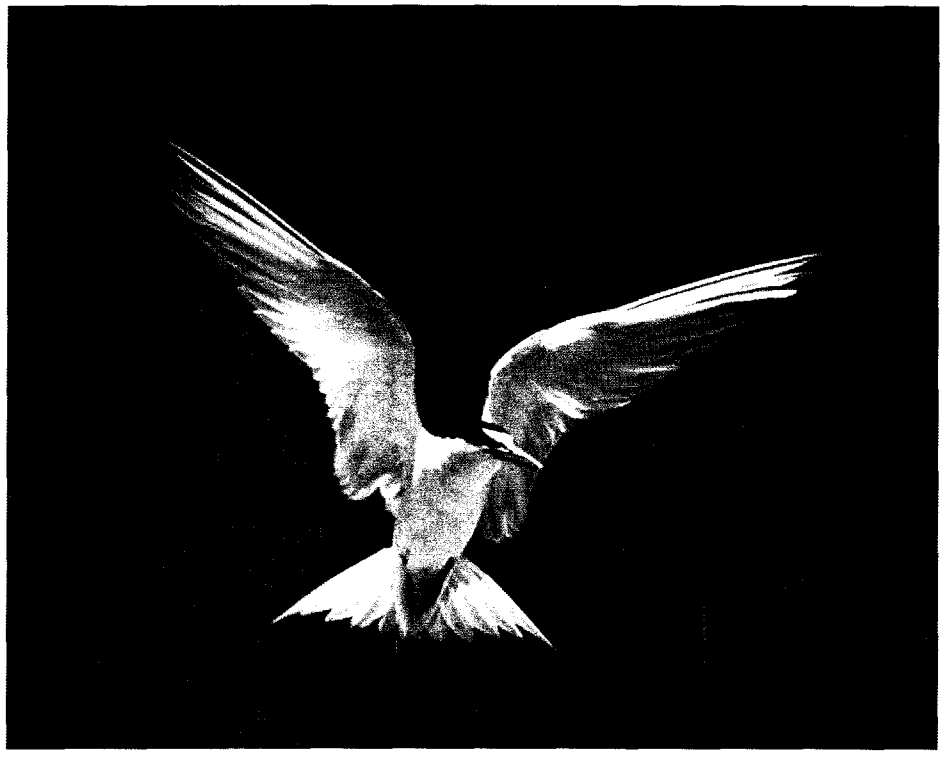
California least tern
(*Sternula antillarum browni*)

5-Year Review
Summary and Evaluation



U.S. Fish and Wildlife Service
Carlsbad Fish and Wildlife Office
Carlsbad, California

September 2006

5-YEAR REVIEW
California least tern
(*Sternula antillarum browni*)

TABLE OF CONTENTS

1. GENERAL INFORMATION 1

1.1. REVIEWERS 1
1.2. METHODOLOGY USED TO COMPLETE THE REVIEW: 1
1.3. BACKGROUND: 1

2. REVIEW ANALYSIS 2

2.1. APPLICATION OF THE 1996 DISTINCT POPULATION SEGMENT (DPS) POLICY 2
2.2. RECOVERY CRITERIA 2
2.3. UPDATED INFORMATION AND CURRENT SPECIES STATUS 5
2.4. SYNTHESIS 22

3. RESULTS 22

3.1. RECOMMENDED CLASSIFICATION 22
3.2. NEW RECOVERY PRIORITY NUMBER 22
3.3. LISTING AND RECLASSIFICATION PRIORITY NUMBER, IF RECLASSIFICATION IS RECOMMENDED 23

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS 23

5.0 REFERENCES 24

5-YEAR REVIEW
California least tern
(*Sternula antillarum browni*)

1. GENERAL INFORMATION

1.1. Reviewers

Lead Region: Diane Elam and Mary Grim, California-Nevada Operations Office, 916- 414-6464

Lead Field Office: Jim A. Bartel, Carlsbad Fish and Wildlife Service, 760-431-9440

1.2. Methodology used to complete the review:

This review was compiled by staff of the Carlsbad Fish and Wildlife Office (CFWO). The review was completed using documents from office files as well as available literature on the California least tern.

1.3. Background:

1.3.1. FR Notice citation announcing initiation of this review:

The notice announcing the initiation of this 5-year review and opening of the first comment period for 60 days was published on July 7, 2005 (70 FR 39327). A notice reopening the comment period for 60 days was published on November 3, 2005 (70 FR 66842). During the comment period, we received comments from 5 individuals that provided information describing local conditions in southern California and San Francisco Bay nesting areas. One commenter recommended delisting the species; another recommended no change in status for the species.

1.3.2. Listing history

Original Listing
FR notice: 35 FR 8491
Date listed: June 2, 1970
Entity listed: subspecies; California least tern (*Sternula antillarum browni*)
Classification: endangered

1.3.3. Associated rulemakings

No associated rulemaking has occurred for this subspecies.

1.3.4. Review History

No status comprehensive reviews have been conducted for this subspecies.

1.3.5. Species' Recovery Priority Number at start of 5-year review

The species recovery number for California least tern is "3C" according to the FY 2005 recovery data call. The "3" indicates that the subspecies has a high degree of threat and potential for recovery. The "C" indicates that the subspecies may be in conflict with

construction or other development projects or other forms of economic activity (48 FR 43098).

