetty, SD 16 - Moderate Priority
Restoration actions would be in the form of education, signs or fencing to reduce disturbance. Restoration actions would benefit both day and night roosts.

Orange County

Dana Point Harbor Jetties, OR 2 - Moderate Priority
Restoration at Dana Point Harbor jetties would involve fencing to restrict shore access to the night roost area and signs to limit watercraft approaches. There is the potential for significant increase in night roost use if human access were eliminated. Restoration actions would benefit both day and night roosts.

Los Angeles County

King Harbor Jetties, LA 8 - Moderate Priority
Restoration activities at King Harbor Jetties (fencing and signs) could limit shore and watercraft disturbance and would enhance night roost quality. Restoration actions would benefit both day and night roosts.

Marina Del Rey Breakwater, LA 9 - Moderate Priority
Marina Del Rey breakwater restoration activities would include placement of signs to keep watercraft from approaching too closely which would enhance day and night roosts.

Malibu Lagoon, LA 11 - Moderate Priority
Restoration actions at Malibu Lagoon would involve advisory signs to keep people and dogs from entering areas close to the lagoon edge where pelicans typically roost during the day and night. Reduced human presence in the estuary would also benefit roosting Snowy Plovers, Least Terns, and a host of wetland bird species.

Ventura County

Santa Clara River Mouth, VN 6 - Moderate Priority
Restoration actions at Santa Clara River would involve advisory signs to keep people and dogs from entering areas close to the lagoon edge where pelicans typically roost during the day and night. Reduced human presence in the estuary would also benefit roosting Snowy Plovers, Least Terns, and a host of wetland bird species.

Ventura Harbor Breakwater, VN 7 - Moderate Priority
Restoration action here would involve advisory signs to keep people and dogs from entering areas where pelicans typically roost. Restoration actions would benefit both day and night roosts.

Rincon Island, VN 10 - Moderate Priority
Restoration options would be to secure an easement on the south and west sides of the island perimeter, install visual barriers between people and the roosting areas, or other control limiting human access to the roosting areas.

Santa Barbara County

Santa Barbara Harbor Stearns Wharf, SB 2 - High Priority
Considering the gap in roost availability along the Santa Barbara coastline and proven high use of the outer Santa Barbara Harbor sites lost in the early 1990s, roost site creation here would be expected to have the greatest benefit to pelicans among all restoration options considered for both day and night roost habitat. Restoration actions would benefit both day and night roosts.

Summary of Day and Night Roost Survey Results

County	Roost Location	Day Roosts Surveys			Night Roosts Surveys	
		Aerial[1]	Ground[2]	Status	Ground[2]	Status
San Diego	SD 1.0 TIJUANA RIVER MOUTH	244		Major		Not Surveyed
	SD 2.0 SOUTH SAN DIEGO BAY	26	64	Important		Not Surveyed
	SD 3.0 SOUTH SAN DIEGO BAY HARBORS	130	187	Major		Not Surveyed/Likely
	SD 4.0 NORTH SAN DIEGO HARBORS		56	Important		Not Surveyed/Likely
	SD 5.0 ZUNIGA POINT JETTY	377	60	Major	245	Major
	SD 6.0 POINT LOMA, CABRILLO NATIONAL MONUMENT	247	2	Major		Not Surveyed
	SD 7.0 POINT LOMA, US NAVY ELECTRONICS LAB	155		Major		Not Surveyed
	SD 8.0 SUNSET CLIFFS	162		Major		Not Surveyed
	SD 9.0 OCEAN BEACH PIER	47		Important		Not Surveyed
	SD 10.0 MISSION BAY JETTIES	63		Important		Not Surveyed
	SD 11.0 LA JOLLA BIRD ROCK	266		Major		Not Surveyed
	SD 12.0 LA JOLLA ROCKS	240		Major	0	Minor
	SD 13.0 LA JOLLA COVE	724	184	Major		Not Surveyed
	SD 13.1 SAN ELIJO LAGOON	1	0	Minor		Not Surveyed
	SD 14.0 BATIQUITOS LAGOON	362	16	Major	0	Minor
	SD 15.0 AGUA HEDIONDO LAGOON	116	241	Major	380	Major
	SD 16.0 OCEANSIDE HARBOR JETTY	284		Major	28	Minor
	SD 16.1 SAN LUIS REY RIVER MOUTH	26		Minor		Not Surveyed
	SD 17.0 SANTA MARGARITA RIVER MOUTH	99		Important		Not Surveyed
	SD 18.0 FRENCH CANYON TO SAN MATEO CREEK MOUTH	75		Important		Not Surveyed
Orange	OR 1.0 CAPISTRANO BIGHT	14		Minor		Not Surveyed
	OR 2.0 DANA POINT HARBOR JETTIES	364	436	Major	239	Major
	OR 2.1 DANA POINT HARBOR OTHER	341	80	Major		Not Surveyed
	OR 3.0 SAN JUAN ROCKS	99		Important		Not Surveyed
	OR 4.0 MUSSEL COVE TO LAGUNA BEACH	72		Important		Not Surveyed
	OR 5.0 RECREATION POINT	133		Major		Not Surveyed
	OR 6.0 TWIN POINTS TO ABALONE POINT	51		Important		Not Surveyed
	OR 7.0 REEF POINT TO ARCH ROCK	41		Important		Not Surveyed
	OR 8.0 NEWPORT BAY JETTIES	115		Major		Not Surveyed
	OR 9.0 BOLSA CHICA LAGOON	69	11	Important		Not Surveyed/Likely
	OR 10.0 ANAHEIM BAY JETTIES	250		Major		Not Surveyed
Los Angeles	LA 1.0 LONG BEACH HARBOR EAST BREAKWATER	506		Major		Not Surveyed
	LA 2.0 LONG BEACH HARBOR MIDDLE BREAKWATER	335		Major	584	Major
	LA 3.0 SAN PEDRO BREAKWATER	370		Major		Not Surveyed
	LA 3.5 LONG BEACH HARBOR OTHER	70		Important		Not Surveyed
	LA 4.0 WHITE'S POINT	30		Important		Not Surveyed
	LA 5.0 PORTUGUESE BEND TO LONG POINT	206		Major		Not Surveyed
	LA 6.0 POINT VICENTE TO RESORT POINT	18		Minor		Not Surveyed
	LA 7.0 LUNADA BAY AND PALOS VERDES POINT	58		Important		Not Surveyed
	LA 8.0 KING HARBOR JETTIES	292	305	Major	90	Important
	LA 8.1 KING HARBOR OTHER	87	14	Important	20	Minor
	LA 9.0 MARINA DEL REY BREAKWATER	700	1115	Major	1642	Major
	LA 10.0 SANTA MONICA TO MALIBU	635		Major		Not Surveyed
	LA 11.0 MALIBU LAGOON	243	339	Major	3	Minor
	LA 12.0 POINT DUME TO POINT MUGU	191		Major	0	Minor
Ventura	VN 1.0 MUGU LAGOON	504	904	Major		Not Surveyed
	VN 2.0 LAGUNA POINT TO ORMOND BEACH	158		Major		Not Surveyed
	VN 3.0 POINT HUENEME JETTIES	65		Important		Not Surveyed
	VN 4.0 CHANNEL ISLANDS HARBOR BREAKWATER	208	111	Major	9	Minor
	VN 4.1 CHANNEL ISLANDS HARBOR INNER		74	Important	28	Minor
	VN 5.0 MANDALAY BEACH AND MCGRATH LAKE	25		Minor		Not Surveyed
	VN 6.0 SANTA CLARA RIVER MOUTH	446	300	Major	14	Minor
	VN 7.0 VENTURA HARBOR BREAKWATER	782	460	Major	227	Major
	VN 7.1 VENTURA HARBOR INNER		20	Minor		Not Surveyed
	VN 8.0 VENTURA RIVER MOUTH	49		Important		Not Surveyed
	VN 9.0 MUSSEL SHOALS PIER	739	211	Historic	51	Historic
	VN 9.1 BEACH AT MUSSEL SHOALS PIER	22	16	Minor		Not Surveyed/Unlikely
	VN 10.0 RINCON ISLAND	2636	359	Major	53	Important
Santa Barbara	SB 1.0 SAND POINT TO FERNALD POINT	114	160	Major		Not Surveyed
	SB 2.0 SANTA BARBARA HARBOR STEARNS WHARF	165	88	Major	36	Important
	SB 2.1 SANTA BARBARA HARBOR OUTER	1636	152	Historic	160	Historic
	SB 2.2 SANTA BARBARA HARBOR OTHER	167		Major		Not Surveyed
	SB 3.0 MISSION CREEK MOUTH	59		Important		Not Surveyed
	SB 4.0 POINT CASTILLO SANDSPIT	306		Major		Not Surveyed
	SB 5.0 WEST BEACH	79		Important		Not Surveyed
	SB 6.0 GOLETA	35		Important		Not Surveyed
	SB 7.0 COAL OIL POINT TO EAGLE CANYON	293		Major		Not Surveyed
	SB 8.0 BIRD ISLAND	160		Major		Not Surveyed/Likely
	SB 9.0 NAPLES	524		Major		Not Surveyed
	SB 10.0 DOS PUEBLOS TO EL CAPITAN	177		Major		Not Surveyed
	SB 11.0 CANADA DEL CORRAL TO TAJIGUAS	88		Important		Not Surveyed
	SB 12.0 ARROYO QUEMADO	70		Important		Not Surveyed
	SB 13.0 CANADA DE LA PILA TO CANADA SAN ONOFRE	115		Major		Not Surveyed
	SB 14.0 CANADA DEL LEON TO GAVIOTA	60		Important		Not Surveyed
	SB 15.0 CANADA DEL AGUA CALIENTE	194		Major		Not Surveyed
	SB 16.0 CANADA DE ALEGRIA TO SAN AUGUSTIN	77		Important		Not Surveyed
	SB 17.0 CANADA DE LA LLEGUA TO CANADA DEL GATO	153		Major		Not Surveyed
	SB 18.0 COJO BAY	481		Major		Not Surveyed
	SB 19.0 GOVERNMENT POINT	80		Important		Not Surveyed
	SB 20.0 POINT CONCEPTION	679		Major		Not Surveyed

[1]From Air Surveys: Based on maximum counts observed on roosts 1992 to 2007.
[2]From Ground Surveys: Based on maximum counts observed on roosts 1986 to 2007.

See Appendix A for references and data.

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MAP KEY TO DETAILED PAGES OF CALIFORNIA BROWN PELICAN ROOSTING LOCATIONS ON THE COAST OF SOUTHERN CALIFORNIA

Prepared for The American Trader Trustee Council

United States Fish and Wildlife Service

National Oceanic and Atmospheric Administration

California Department of Fish and Game

Atlas Prepared by United States Fish and Wildlife Service

SD 7.0 POINT LOMA, US NAVY ELECTRONICS LAB

Jurisdiction: US Navy

Habitat: Mainland and Offshore Rock

Photo Copyright Deborah Jaques and Craig Strong

	Max Pelican Count	
	Aerial	Ground
Day Roost		
1992	155	
1993	6	
1998	0	
1999	0	
2000	28	
2001	44	
Day Roost Average	24	

Cliff ledges and a few small offshore rocks provide roost habitat for highly variable numbers of pelicans along approximately 2 km of coast within the Naval base, which is part of the Point Loma Ecological Reserve. Restricted access on the military property is likely critical to maintenance of the roost by limiting disturbance. Most birds have been seen on the mainland ledges, but both the ledges and offshore rocks are used. Night roost status is unknown.

Day Roost—Major **Night Roost—Not Surveyed**

SD 6.0 POINT LOMA, CABRILLO NATIONAL MONUMENT

Jurisdiction: National Park Service

Habitat: Mainland and Offshore Rock

Photo Copyright Deborah Jaques and Craig Strong

	Max Pelican Count	
	Aerial	Ground
Day Roost		
1992	49	
1993	0	
1998	24	
1999	23	2
2000	247	
2001	45	
2002	8	
Day Roost Average	31	2

Point Loma is a four-mile long 400 foot high peninsula located at the north entrance of San Diego Bay. The Cabrillo National Monument is at the tip of the peninsula. Pelicans roost in various locations on the ocean side of the peninsula on cliffs, soil slopes, low rocky outcrops, and small offshore rocks. Fences at the tops of steep cliffs deter visitors from approaching pelican roost groups; however, human disturbance has been observed and affects pelican use of the site. Restoration efforts could include improved fencing, signage, and public education efforts.

Day Roost—Major **Night Roost—Not Surveyed**

SD 5.0 ZUNIGA POINT JETTY

Jurisdiction: US Army Corps of Engineers

Habitat: Jetty

Photo Copyright Deborah Jaques and Craig Strong

	Max Pelican Count	
	Aerial	Ground
Day Roost		
1992	165	
1993	123	
1998	377	
1999	221	51
2000	82	60
2001	80	
2002	36	
Day Roost Average	93	44

Night Roost	
2000	245
Night Roost Average	219

The roost is on breakwater rocks and the jetty on the south side of San Diego Harbor entrance. Pelican use is limited by tidal height, as much of the structure is submerged at high tides. Birds also use the concrete jetty and rocks on the mainland point if the breakwater is unavailable or crowded. Human presence is restricted on the point by the North Island Naval Base, and mammalian predators have been controlled to protect Least Tern nesting habitat. Though the structure is maintained by Army Corps of Engineers, the Navy manages resources allowing pelican use. Pelicans largely avoided the elevated channel marker structures towards the tip of the breakwater, and preferred the low rocks that were subject to inundation. California sea lions are common on the outer channel marker, but it is not known why the other two markers are used so little. Recreational boats, shipping traffic, and frequent overflights by low altitude military aircraft are potential disturbance sources, but data are unavailable. Restoration activities here would involve supplementing the breakwater above high water with rip-rap to create a larger and higher quality night roost.

Day Roost—Major **Night Roost—Major**

SD 4.0 NORTH SAN DIEGO HARBORS

Jurisdiction: Private, US Navy

Habitat: Harbor

	Max Pelican Count	
	Aerial	Ground
Day Roost		
1999		56
Day Roost Average		56

Day Roost—Important

Night Roost—Not Surveyed/Likely

The northern shoreline of San Diego Bay is heavily developed. Private and military structures at the north end of San Diego Bay support significant numbers of pelicans by day. At some marinas, large concentrations of birds are attracted by bait disposal or deliberate feeding by fishermen. Shelter Cove harbor, North Island Naval Air Station, and the Coast Guard/military harbor around Ballast Point also have roost structures (barges, docks, pilings, buoys), but these are subject to alteration depending on activities of the military and owners of the structures. Air survey coverage of these sites has been incomplete, and description of exact locations unclear, thus they were combined here. Improvements to roost habitat in these areas are not desirable due to potential conflicts associated with private ownership, military operations, heavy recreational use, nuisance problems, and inherent hazards to pelicans.

SD 3.0 SOUTH SAN DIEGO BAY HARBORS

Jurisdiction: Private, US Coast Guard, US Navy

Habitat: Harbor

	Max Pelican Count	
	Aerial	Ground
Day Roost		
1992	20	
1993	130	
1999	96	
2000		187
Day Roost Average	36	187

Several private and military lands along the southwestern edge of San Diego Bay, the "Silver Strand," provide habitat for roosting pelicans. These sites are subject to physical changes that affect their use as roost sites. One of the largest and most consistent roosts has been on a breakwater constructed with rubber tires at Fiddler's Cove Marina (a military recreation harbor along Silver Strand). Pelicans also roost on the beach in restricted access military installations in association with Least Tern habitat.

Day Roost—Major **Night Roost—Not Surveyed/Likely**

SD 2.0 SOUTH SAN DIEGO BAY

Jurisdiction: US Fish & Wildlife Service, City of Chula Vista

Habitat: Levee

Photo Copyright Deborah Jaques and Craig Strong

	Max Pelican Count	
	Aerial	Ground
Day Roost		
1992	16	
1993	23	
1998	26	
1999	0	
2000		64
Day Roost Average	11	43

Man-made earthen levees have created "salt ponds" used as part of the commercial salt making operation present at this site. These levees provide day and night roosting habitat for pelicans, as well as nesting and roosting habitat for other water birds. The main roost site is at the southwest corner of the bay, on a peninsula formed by a defunct levee. Although high numbers have not been recorded here, use appears to have increased since 1986. Because the levees are not "islands" there is considerable opportunity for predation and disturbance. Significant potential exists for improving the quality and quantity of roost habitat on or adjacent to the salt pond levees, and for the establishment of a night roost by making the levees into islands where they are not longer used for commercial activities. The south end of the bay has extensive open water habitat with low water velocities and little watercraft activity. Restoration activity would target island habitat creation by alteration of existing levees or addition of floating structures. An experimental floating platform was installed in 2004, however, all pelican roosting was observed on the previously existing levees.