1.3.6. Recovery Plan or Outline

Name of plan: California Least Tern Recovery Plan
Date issued: September 27, 1985 (revised)
Dates of previous revisions: 1980

2. REVIEW ANALYSIS

2.1. Application of the 1996 Distinct Population Segment (DPS) policy

2.1.1. Is the species under review a vertebrate?

Yes

2.1.2. Is the species under review listed as a DPS?

No

2.1.3. Is there relevant new information for this species regarding the application of the DPS policy?

No

2.2. Recovery Criteria

2.2.1. Does the species have a final, approved recovery plan containing objective, measurable criteria?

Yes. The most recent revised recovery plan was published in 1985.

2.2.2. Adequacy of recovery criteria.

2.2.2.1. Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat?

No. Since the completion of the recovery plan, new information about the species population dynamics and its threats has been discovered. Specifically, the recovery plan did not consider the following:

- New information about reproductive rates that suggests that the recovery plan criteria of no less than one young fledge per tern pair may not be necessary for stable or increasing populations.
- Information about the location of additional nesting sites.
- New modeling efforts regarding population viability analyses.
- New predators and the effectiveness of predator control efforts
- Increased human populations along the California coastline and their impacts upon tern habitat.

2.2.2.2. Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats)?

As with more than 100 domestic species, the California least tern was transferred onto the List of Endangered and Threatened Wildlife and Plants (50 CFR § 17.11–17.12) from the Endangered Species Conservation Act of 1969. Because these early listed species had no listing package per se, the Service did not complete what is currently termed a five-factor analysis at the time of listing. For this reason and because the recovery plan was written some time ago (1985), the recovery criteria do not explicitly address particular threats to the species. While the recovery criteria are discussed briefly in the next section, this review will focus on the new threats analysis in section *2.3.3 Five Factor Analysis.*

2.2.3. List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information:

Downlisting Criteria:

- At least 1,200 breeding pairs distributed in at least 15 of 23 coastal management areas (Table 1)
- Each of the 15 "secure" coastal management areas must have at least 20 breeding pairs.
- Each of the 15 "secure" coastal management areas must have a 3-year mean reproductive rate of at least 1.0 young fledged per breeding pair

Delisting Criteria:

- At least 1,200 breeding pairs distributed in at least 20 of 23 coastal management areas (Table 1).
- Each of the 20 "secure" coastal management areas must have at least 20 breeding pairs.
- Each of the 20 "secure" coastal management areas must have a 5-year mean reproductive rate of at least 1.0 young fledged per breeding pair
- San Francisco Bay, Mission Bay, and San Diego Bay must be included within the 20 secure management areas with 4, 6, and 6 secure colonies respectively

The gross number of pairs of California least terns is nearly six times greater than the number identified in the downlisting and delisting criteria. No other recovery goal has been fully met. There are 40 known nesting sites in California. Thirty of those 40 nesting sites have more than 20 breeding pairs (Fancher pers. com.).

As indicated in Figure 1, the number of nesting terns is not uniformly distributed across all sites (Marschalek 2006). Currently, the five most populous nest sites (Camp Pendleton, Los Angeles Harbor, Naval Base Coronado, Batiquitos Lagoon, and Point Mugu) host 71% of the entire population (Marschalek 2006).

Table 1. Coastal Management Areas identified in the California Least Tern Recovery Plan (USFWS 1985).

Management Area	County	Site
Management Area A	Alemda	Almeda Naval Air Station
		Alvarado Salt Ponds
		Oakland Airport
	San Mateo	Bair Island
Management Area B	San Luis Obispo	Pismo Beach
		Oso Flaco Lake
Management Area C	Santa Barbara	Santa Maria River
Management Area D	Santa Barbara	San Antonio Creek
		Purisima Point (North)
		Purisima Point (South)
		Santa Ynez
Management Area E	Ventura	Santa Clara River
Management Area F	Ventura	Ormond Beach
		Mugu Lagoon
Management Area G	Los Angeles	Venice Beach
		Playa del Ray
Management Area H	Los Angeles	Terminal Island
*	Los Angeles	San Gabriel River
Management Area I	Los Angeles	Cerritos Lagoon
*	Los Angeles	Costa del Sol
Management Area J	Orange	Anaheim Bay
		Surfside Beach
Management Area K	Orange	Bolsa Chica (North)
		Bolsa Chica (South)
Management Area L	Orange	Huntington Beach
Management Area M	Orange	Upper Newport Bay
Management Area N	San Diego	San Mateo Creek
		Alison Creek
		Santa Margarita Creek (North)
		Santa Margarita Creek (South)
Management Area O	San Diego	Buena Vista Lagoon
Management Area P	San Diego	Agua Hedionda Lagoon
Management Area Q	San Diego	Batiquitos Lagoon
Management Area R	San Diego	San Elijo Lagoon
Management Area S	San Diego	San Dieguito Lagoon
*	San Diego	Whispering Palms Encinitas
Management Area T	San Diego	Los Penasquitos Lagoon
Management Area U	San Diego	FAA Island
		North Fiesta Island
		Stony Point
		South Sea World Drive
		Clover Leaf
Management Area V	San Diego	Naval Training Center
		San Diego Int. Airport
		Chula Vista Wildl. Reserve
		Sweetwater River
		North Island NAS
		Delta Beach
		Coronado Cays
		Saltworks
Management Area W	San Diego	Tijuana River Mouth

*Areas not included in the secure management locations identified in the recovery criteria

The current reproductive rate for the species has been considerably lower (0.23-0.36 fledglings/pair for 2005) than values recommended for recovery in the Recovery Plan (USFWS 1985), while the population has increased. This suggests that the recovery criterion of no less than 1 fledling/pair is not necessary for recovery as populations increases are occurring at lower reproductive rates. The reason for the population increase likely can be related to affirmative predator and disturbance control efforts associated with several large nest sites (i.e. Camp Pendleton, Los Angeles Harbor, and U.S. Navy sites in San Diego) where most of the population gain has occurred.