Day Roost—Important **Night Roost—Not Surveyed**

SD 1.0 TIJUANA RIVER MOUTH

Jurisdiction: US Fish & Wildlife Service, CA Dept of Parks & Recreation

Habitat: River Mouth

Photo Copyright Deborah Jaques and Craig Strong

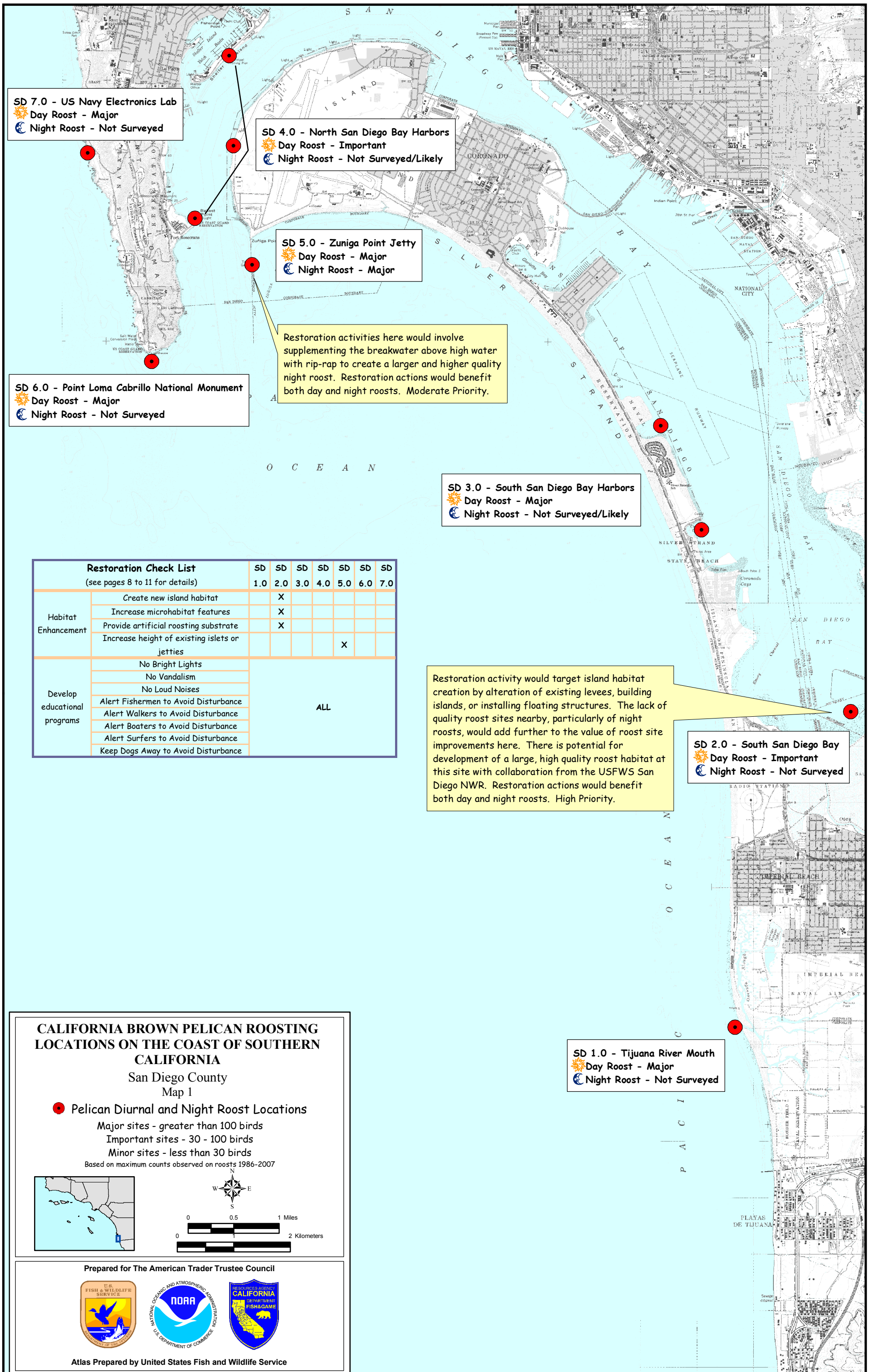
	Max Pelican Count	
	Aerial	Ground
Roost		
1992	58	
1993	0	
1998	25	
1999	244	
2000	236	
2001	64	
Roost Average	67	

This area is part of the largest salt marsh in California. California Department of Parks and Recreation property is on the south side of the river mouth, but most pelican use occurs in the Tijuana Slough National Wildlife Refuge. The capacity and quality of this roost is variable, depending on tidal state, and tidal and flood effects on sandbar configuration over the seasons. This area is also subject to frequent disturbance from ground and helicopter traffic associated with illegal border crossings. It is unlikely that meaningful roost habitat improvements could be achieved here due to disturbance effects and varying natural conditions at the site.

Day Roost—Major **Night Roost—Not Surveyed**

See Appendix A for data sources

"max" - single highest count at each location for each year
"average" - average of all counts recorded at each location for all dates



Restoration Check List (see pages 8 to 11 for details)		SD 1.0	SD 2.0	SD 3.0	SD 4.0	SD 5.0	SD 6.0	SD 7.0
Habitat Enhancement	Create new island habitat		X					
	Increase microhabitat features		X					
	Provide artificial roosting substrate		X					
	Increase height of existing islets or jetties					X		
Develop educational programs	No Bright Lights	ALL						
	No Vandalism							
	No Loud Noises							
	Alert Fishermen to Avoid Disturbance							
	Alert Walkers to Avoid Disturbance							
	Alert Boaters to Avoid Disturbance							
	Alert Surfers to Avoid Disturbance							
	Keep Dogs Away to Avoid Disturbance							

CALIFORNIA BROWN PELICAN ROOSTING LOCATIONS ON THE COAST OF SOUTHERN CALIFORNIA

San Diego County

Map 1

Pelican Diurnal and Night Roost Locations

Major sites - greater than 100 birds

Important sites - 30 - 100 birds

Minor sites - less than 30 birds

Based on maximum counts observed on roosts 1986-2007

N W E S

0 0.5 1 Miles

0 1 2 Kilometers

Prepared for The American Trader Trustee Council

Atlas Prepared by United States Fish and Wildlife Service

SD 13.0 LA JOLLA COVE

Jurisdiction: City of La Jolla

Habitat: Mainland and Offshore Rock

Photo Copyright Deborah Jaques and Craig Strong

		Max Pelican Count	
		Aerial	Ground
Day Roost			
	1992	155	
	1993	0	
	1998	88	
	1999	346	
	2000	239	184
	2001	257	
	2002	103	
	2006	724	
	2007	157	
	2005	21	
Day Roost Average		120	184

The sandstone cliffs north and west of La Jolla Caves are a frequently used day roost. The area is lightly fenced and has advisory signs to keep people from cliff edges. It is heavily used by people and, although pelicans have habituated to human proximity here, several disturbances were noted during a two hour observation. There is potential for low cost restoration action here through improvement to the existing fence and more effective advisory signs.

Day Roost—Major **Night Roost—Not Surveyed**

SD 12.0 LA JOLLA ROCKS

Jurisdiction: Bureau of Land Management

Habitat: Mainland and Offshore Rock

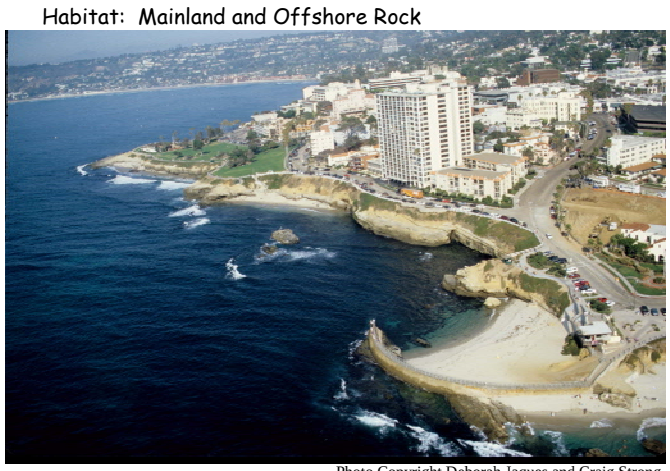


Photo Copyright Deborah Jaques and Craig Strong

		Max Pelican Count	
		Aerial	Ground
Day Roost			
	1992	0	
	1993	60	
	1998	0	
	1999	240	
	2000	174	
	2001	3	
Day Roost Average		70	
Night Roost			
	2000		0
Night Roost Average			*

The La Jolla Rocks roosting area extends from False Point to Point La Jolla, and is a section of rocky coastline consisting of low bluffs, sandstone outcrops and a few small offshore rocks. Pelicans use the mainland outcrops and small rocks for roosting, often in close proximity to people, since there is regular public use of the shoreline in the area. Existing fences and other barriers may prevent chronic disturbance.

Day Roost—Major **Night Roost—Minor**

SD 11.0 LA JOLLA BIRD ROCK

Jurisdiction: Bureau of Land Management

Habitat: Offshore Rock

Photo Copyright Deborah Jaques and Craig Strong

		Max Pelican Count	
		Aerial	Ground
Day Roost			
	1992	29	
	1993	36	
	1998	4	
	1999	0	
	2000	266	
	2001	14	
Day Roost Average		38	

This is the largest and farthest offshore of several small rocks around La Jolla Point (south end of La Jolla). The flat top is above reach of wave wash and provides a high quality roost, although rarely supporting over 20 birds. It is a suitable night roost but night use has not been surveyed. In an exceptional count during 2000 (data not available for this atlas), 359 birds were listed at the rock, but over half of these were 'overflow' from the rock and roosted on the adjacent mainland.

Day Roost—Major **Night Roost—Not Surveyed**

SD 10.0 MISSION BAY JETTIES

Jurisdiction: US Army Corps of Engineers

Habitat: Jetty

Photo Copyright Bruce Perry, Department of Geological Sciences, CSU Long Beach

		Max Pelican Count	
		Aerial	Ground
Day Roost			
	1992	25	
	1993	3	
	1998	0	
	1999	0	
	2000	63	
	2001	35	
Day Roost Average		14	

The Mission Bay jetties were constructed during the 1950's as part of a project to convert the salt marshes and mudflats of the San Diego River mouth into a recreational harbor. The two jetties at the mouth of the bay are referred to as the North Jetty and the Middle Jetty. The jetties are relatively short and are frequently used by fishermen, limiting their use by roosting pelicans.

Day Roost—Important **Night Roost—Not Surveyed**

SD 9.0 OCEAN BEACH PIER

Jurisdiction: City of San Diego

Habitat: Man-Made Structure

Photo Copyright Deborah Jaques and Craig Strong

		Max Pelican Count	
		Aerial	Ground
Day Roost			
	1992	47	
	1993	12	
	1998	3	
	1999	0	
Day Roost Average		11	

The Ocean Beach Municipal Pier is a concrete sport fishing pier that extends nearly 2,000 feet into the Point Loma kelps beds. It was constructed in 1966, but has been closed intermittently due to damage from storms. Pelicans roost on the railings and rooftops of various buildings on the pier.