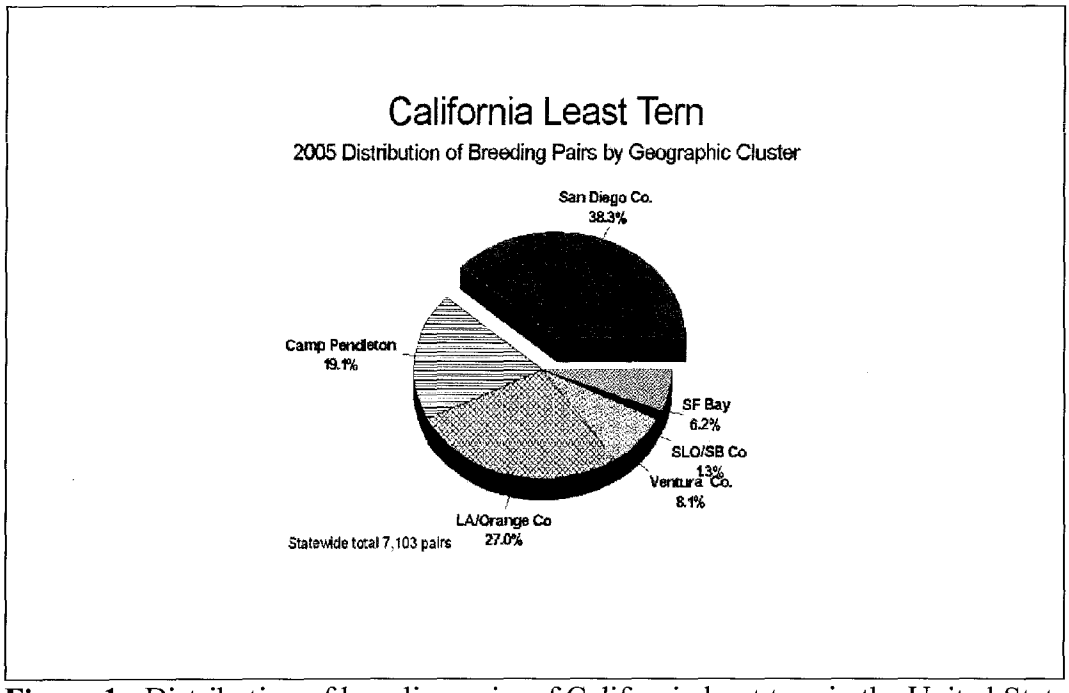


Figure 1. Distribution of breeding pairs of California least tern in the United States. Figure from Fancher (pers. com.) using data derived from Marschalek (2006).

2.3. Updated Information and Current Species Status

2.3.1. Biology and Habitat

The California least tern is the smallest of the North American terns and is found along the Pacific Coast of California, from San Francisco southward to Baja California. California least terns nest in colonies on relatively open beaches kept free of vegetation by natural scouring from tidal action. The typical colony size is 25 pair. Most least terns begin breeding in their third year. Their nest is a simple scrape in the sand or shell fragments. A typical clutch is 2 eggs and both adults incubate and care for the young. They can re-nest up to two times if eggs or chicks are lost early in the breeding season. They are very gregarious and forage, roost, nest and migrate in colonies. Fall migration commences the last week of July and first week of August. Several weeks before fall migration, adults and young wander along marine coastlines, congregating at prime fishing sites (NatureServe 2006).

Distribution

The historical breeding range of California least tern was described in the early literature as extending along the Pacific Coast from Moss Landing, Monterey County, California, to San José del Cabo in Baja California Sur, Mexico (A.O.U. 1957, Dawson 1924, Grinnell 1928, Grinnell and Miller 1944). Since 1970, nesting sites have been documented in California from San Francisco Bay area to the Tijuana River at the Mexican border (Marschalek 2006) and in Mexico within the Gulf of California and on the western coast of Baja California from Ensenada to San José del Cabo at the tip of the peninsula (Lamb 1927, Grinnell 1928, Patten and Erickson 1996).

Nesting - Mexico

Two nesting colonies in Baja California were identified in the early literature: 1) Laguna Ojo de Liebre (Scammons Lagoon) (Bancroft 1927, Grinnell 1928), and 2) San José del Cabo (Grinnell 1928). In the mid-1970s, additional colonies were discovered near and at Bahía de San Quintín (B. Massey 1977). Palacios (1988) reported nesting during 1985 and 1986 in La Paz, where the birds nested at several sites in the bay.

In 1991 and 1992, a survey of the entire west coast of the Baja peninsula documented 13 breeding colonies at five different locations from Ensenada through Bahía Magdalena, with one to six sites at each location. A total of 240 breeding pairs were found. The largest site, with 64 breeding pairs, was at the north end of the barrier beach in Estero de Punta Banda, Ensenada. Two other sites had more than 30 pairs: Punta Azufre on the southern barrier beach at Bahía San Quintín and Estero El Coyote in the San Ignacio Lagoon complex. All others had only between 3 and 22 pairs (Palacios and Alfaro 1993).

Elsewhere in Mexico, least tern nest sites were found at three additional sites: 1) San Felipe in the Gulf of California (Carvacho *et al.* 1989); 2) Isla Montague in the Colorado River delta (Palacios and Mellink 1993); and 3) northwestern Sonora on the Mexican mainland (Mellink and Palacios 1993). In addition, vast stretches of uninhabited Baja California coastline around major estuaries appear to be suitable nesting habitat for the least tern, but are not used. The absence of least terns is particularly surprising at the Laguna Ojo de Liebre complex and along the length of Bahía Magdalena (Massey 1977).