Day Roost—Important **Night Roost—Not Surveyed**

SD 8.0 SUNSET CLIFFS

Jurisdiction: Bureau of Land Management

Habitat: Offshore Rocks

Photo Copyright Deborah Jaques and Craig Strong

		Max Pelican Count	
		Aerial	Ground
Day Roost			
	1992	71	
	1993	0	
	1998	0	
	2000	162	
	2001	8	
Day Roost Average		34	

This roost area extends from Sunset Cliffs to the Ocean Beach pier, and is characterized by steep cliffs and small offshore rocks, with residential neighborhoods above. The largest rock, at the north end of the roost area, is known as "Alligator Rock."

Day Roost—Major **Night Roost—Not Surveyed**

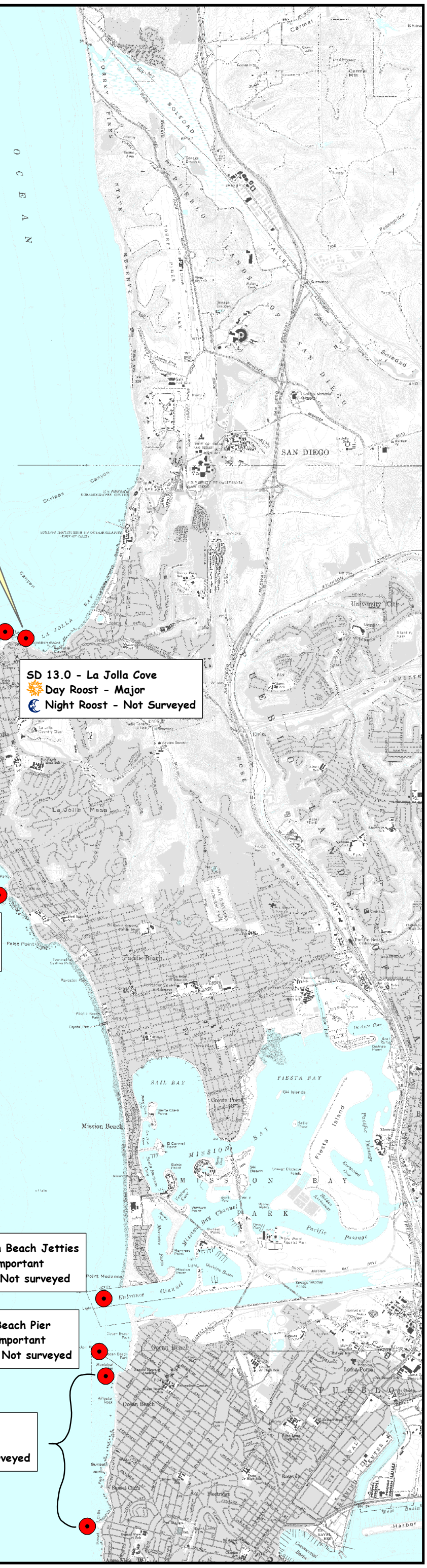
See Appendix A for data sources

*Although no pelicans were observed on these surveys either 1) other survey results not reported here or 2) casual observations indicated that pelicans currently use or have previously used this roost site.

"max" - single highest count at each location for each year

"average" - average of all counts recorded at each location for all dates

Restoration Check List (see pages 8 to 11 for details)		SD 8.0	SD 9.0	SD 10.0	SD 11.0	SD 12.0	SD 13.0
Reduce human disturbance	Repair and install signs to reduce human foot traffic						X
Restrict human and pet access	Create permanent undisturbed buffer zone with fencing (install new and repair old)						X
Develop educational programs	No Bright Lights	All					
	No Vandalism						
	No Loud Noises						
	Alert Fishermen to Avoid Disturbance						
	Alert Walkers to Avoid Disturbance						
	Alert Boaters to Avoid Disturbance						
	Alert Surfers to Avoid Disturbance						
	Keep Dogs Away to Avoid Disturbance						



CALIFORNIA BROWN PELICAN ROOSTING LOCATIONS ON THE COAST OF SOUTHERN CALIFORNIA

San Diego County

Map 2

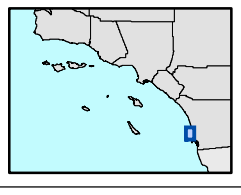
Pelican Diurnal and Night Roost Locations

Major sites - greater than 100 birds

Important sites - 30 - 100 birds

Minor sites - less than 30 birds

Based on maximum counts observed on roosts 1986-2007



N W E S

0 0.5 1 Miles

0 1 2 Kilometers

Prepared for The American Trader Trustee Council

Atlas Prepared by United States Fish and Wildlife Service

SD 17.0 SANTA MARGARITA RIVER MOUTH

Jurisdiction: US Marine Corps

Habitat: River Mouth

Photo Copyright © 2002-2008 Kenneth & Gabrielle Adelman, California Coastal Records Project, www.Californiacoastline.org

	Max Pelican Count	
	Aerial	Ground
Day Roost		
1992	30	
1993	0	
1998	99	
1999	31	
2001	11	
Day Roost Average	20	

The Santa Margarita River mouth forms a small intermittent estuary. It is located at the southwestern corner of Marine Corps Base Camp Pendleton. The land is undeveloped but is primarily used for military training, although research and recreational activities are allowed with a permit from the base. Pelicans use interior sandbars and the perimeter of the estuary for roosting.

Day Roost—Important **Night Roost—Not Surveyed**

SD 16.1 SAN LUIS REY RIVER MOUTH

Jurisdiction: City of Oceanside

Habitat: River Mouth

Photo Copyright Deborah Jaques and Craig Strong

	Max Pelican Count	
	Aerial	Ground
Day Roost		
1992	12	
1993	26	
Day Roost Average	11	

The San Luis Rey River is an ephemeral river whose estuary once extended over 2,200 acres. The channel has been altered by agricultural and urban development, and the mouth was dredged in 1964 as part of the development of the Oceanside Harbor. The current mouth is very small but includes a small island that is used by pelicans for roosting.

Day Roost—Minor **Night Roost—Not Surveyed**

SD 16.0 OCEANSIDE HARBOR JETTY

Jurisdiction: US Army Corps of Engineers

Habitat: Jetty

Photo Copyright Deborah Jaques and Craig Strong

	Max Pelican Count	
	Aerial	Ground
Day Roost		
1992	284	
1993	122	
1998	75	
1999	9	
2000	47	
2001	38	
Day Roost Average	57	

Night Roost	
2000	28
Night Roost Average	28

The roost is on the outer limits of the long jetty on the north side which has difficult human access from shore. It is regularly used by pelicans during the day and also observed to be used as a minor night roost. There are few alternative night roosts in the area. Disturbance sources are fishermen accessing the jetty by walking or by boat, watercraft, and low flying aircraft, although the considerable length of the jetty probably prevents chronic disturbance by pedestrians. Restoration actions could be in the form of signs or fencing to reduce disturbance.

Day Roost—Major **Night Roost—Minor**

SD 15.0 AGUA HEDIONDO LAGOON

Jurisdiction: City of Carlsbad

Habitat: Lagoon

Photo Copyright Deborah Jaques and Craig Strong

	Max Pelican Count	
	Aerial	Ground
Day Roost		
1992	38	
1993	40	
1999	116	113
2000		241
Day Roost Average	46	135

Night Roost	
1986	164
1999	179
2000	380
Night Roost Average	231

The primary roost at this site has been on floats set out by a mariculture company for shellfish production, which, historically, were the largest night roost in the Carlsbad area. This lagoon has been consistently used by pelicans in all prior surveys of southern California, with an average count of 70 birds present. Night roost use is higher than day use, with an average count of over 200. During ground surveys we noted the maximum capacity the roost has varied around 250 to 380 or more depending on the configuration of mariculture structures. Disturbance from mariculture activities is persistent and occurs several times a day, but there is little other disturbance. Contact with the company revealed that the company was under order from the City of Carlsbad to eliminate the roost due to concerns of excess bacteria loading of the lagoon. During summer and fall of 2000, wire exclusion devices had been placed on the larger floats that pelicans used. The site was still used, but remaining floats available for roosting were round and less stable, and provided a reduced capacity and lower quality roost than existed previously. The entire roost may be (or has been) eliminated. Roost site creation or enhancement here appears to be in conflict with current management goals at Agua Hedionda.

Day Roost—Major **Night Roost—Major**

SD 14.0 BATIQUITOS LAGOON

Jurisdiction: California Department of Fish & Game

Habitat: Lagoon

Photo Copyright © 2002-2008 Kenneth & Gabrielle Adelman, California Coastal Records Project, www.Californiacoastline.org

	Max Pelican Count	
	Aerial	Ground
Day Roost		
1992	362	
1993	102	
1998	0	
1999	0	0
2000		16
Day Roost Average	59	7

Night Roost	
2000	0
Night Roost Average	*

This lagoon lies about 7 km south of Agua Hedionda. Low numbers of pelicans consistently use the lagoon as a day roost, relying on the banks or sand islands exposed at low tide as substrate. In 1992, 362 pelicans were counted near the mouth of the lagoon. The area is managed by California Department of Fish and Game, which has invested considerable resources to stabilize the lagoon mouth and establish Least Tern nesting areas near the mouth. The lagoon has a large acreage of open water of moderate depth with low recreational use and low current velocities where roost creation is possible. The persistent use by pelicans on the existing low quality habitat indicates a high potential for success if secure roosts were created. Roost site creation would provide some mitigating compensation for the impending removal of the roost at Agua Hedionda, 7 km to the north. There is potential for development of large, high quality roost habitat using natural substrate at this site with collaboration from the California Department of Fish and Game at the Ecological Reserve.

Day Roost—Major **Night Roost—Minor**

SD 13.1 SAN ELIJO LAGOON

Jurisdiction: California Department of Parks & Recreation

Habitat: Lagoon

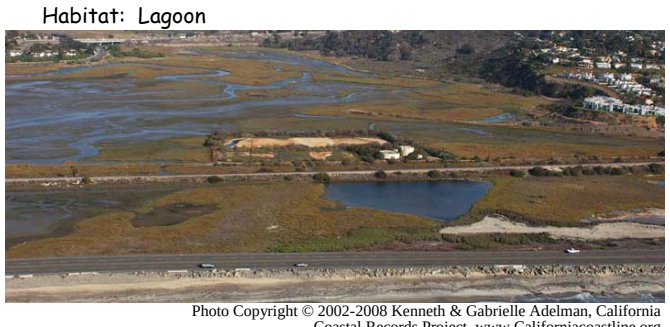


Photo Copyright © 2002-2008 Kenneth & Gabrielle Adelman, California Coastal Records Project, www.Californiacoastline.org

	Max Pelican Count	
	Aerial	Ground
Day Roost		
1998	1	
1999	0	
2000		0
Day Roost Average	1	*

Highway 101, the Santa Fe Railroad, and I-5 divide the lagoon into three basins connected by narrow channels. San Diego County, with the assistance of the California Department of Fish and Game, manages all three basins as an Ecological Reserve. Although surveys have not been conducted in this area, frequent pelican roosting and feeding activities have been observed here. Improvements for pelicans may include the development of a permanent island habitat in one of the lagoon basins.

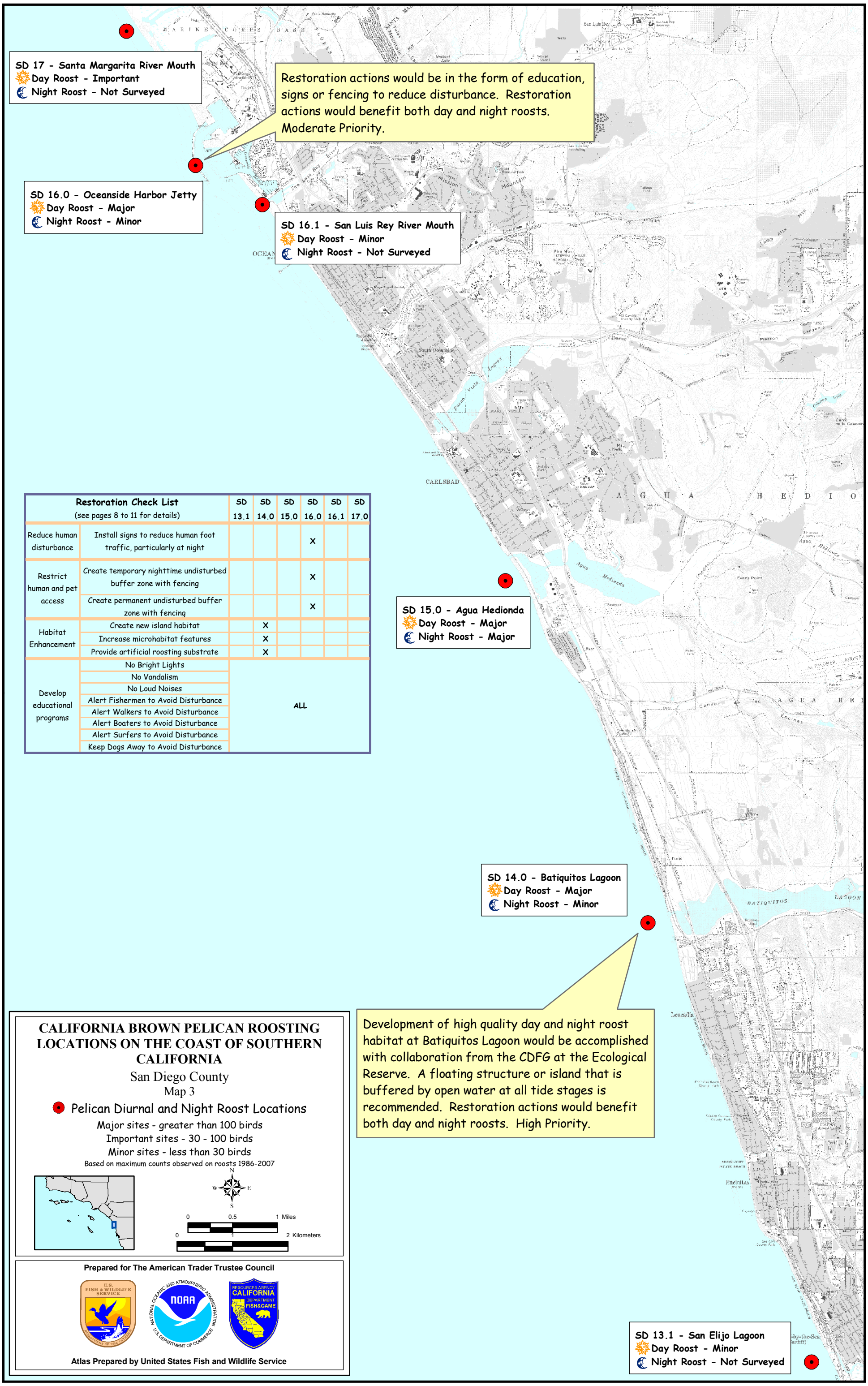
Day Roost—Minor **Night Roost—Not Surveyed**

See Appendix A for data sources

*Although no pelicans were observed on these surveys either 1) other survey results not reported here or 2) casual observations indicated that pelicans currently use or have previously used this roost site.

"max" - single highest count at each location for each year

"average" - average of all counts recorded at each location for all



Restoration Check List (see pages 8 to 11 for details)		SD 13.1	SD 14.0	SD 15.0	SD 16.0	SD 16.1	SD 17.0
Reduce human disturbance	Install signs to reduce human foot traffic, particularly at night				X		
Restrict human and pet access	Create temporary nighttime undisturbed buffer zone with fencing				X		
	Create permanent undisturbed buffer zone with fencing				X		
Habitat Enhancement	Create new island habitat		X				
	Increase microhabitat features		X				
	Provide artificial roosting substrate		X				
Develop educational programs	No Bright Lights	ALL					
	No Vandalism						
	No Loud Noises						
	Alert Fishermen to Avoid Disturbance						
	Alert Walkers to Avoid Disturbance						
	Alert Boaters to Avoid Disturbance						
	Alert Surfers to Avoid Disturbance						
	Keep Dogs Away to Avoid Disturbance						