Nesting - United States

The nesting range in California has apparently always been discontinuous, with large colonies spread out along beaches at estuaries. In the northern portion of the species' breeding range, nesting was documented several miles north of Moss Landing at the mouth of the Pajaro River, Santa Cruz County, as early as 1939 to 1954 (Pray 1954, W.E. Unglish, Western Foundation of Vertebrate Zoology egg collection). Although nesting at San Francisco Bay was not confirmed until 1967 (Chandik and Baldridge 1967), numerous spring and summer records of least terns in the area were recorded from the first half of the century (e.g., Allen 1934, Chase and Paxton 1965, De Benedictis and Chase 1963, Grinnell and Wythe 1927, Sibley 1952). These records suggest that nesting may have occurred in the Bay area prior to 1967.

Although San Francisco Bay may be the northern limit of the least tern range, terns have been observed at three locations north of the Bay: Humboldt Bay (Yocom and Harris

1975); Fort Stevens, Oregon (Walker 1972), and Ocean Shores, Washington (Hunn and Mattocks 1979). These records outside the typical range of the subspecies likely represent disoriented, migrating individuals (Fancher pers. com.).

Along the coast of Southern California, historic records of nesting colonies exist for Santa Barbara, Ventura, Los Angeles, Orange, and San Diego counties. As early as 1908, colonies on the beaches at Venice, Los Angeles County (125 pairs), and Bolsa Chica and Newport, Orange County (collectively thousands of birds) were viable, but the colony at Redondo Beach, Los Angeles County, had already been abandoned (Chambers 1908, Fancher 1994). By 1922, development at Venice had caused the birds to abandon the beach there and retreat in stages to a nesting site a mile inland on a dried-up mudflat (Lamb 1927), presumably along Ballona Creek.

An overview recent survey data shows that historic distribution patterns continue with the majority of nesting sites being concentrated in southern California (Figure 2) (CNDDB 2006).

Migration and wintering

Adult terns move south along the California coast with their fledglings in the autumn, stopping to rest and feed along the migration route (Thompson *et al.* 1997). Little is known about actual migration routes south of the California border, but the terns presumably move along the west coast of Baja California, cross to the west coast of mainland Mexico, and continue along the coast to the south (Thompson *et al.* 1997). In Costa Rica, least terns are sporadically common during fall and spring migration at sites where shorebirds gather (Stiles and Skutch 1989), suggesting that a portion of the tern population winters even farther south.

The wintering range is not clearly defined. Although least terns have been seen in Baja California in winter (Massey 1995), occasional wintering of least terns has been documented on the mainland of Mexico. Banded California least terns have been located on the Colima coast (Massey 1981), and the Pacific coast of Guatemala (C. Collins, pers. comm.). Least terns were seen in the winter months (at Chomes on the west coast of Costa Rica and the Pacific coast of Panama (Vaucher 1988). However, other investigators have checked suitable locations in Panama and not found wintering least terns (Massey pers. com.). Scattered sightings of least terns have been made in coastal Peru in all seasons; one was seen in association with the closely related Peruvian tern (*Sterna lorata*) and was easily distinguishable from it (Schulenberg *et al.* 1987). These fragments of distributional information do not create a comprehensive picture of the migratory route and winter range California least tern, emphasizing the need for additional studies.

Sites

The historical pattern of large "colonies" of California least tern spread along undisturbed beaches ended with the development of the California coast. The fragmentation of large beach areas resulted in the nesting birds resettling in the small fragments of habitat remaining in the same general area. This relocation mechanism is particularly thwarted in places like Los Angeles County and Mission Bay (San Diego County), where habitat destruction has been almost complete (Hayes and Fancher pers. com.).