CALIFORNIA BROWN PELICAN ROOSTING LOCATIONS ON THE COAST OF SOUTHERN CALIFORNIA

San Diego County

Map 3

Pelican Diurnal and Night Roost Locations

Major sites - greater than 100 birds

Important sites - 30 - 100 birds

Minor sites - less than 30 birds

Based on maximum counts observed on roosts 1986-2007

N W E S

0 0.5 1 Miles

0 1 2 Kilometers

Prepared for The American Trader Trustee Council

Atlas Prepared by United States Fish and Wildlife Service

SD 18.0 FRENCH CANYON TO SAN MATEO CREEK MOUTH

Jurisdiction: US Marine Corps, CA Dept of Parks & Recreation

Habitat: Beach and Creek Mouth

Photo Copyright Deborah Jaques and Craig Strong

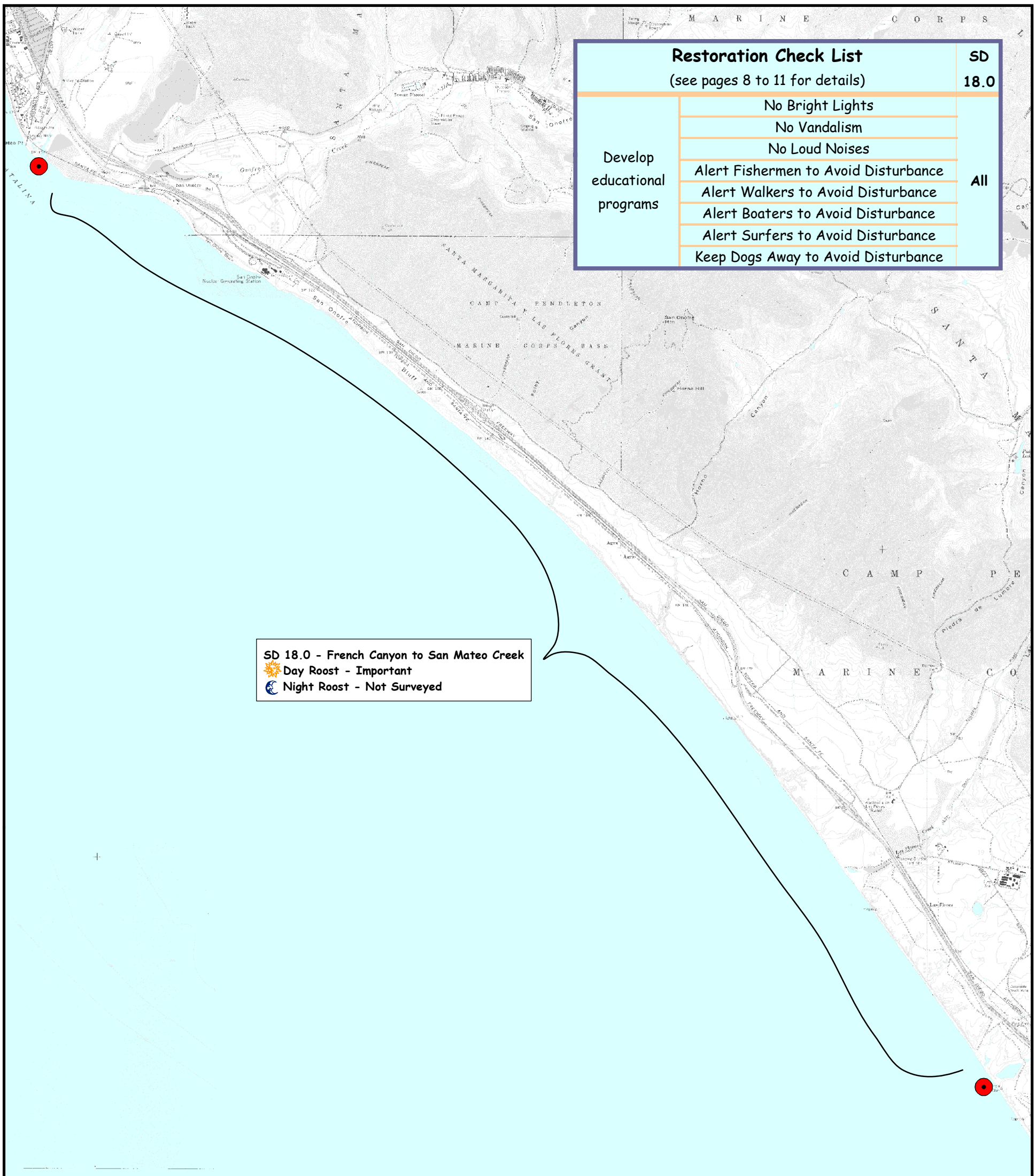
		Max Pelican Count	
		Aerial	Ground
Day Roost			
	1992	29	
	1993	0	
	1998	0	
	1999	0	
	2000	75	
Day Roost Average		14	

The coastline from French Canyon to San Mateo Creek includes lands that are part of Camp Pendleton and San Onofre State Beach. The region is characterized by relatively undeveloped flat sandy beaches with several small intermittent estuaries that are used irregularly by pelicans.

Day Roost—Important **Night Roost—Not Surveyed**

See Appendix A for data sources

"max" - single highest count at each location for each year
"average" - average of all counts recorded at each location for all dates



Restoration Check List (see pages 8 to 11 for details)		SD 18.0
Develop educational programs	No Bright Lights	All
	No Vandalism	
	No Loud Noises	
	Alert Fishermen to Avoid Disturbance	
	Alert Walkers to Avoid Disturbance	
	Alert Boaters to Avoid Disturbance	
	Alert Surfers to Avoid Disturbance	
	Keep Dogs Away to Avoid Disturbance	

CALIFORNIA BROWN PELICAN ROOSTING LOCATIONS ON THE COAST OF SOUTHERN CALIFORNIA

San Diego County

Map 4

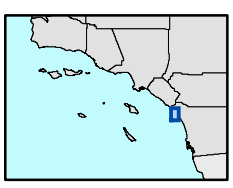
Pelican Diurnal and Night Roost Locations

Major sites - greater than 100 birds

Important sites - 30 - 100 birds

Minor sites - less than 30 birds

Based on maximum counts observed on roosts 1986-2007



N W E S

0 0.5 1 Miles

0 0.9 1.8 Kilometers

Prepared for The American Trader Trustee Council

Atlas Prepared by United States Fish and Wildlife Service

OR 3.0 SAN JUAN ROCKS

Jurisdiction: Bureau of Land Management

Habitat: Offshore Rocks

Photo Copyright © 2002-2008 Kenneth & Gabrielle Adelman, California Coastal Records Project, www.Californiacoastline.org

	Max Pelican Count	
	Aerial	Ground
Day Roost		
1992	43	
1993	10	
1998	3	
1999	0	
2000	99	
Day Roost Average	21	

The small rocks near Dana Point are relatively low relief. Pelican use is limited by surf and tidal conditions.

Day Roost—Important **Night Roost—Not Surveyed**

OR 2.1 DANA POINT HARBOR OTHER

Jurisdiction: Private

Habitat: Man-Made Structure

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	Max Pelican Count	
	Aerial	Ground
Day Roost		
1992	341	
1993	52	
2000	4	80
Day Roost Average	57	69

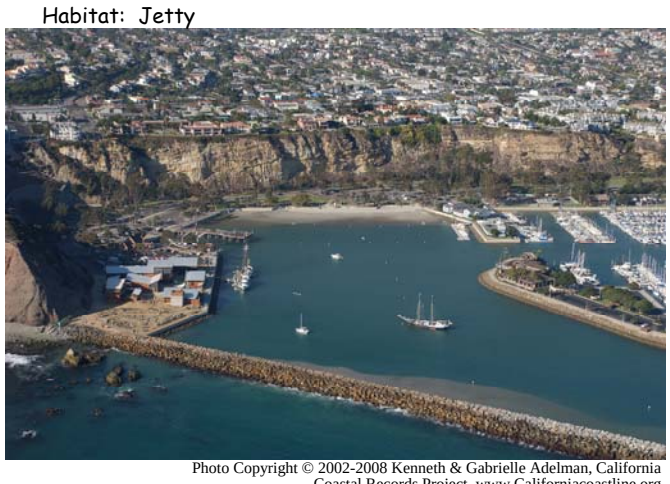
Artificial structures within the Dana Point harbor are sometimes used by pelicans for roosting, the most common site being the bait barge. Pelicans, herons, and gulls pose a nuisance to commercial bait barge operations within the harbor.

Day Roost—Major **Night Roost—Not Surveyed**

OR 2.0 DANA POINT HARBOR JETTIES

Jurisdiction: US Army Corps of Engineers

Habitat: Jetty



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	Max Pelican Count	
	Aerial	Ground
Day Roost		
1992	97	
1993	52	
1998	133	
1999	364	141
2000	195	436
2001	157	
Day Roost Average	120	184

Night Roost	
1986	239
1991	39
2000	138
Night Roost Average	124

The Dana Point Harbor jetties were constructed in 1968. Pelicans roost on both jetties, but favor the longer north jetty since it receives the least disturbance. Only the north jetty has been observed to be used as a night roost. Pelicans are habituated and tolerant of close watercraft approach at Dana point, but disturbance to small numbers of pelicans from erratic or particularly close boat activity, such as jet skis and kayaks, does occur. Information was not available to assess the issue of human disturbance by fisherman using the jetty. Restoration here would involve fencing to restrict shore access to the night roost area and signs to limit watercraft approaches. This may be the largest night roost south of Long Beach Harbor with the elimination of the Agua Hedionda site. There is the potential for significant increase in night roost use if human access were eliminated.

Day Roost—Major **Night Roost—Major**

OR 1.0 CAPISTRANO BIGHT

Jurisdiction: Bureau of Land Management, CA Dept of Parks & Recreation

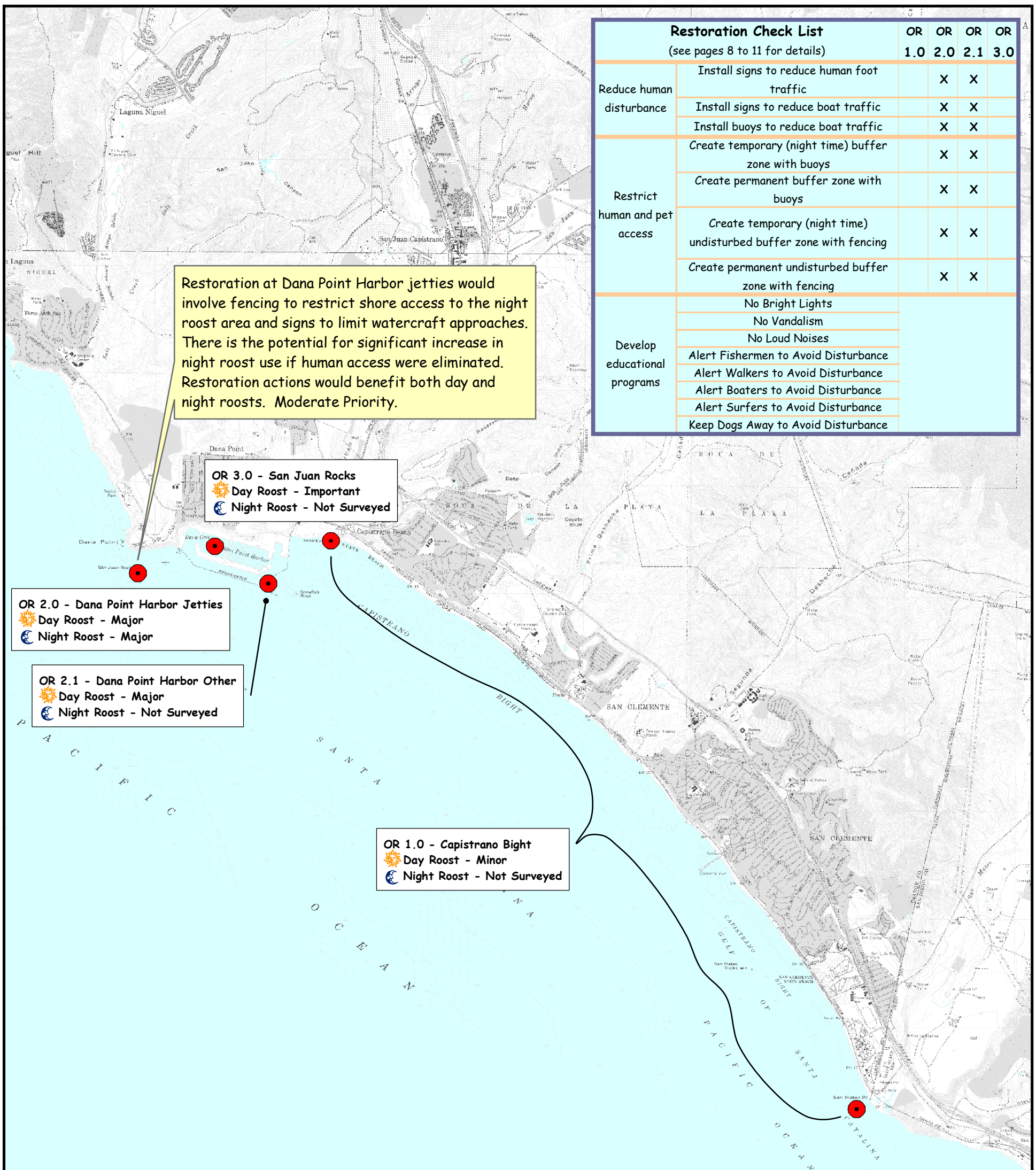
Habitat: Beach, Creek Mouth and Offshore Rocks

	Max Pelican Count	
	Aerial	Ground
Day Roost		
1992	14	
1993	2	
1998	4	
1999	0	
2000	5	
2001	11	
2002	1	
Day Roost Average	4	

The Capistrano Bight includes the beaches and creek mouths between San Mateo point and San Juan Creek. The shoreline is part of San Clemente and Doheney State Beaches. Pelicans occasionally roost on the beaches, particularly at the San Juan creek mouth, but are subject to disturbance from park visitors.

Day Roost—Minor **Night Roost—Not Surveyed**

"max" - single highest count at each location for each year
"average" - average of all counts recorded at each location for all dates



Restoration Check List (see pages 8 to 11 for details)		OR 1.0	OR 2.0	OR 2.1	OR 3.0
Reduce human disturbance	Install signs to reduce human foot traffic		X	X	
	Install signs to reduce boat traffic		X	X	
	Install buoys to reduce boat traffic		X	X	
Restrict human and pet access	Create temporary (night time) buffer zone with buoys		X	X	
	Create permanent buffer zone with buoys		X	X	
	Create temporary (night time) undisturbed buffer zone with fencing		X	X	
	Create permanent undisturbed buffer zone with fencing		X	X	
Develop educational programs	No Bright Lights				
	No Vandalism				
	No Loud Noises				
	Alert Fishermen to Avoid Disturbance				
	Alert Walkers to Avoid Disturbance				
	Alert Boaters to Avoid Disturbance				
	Alert Surfers to Avoid Disturbance				
	Keep Dogs Away to Avoid Disturbance				

OR 8.0 NEWPORT BAY JETTIES

Jurisdiction: US Army Corps of Engineers

Habitat: Jetty

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	Max Pelican Count	
	Aerial	Ground
Day Roost		
1998	0	
1999	115	
2000	9	
2001	49	
Day Roost Average	30	

The two jetties at the mouth of Newport Bay are known as the west rubble mound and the east rubble mound. The structures are relatively short in length and subject to disturbance by fishermen, limiting their use by pelicans.

Day Roost—Major **Night Roost—Not Surveyed**

OR 7.0 REEF POINT TO ARCH ROCK

Jurisdiction: Bureau of Land Management

Habitat: Offshore Rocks

Photo Copyright Deborah Jaques and Craig Strong

	Max Pelican Count	
	Aerial	Ground
Day Roost		
1992	41	
1993	0	
1998	0	
1999	0	
2001	5	
2002	7	
Day Roost Average	6	

Pelicans roost on the rocks adjacent to state park property. Habitat is limited by surf and tidal conditions.

Day Roost—Important **Night Roost—Not Surveyed**

OR 6.0 TWIN POINTS TO ABALONE POINT

Jurisdiction: Bureau of Land Management

Habitat: Offshore Rocks

Photo Copyright Deborah Jaques and Craig Strong

	Max Pelican Count	
	Aerial	Ground
Day Roost		
1992	51	
1993	4	
1998	0	
1999	34	
2000	23	
2001	16	
2002	21	
Day Roost Average	12	

The region from Twin Point to Abalone is characterized by low rocky headlands, small offshore rocks and pocket beaches. Pelicans primarily roost on the offshore rocks. Habitat is limited by surf and tidal conditions.

Day Roost—Important **Night Roost—Not Surveyed**

OR 5.0 RECREATION POINT

Jurisdiction: Bureau of Land Management

Habitat: Offshore Rocks

Photo Copyright Deborah Jaques and Craig Strong

	Max Pelican Count	
	Aerial	Ground
Day Roost		
1992	31	
1993	5	
1998	133	
1999	39	
2000	21	
2001	46	
Day Roost Average	28	

The rocky outcrop and offshore rock at Recreation Point, adjacent to Heisler Park is regularly used by small numbers of pelicans.

Day Roost—Major **Night Roost—Not Surveyed**

OR 4.0 MUSSEL COVE TO LAGUNA BEACH

Jurisdiction: Bureau of Land Management

Habitat: Offshore Rocks

Photo Copyright Deborah Jaques and Craig Strong

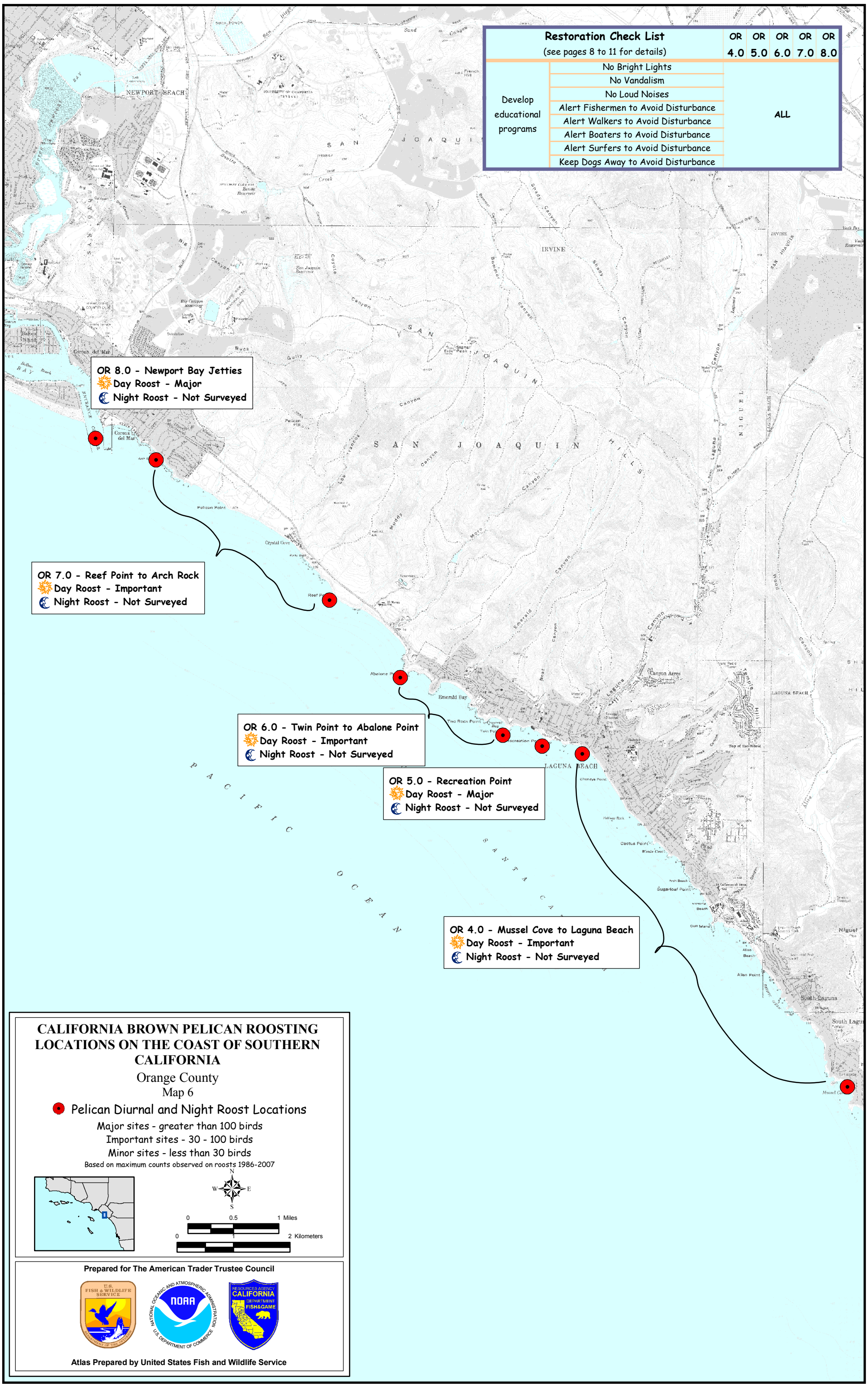
	Max Pelican Count	
	Aerial	Ground
Day Roost		
1992	19	
1993	2	
1998	0	
1999	0	
2000	48	
2001	19	
2002	72	
Day Roost Average	15	

The region from Mussel Cove to Laguna Beach is characterized by low rocky headlands, small offshore rocks and pocket beaches. Pelicans primarily roost on rock substrate. Habitat is limited by surf and tidal conditions.