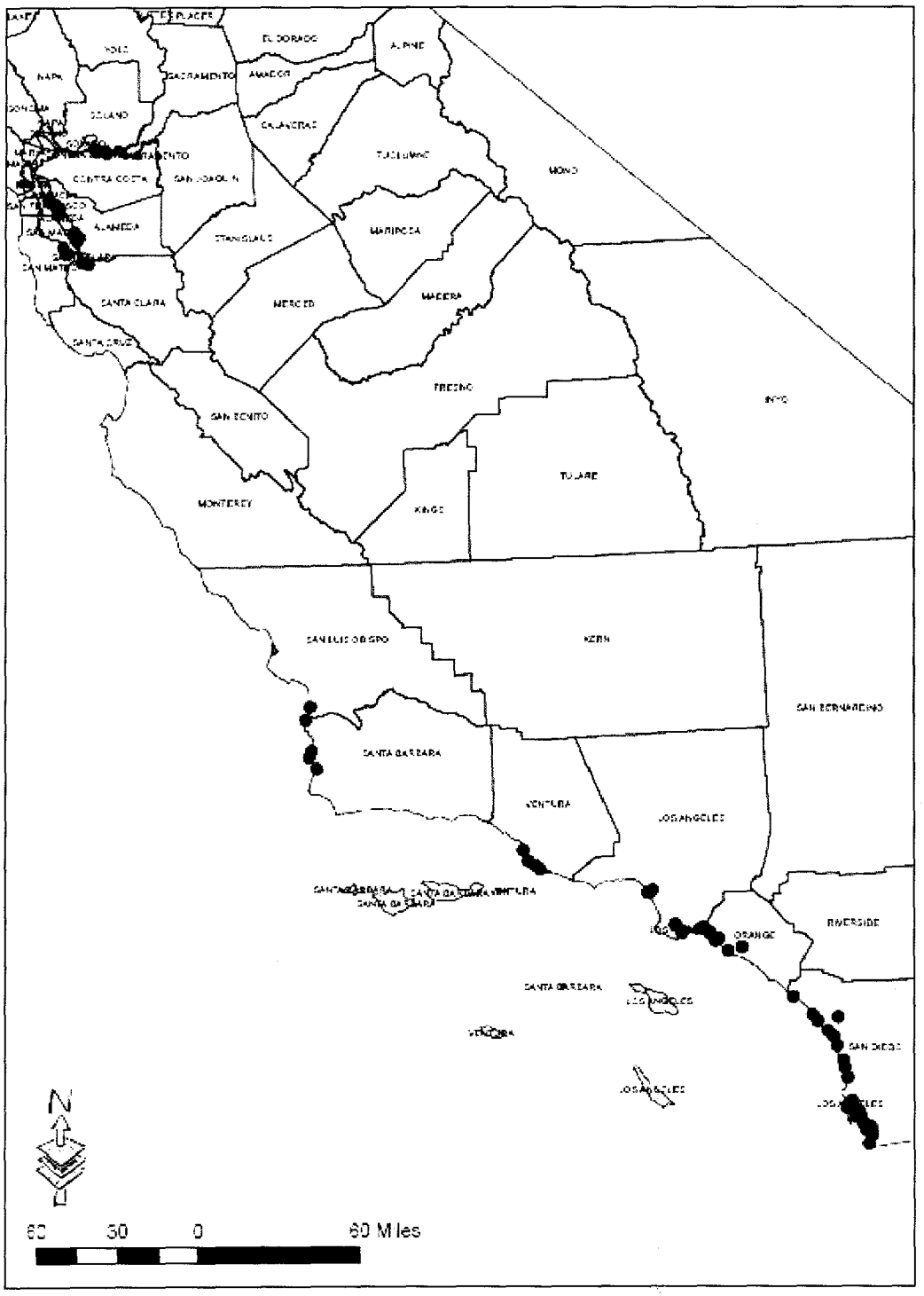


Figure 2. Locations of California least tern nesting sites (CNDDB 2006).

Clusters
Because of the documented movements of individual birds, the limits of the original colonies, particularly in San Diego County, are difficult to define. Therefore the Service views the population in terms of geographic "clusters" of sites rather than colonies (Massey and Fancher 1989, Fancher 1992). The available data and analysis suggest consideration and management of clusters of sites is more tenable for purposes of recovery (USFWS 1985).

Within each designated cluster, two to 24 sites have been in use in recent years. To date, approximately 47 separate clusters from San Francisco to the Mexican border have been active for one or more seasons. Within the United States, the distance between neighboring clusters is from 50 to 300 km (30 to 180 miles). Some of these sites are close together and might be appropriately considered to be parts of a single social unit (Caffery 1993, 1994, Kean 1998, 1999, 2000, 2001, Marschalek 2005, 2006).

The west coast of Baja California, Mexico, supports widely separated clusters of breeding sites at all the major estuaries. The Mexican population, however, apparently is small compared to that in the United States. The results of a 1992 survey demonstrated that the largest cluster in Baja California, which was midway down the peninsula in a complex of esteros (Laguna Ojo de Liebre, L. Guerrero Negro, L. Manuela), contained only 75 pairs (Palacios and Alfaro 1993, Palacios and Mellink 1996).

Despite the fact that unoccupied but disturbed nesting habitat is found north of Los Angeles County, the breeding population has always concentrated in two of the five southern California clusters of nesting sites (Figure 1). San Diego County has been the most populous cluster except for 1980 and 1981. Reasons why southern California beaches are used more by California least terns are not known. This apparent preference is further corroborated by an analysis of colony sizes within the species' entire range from San Francisco southward to Baja California; population numbers decrease both north and south of the of the southern California clusters (Marschalek 2006).

Although there is some degree of site fidelity, California least terns have been observed to move among colonies. Documented colony movements, which were derived from observations of color-marked birds, were reported at Long Beach (Massey and Fancher 1989), Aliso Creek (Collins *et al.* 1991), Upper Newport Bay (Orange County) (B. Massey, unpubl. data) (Fancher *et al.* 1988), and Batiquitos Lagoon (San Diego County (Massey 1995).

Abundance
Although no reliable estimates are available relating to the historical, total number of California least terns, the subspecies apparently was once abundant and well-distributed on barrier beaches and beach strand along the southern California coast. Shepardson (1909) describes a colony of about 600 pairs along a 4.8 km (3 mi) stretch of beach in San Diego County. "Good-sized" colonies formerly were located in Los Angeles and Orange County (Grinnell 1898) and probably throughout the remainder of its range. Although the least terns are considered a colonial nester, there are many records of solitary pairs nesting at certain sites or low densities of limited nesting pairs over several kilometers of beach habitat (USFWS 1985).

The reduction in California least tern numbers apparently was gradual and associated with human population increase in the area. This subspecies appears to have escaped the whole-scale killing, i.e. harvest inflicted on the East Coast populations by the millinery trade of the late 1800's (Bent 1921, Hagar 1937). However, the least tern experienced some early local losses due to shooting (Holterhoff 1884) and egg collecting (McCormick 1899). It is doubtful that these activities were widespread enough to significantly impact the population as a whole. Although select least tern colonies were still thriving in the early 1900's, others were already beginning to be influenced by humans. Moreover, although the overall extent of the range has remained essentially unchanged, the species was noted as seriously declining within that range before the 1930's (Willett 1933).