Day Roost—Important **Night Roost—Not Surveyed**

"max" - single highest count at each location for each year
"average" - average of all counts recorded at each location for all dates

Restoration Check List (see pages 8 to 11 for details)		OR 4.0	OR 5.0	OR 6.0	OR 7.0	OR 8.0
Develop educational programs	No Bright Lights	ALL				
	No Vandalism					
	No Loud Noises					
	Alert Fishermen to Avoid Disturbance					
	Alert Walkers to Avoid Disturbance					
	Alert Boaters to Avoid Disturbance					
	Alert Surfers to Avoid Disturbance					
	Keep Dogs Away to Avoid Disturbance					



CALIFORNIA BROWN PELICAN ROOSTING LOCATIONS ON THE COAST OF SOUTHERN CALIFORNIA

Orange County

Map 6

Pelican Diurnal and Night Roost Locations

Major sites - greater than 100 birds

Important sites - 30 - 100 birds

Minor sites - less than 30 birds

Based on maximum counts observed on roosts 1986-2007

N W E S

0 0.5 1 Miles

0 1 2 Kilometers

Prepared for The American Trader Trustee Council

Atlas Prepared by United States Fish and Wildlife Service

OR 10.0 ANAHEIM BAY JETTIES

Jurisdiction: US Army Corps of Engineers

Habitat: Jetty

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	Max Pelican Count	
	Aerial	Ground
Day Roost		
1992	250	
1993	134	
1998	224	
1999	100	
2000	45	
2001	134	
2002	143	
Day Roost Average	90	

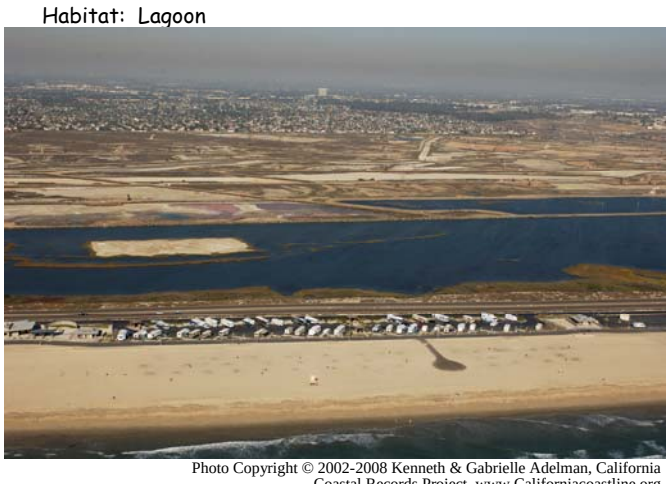
The jetties on either side of Anaheim Bay (being considered for reconfiguration by the U.S. Army Corps of Engineers), at the entrance to Seal Beach National Wildlife Refuge, support a large day roost for pelicans. The longer southern jetty is the main roost, and often the only one with pelicans on it. Fishermen access both jetties with unknown frequency, and cause disturbance when they do. We would not expect this site to support a night roost since the nearby Long Beach breakwaters offer more secure habitat, however, night roost status has not been determined. Pelicans sometimes forage within the wetlands of Seal Beach National Wildlife Refuge, but there is little roost habitat available there, so most birds rely on the jetty or breakwaters. Protecting the jetty roost habitat from fisherman access would improve the quality of the site, and creation or improvement of roost habitat within Seal Beach NWR would provide an alternate site adjacent to an estuarine foraging area, but it would difficult to assess the benefit of these possible restoration actions since a large, relatively secure roost is available on the adjacent Long Beach breakwaters.

Day Roost—Major **Night Roost—Not Surveyed**

OR 9.0 BOLSA CHICA LAGOON

Jurisdiction: California Department of Fish & Game

Habitat: Lagoon



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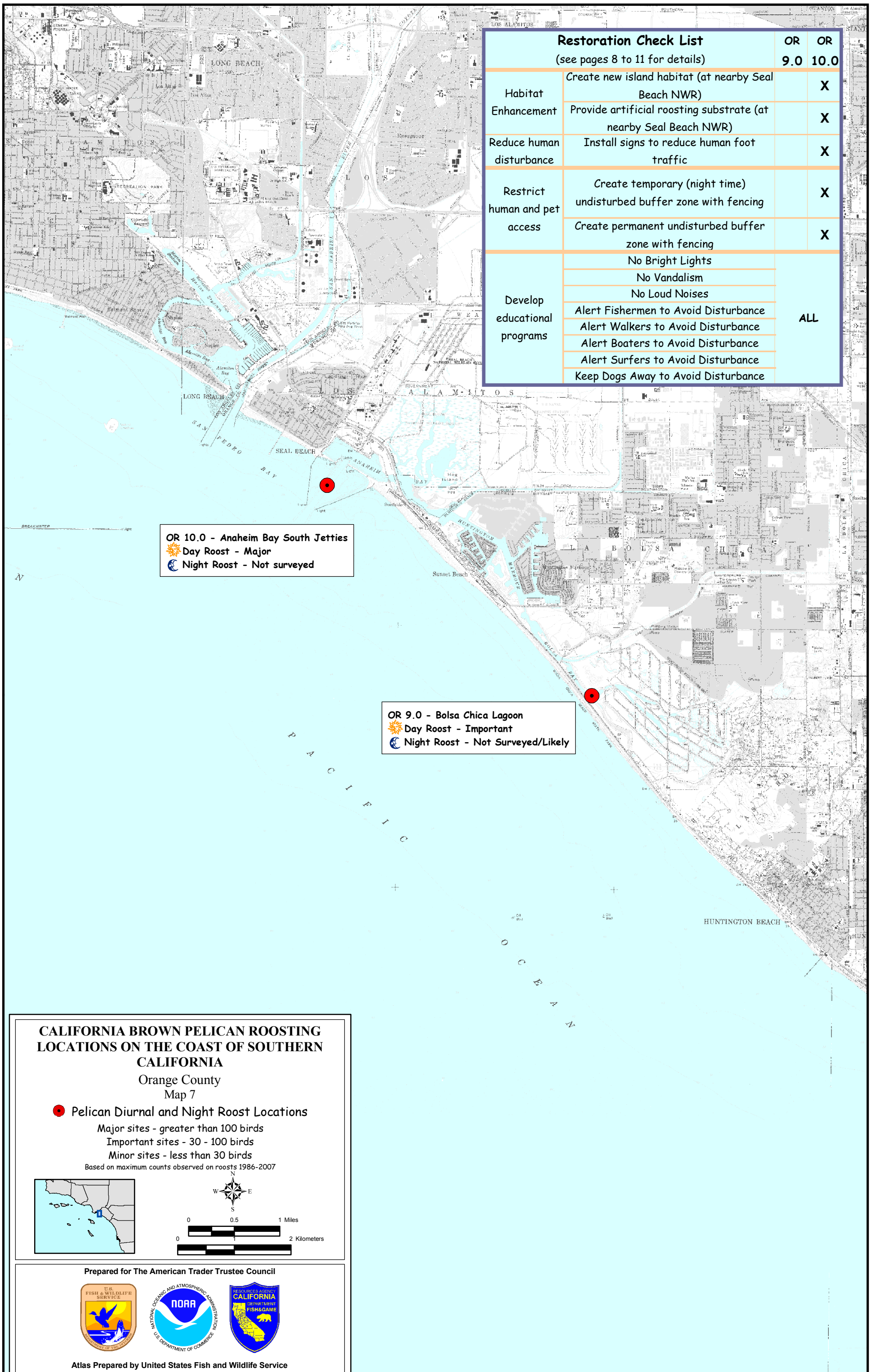
	Max Pelican Count	
	Aerial	Ground
ay Roost		
1992	7	
1993	25	
1998	69	
1999	0	11
ay Roost Average	15	11

Bolsa Chica was restored to a tidal habitat (2004 to 2007) and is now being maintained to support estuarine resources. Island habitats created near the south end of the wetlands area provide the roost substrate for pelicans. The islands have a permanent water buffer and are suitable night roost habitat, but it is not known if they are used at night. The Long Beach breakwaters provide alternate high quality roost habitat 9 km to the north. The islands were created and are managed to provide nesting habitat for endangered Least Terns. Presence of large pelican groups here has potential for disruption of tern nesting activities and may be in conflict with existing management objectives.

Day Roost—Important **Night Roost—Not Surveyed/Likely**



Restoration Check List (see pages 8 to 11 for details)		OR 9.0	OR 10.0
Habitat Enhancement	Create new island habitat (at nearby Seal Beach NWR)		X
	Provide artificial roosting substrate (at nearby Seal Beach NWR)		X
Reduce human disturbance	Install signs to reduce human foot traffic		X
Restrict human and pet access	Create temporary (night time) undisturbed buffer zone with fencing		X
	Create permanent undisturbed buffer zone with fencing		X
Develop educational programs	No Bright Lights	ALL	
	No Vandalism		
	No Loud Noises		
	Alert Fishermen to Avoid Disturbance		
	Alert Walkers to Avoid Disturbance		
	Alert Boaters to Avoid Disturbance		
	Alert Surfers to Avoid Disturbance		
	Keep Dogs Away to Avoid Disturbance		