The California least tern has been, and is, concentrated in three southern California counties: Los Angeles, Orange, and San Diego (Figure 1). The Santa Margarita River mouth in San Diego County generally has supported the largest numbers of terns in recent years. Between Ventura County and the San Francisco Bay area, only Purisma Point and Mussel Rock Dunes (formerly called Guadalupe Dunes), and Vandenberg have been used regularly (Marschalek 2006).

Although the annual rate of population change has been variable and sometimes negative, the net result has been a population increase. Table 2 and Figure 2 contain the chronological status of the breeding population and the annual productivity since 1973. Table 3 contains a list of recently surveyed sites and number of tern pairs located at each (Marshalek 2005).

Table 2. Chronology of California least tern populations trends from 1973 – 2005

Time period	**Populations Status**
1973 -1976	The breeding population was approximately 600 pairs.
1977 – 1983	The breeding populations had more than doubled to 1,264 pairs.
1984 – 1987	A 25% decline followed the El Nino of 1982 – 1983.
1988 – 1994	The population increased to approximately 2,800 pairs.
1995 – 2005	The population steadily increased to approximately 7,100 pairs.

(Craig 1971; Bender 1974a, 1974b; Massey 1975, 1988, 1989; Atwood *et al.* 1977; Jurek 1977; Atwood *et al.* 1979; Collins 1984, 1986, 1987; Gustafson 1986; Johnston and Obst 1992; Obst and Johnston 1992; Caffery 1993, 1994, 1995b, 1997, 1998; Keane 1998, 200, 2001; Patton 2002; Marschalek 2005)

The observed increase in the number of California least terns to 775 pairs and 450 fledglings in 1977 was the first encouraging sign that protective efforts were working (Atwood *et al.* 1977). Early recovery efforts, which were concentrated on surveys, site management, and protection at known nesting sites (e.g. fencing of enclosures, removing predators, rigorous monitoring and research) were effective in bringing about the doubling of the population in a decade (Fancher 1992).

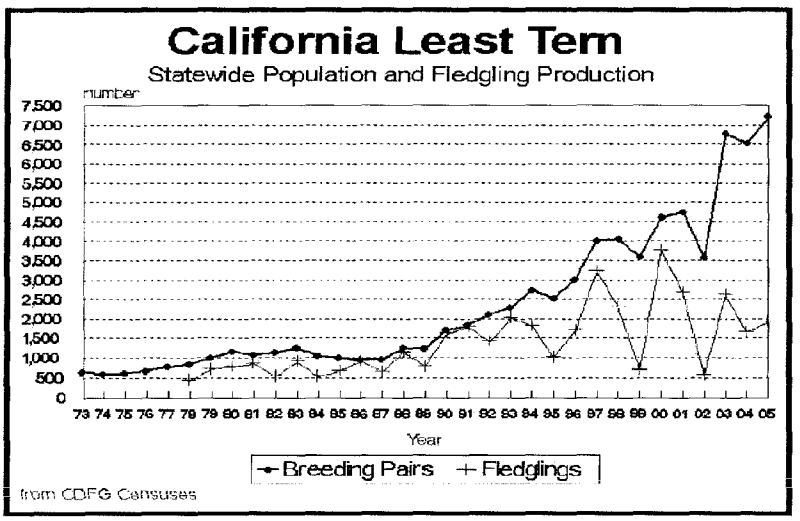


Figure 2. Statewide California least tern population and fledgling production, 1973-2005 (Craig 1971, Bender 1974a, 1974b; Massey 1975, 1988, 1989; Atwood *et al.* 1977, Jurek 1977, Atwood *et al.* 1979, Collins 1984, 1986, and 1987; Gustafson 1986, Johnston and Obst 1992, Obst and Johnston 1992, Caffrey 1993, 1994, 1995b, 1997, 1998; Keane 1998, 2000, 2001; Patton 2002, Marschalek 2005, 2006).

Table 3. Breeding pair estimates in 2004* (Marschalek 2005).

Site name	Total Pairs
San Francisco Bay Area	
Pittsburg Power Plant	12
Albany Central Ave. Mitigation Island	0
Alameda Point	379
San Luis Obispo/Santa Barbara Counties	
Oceano Dunes SVRA	47
Guadalupe-Mussel Rock	8
Vandenberg AFB	1
Coal Oil Point Reserve	6
Ventura County	
Santa Clara River/ McGrath State Beach♠	64
Hollywood Beach	50
Ormond Beach♠	29
Point Mugu – Totals♠	490
Los Angeles/Orange Counties	
Venice Beach♠	17
LA Harbor	951
Seal Beach NWR - Anaheim Bay♠	190.5
Bolsa Chica Ecological Reserve♠	137
Huntington State Beach♠	309.5
Burris Sand Pit	3
Upper Newport Bay Ecological Reserve♠	60
San Diego County	
MCB Camp Pendelton	1355
Red Beach	1
White Beach	86
Santa Margarita – North Beach North♠	424
Santa Margarita – North Beach South♠	770
Santa Margarita River - Saltflats	38
Santa Margarita River – Saltflats Island	36
Batiquitos Lagoon Ecological Reserve♠	431
San Elijo Lagoon Ecological Reserve♠	0
Mission Bay	
FAA Island♠	178
North Fiesta Island♠	11
Mariner's Point	100
San Diego River Mouth (S)	27
San Diego Bay	
Lindbergh Field and Former Naval Training Center♠	65
US Navy Totals	1041
NI MAT♠	162
DBN♠	237
DBS♠	173
NABO	469
D Street Fill/Sweetwater Marsh NWR♠	77
Chula Vista Wildlife Reserve♠	30
South San Diego Bay Unit, SDNWR – Saltworks♠	31
Silver Strand State Beach	1
Tijuana Estuary NERR	253
TOTAL	**6354**

*Breeding pair numbers represent the minimum number recorded if a site reported a range of abundance.
♠These sites were identified in the recovery plan as needing at least 20 breeding pairs to be before a change in status could be considered

Productivity
A review of the pre-1988 census data suggests that productivity as an important variable in predicting future population levels. During that time, the fledglings/pair ratio in a given year apparently was highly correlated with the number of breeding pairs two years later. In general, when ratios of fledglings per pair were at or near 0.70, there was little change in the population two to three years later. If the yearly productivity ratio was lower than 0.70, the population subsequently showed a decline, and if higher, the populations increased (Fancher 1992).

Since 1992, despite several years of productivity lower than 0.70, growth of the adult population generally has been positive except for 2002 with a one year loss of over 1,100 breeding pair, and 2004, with a one year loss of over 500 pair (Keene 1998, 1999, 200, 2001). Productivity remains low with approximately 2000 fledged young produced in 2005 (0.25 fledglings per pair) (Marshalek 2006).

This examination of productivity and subsequent population change suggests that the recovery plan may need to be revised. The criteria contained within the recovery plan states that the fledgling to adult ratio must be 1.0 for both downlisting and delisting. However, this recovery data suggests that populations will increase at lower productivity levels.

Habitat Use and Availability

Nesting sites
Few of the current nesting sites approximate the historical high and moderate quality natural habitat of the least tern. Currently, there are no beaches devoid of human recreation, development, or military pressure. Mussel Rock Dunes, Mugu Lagoon, Santa Margarita River mouth, and Tijuana River mouth come closest, with the birds nesting on ocean-fronting beaches where natural habitat still exists on all sides. The ocean side of the Naval Amphibious Base, Coronado (opposite Delta Beach) is also beach strand. However, even natural sites like North Beach (Santa Margarita River mouth) have been fenced to protect the eggs and chicks from adjacent military training activities and predators. Fencing is an anti-predator and human disturbance reduction strategy, but restricts freedom of movement of chicks. Lack of fencing or damage to extant fencing has led to complete loss of reproductive success at tern nest sites (Fancher pers. com.).

The majority of sites are on developed or anthropogenically created lands that include (or included) airports (Alameda Colony [formerly Alameda Naval Air Station], Oakland Airport, Lindbergh Field), landfills (Terminal Island, Anaheim Bay, Fiesta Island, Mariner's Point, Sweetwater River mouth), and sand-topped islands specially created for the terns (Bolsa Chica, Upper Newport Bay, Batiquitos Lagoon) (Marschalek 2006).

The creation of new sites and restoration of some that are currently not in use may be important to augment the current population resurgence and contribute towards the recovery of the California least tern (USFWS 1985). While this goal is identified in the step-down outline of the recovery plan, it has not been achieved to date.

Roosting and foraging
In addition to nesting areas, secure roosting and foraging areas are essential to the recovery of the species. Roosting areas are of two kinds: pre-season nocturnal roosts and post-season dispersal sites where adults and fledglings congregate. The best documented night roost is in Belmont Shore, Long Beach (Atwood 1986). However, no recent surveys have been conducted to verify continued use of this night roost site.

California least terns forage primarily in near shore ocean waters and in shallow estuaries and lagoons (Massey 1987). However, a study at Huntington Beach, Orange County revealed that adults also feed close to shore in Ocean waters (Collins *et al.* 1979). At colonies where feeding activities have been studied, the birds foraged mostly within 3.2 km (2 miles) of the breeding area and primarily in near shore ocean waters less than 18.3 m (60 feet) deep (Collins *et al.* 1979, Atwood and Minsky 1983).

Genetics and Taxonomy
California least tern was listed as *Sterna antillarum brownii*. However the 47th Supplement to the American Ornithologist's Union (AOU) checklist recognizes least terns under a previously published name *Sternula antillarium* (Banks *et al.* 2006) based on mitochondrial DNA molecular phylogeny (Bridge et al. 2005). Within this species, classification of the various subspecies continues to be debated. In North America, at least 5 subspecies have been described based on morphology; these include S.a. antillarum (Lesson 1847), *S. a. athalassos* (Burleigh and Lowery 1942), *S. a. browni* (Mearns 1916), *S. a. mexicana* (Van Rossem and Hachisuka 1937), and *S. a. staebleri* (Brodkorb 1940).

Analysis of the genetic differentiation of California, Interior, and East coast subspecies has been inconclusive. Most genetic studies have found little or no evidence of differentiation among least tern subspecies (Thompson *et al.* 1992, Whittier 2001, 2006, Draheim 2006).

2.3.2. Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

2.3.2.1. Present or threatened destruction, modification or curtailment of its habitat or range:

Nesting Habitat Threats
The majority of the tern population relies on degraded habitat on the beaches of Southern California, of one of the most densely populated portions of the entire U.S. west coast (Marschalek 2006). Most extant colonies are small patches of degraded nesting habitat surrounded on all sides by human activity. Nesting habitat is often separated from ocean access by recreational beach use. The larger tern colonies are on military lands and are surrounded by constant military training activities (Fancher pers. com.). Because of beach development throughout the southern California coastline, little available beach habitat exists where new nesting sites could be established.

Conflicts between human beach use and habitat protection continues. Examples of human disturbance include: a) people walking too close to nesting sites, b) people (or

their domestic animals) entering nest sites, c) noise or pollution from nearby construction or other human activities, d) helicopters flying low or landing in nesting areas, e) jet skiing in feeding zones, and f) military training exercises (USFWS 1985).

Wintering Habitat Threats
Loss and fragmentation of wintering habitat may also affect the California least tern (Goss-Custard *et al* 1995). However, because the wintering locale and habitat for this species remains in question (Schulenberg *et al.* 1987, Vaucher 1988, Stiles and Skutch 1989, and Barrantes and Pereira 1992), we cannot determine the current threat to wintering habitat.

Habitat Management Needs
Given the reduced habitat base for nesting in California, intensive, site-specific adaptive management is necessary to ensure successful current and future year tern nesting. The species has become conservation reliant, and without species specific habitat protection the threats that are "pervasive, recurring, and cannot be eliminated" continue to affect the birds annually (Scott et al. 2005, Scott and Goble 2006).

Most California least tern nest sites are small (some are only a fraction of a hectare) and enclosed with permanent, or temporary fencing to prevent human disturbance and minimize predation (Rimmer and Deblinger 1990). Pre-season preparation of habitat protections, the ability to respond to changes in threats, and rigorous monitoring must be established early in the nesting season to ensure the success of a site (Fancher pers. com., Hayes pers. com.).

The 1985 recovery plan recommended developing and implementing management plans/programs for "secure" nesting habitat in Alameda, San Mateo, Santa Barbara, Ventura, and Los Angeles, Orange, and San Diego counties. Management plans created for long-term site ecological security would focus on reducing perturbation, destruction, or pollution of nesting or foraging habitat (USFWS 1985). No plans have been completed for any of these areas.

Summary of Factor A
While loss and fragmentation of California least tern habitat has occurred historically, the rate of habitat loss in recent years is reduced because almost all coastal habitats have already been fragmented and degraded. There is currently a lack of undisturbed or moderately disturbed suitable breeding habitat available for population expansion. The level of human coastal use is anticipated to continue the conflict between resurging tern populations and limited habitat availability. Although most of the important nesting sites are in public ownership, competing land uses continue to be a high threat for disturbance to or elimination of nesting habitat. These nests sites must be intensely managed to remain suitable nesting habitat.

2.3.2.2. Overutilization for commercial, recreational, scientific, or educational purposes:

The historic species decline has been partially attributed to use of the species for millinery during the early 1900's (USFWS 1985, Birdsall 2002). Due to the Migratory Bird Treaty Act of 1918, change in women's perception on the use of wild-killed feathers in millinery, and change of fashion (Birdsall 2002), the use of tern

feathers for hat making is not a threat to the species today. We have no information to suggest that over utilization is a threat to California least tern.

2.3.2.3. Disease or predation:

Disease

Disease has not been known to affect the California least tern during the period it has been listed. The species has likely been exposed to West Nile virus, as displayed by *Corvus sp.* mortalities in Los Angeles and Orange Counties (Turrell *et al.* 2002, 2005, Reisen *et al.* 2006), however direct mortalities from this disease to California least tern are unknown, to date. Avian H2 influenza transmission to California least terns is possible, but currently has not been detected (Makarova *et al.* 1999, Hanson 2001). Nevertheless, the flocking nature of terns and the reduction in their habitat has resulted in the species being concentrated in areas with limited resources and environmental stressors that increase their vulnerability to disease and mass die-offs (Lafferty and Gerber 2002, Lafferty and Holt 2003, Mendes *et al.* 2006).

Predation

Predators of California least tern in California that are known to consume or break eggs include: Virginia opossum (*Didelphis virginiana*), spotted skunk (*Spilogale putorius*), striped skunk (*Mephitis mephitis*), northern harrier (*Circus cyaneus*), American crow, common raven (*Corvus corax*), coyote (*Canis latrans*), red fox (*Vulpes fulva*), rats (*Rattus sp.*), Norway rats, (*Rattus norvegicus*), Beechey ground squirrel (*Spermophilus beecheyi*), and feral cat (*Felis domesticus*) (Marschalek 2006). Avian predators on chicks include the American kestrel, northern harrier, loggerhead shrike (*Lanius ludovicianus*), gull-billed tern (*Sternula nilotica*) (Densmore 1990), red fox, feral dog, and feral cat. Fledglings and adults have been preyed upon by the American kestrel, peregrine falcon (*Falco peregrinus anatum*), great horned owl (*Bubo virginianus*), burrowing owl (*Speotyto cunicularia*), and feral cat. Other diminutive invasive species that cause predation on California least terns have included southern fire ants, (*Solenopsis xyloni*) (Hooper-Bui *et al.* 1998, 2004) and Argentine ants (*Linepithema humile*) (Suarez *et al.* 2005).

Predators consume least terns at all stages of life (i.e. egg, hatchling, fledgling, juvenile, adult, and as scavenged prey). While most predators will consume, if available, tern hatchling chicks, predators may also take fledglings and adults. Even with lethal and non-lethal predation prevention management used at most sites in 2005, predation led to the mortality of 833 eggs, 104-107 chicks, 36 fledglings, and 35 adults. American crows (Corvus brachyrhynchos) caused 30 % of these incidences, and continue to be a significant problem (see also Keane 2001, Patton 2002). At one of the more protected nest sites in 2005, i.e. Camp Pendleton, 35 species were reported as possible predators of least terns, and included seemingly diminutive species such as deer mice (*Peromyscus sp.)* and ants (Marshcalek 2006).

Native species such as crows, Cooper's hawks, American kestrels, opossum, skunks, and raccoons (*Procyon lotor*) may have artificially high population levels around urban areas and urban interfaces due to their adaptability to humans and ability to exploit garbage and other food sources attributable to humans (Garrott *et al.* 1993, Bolger *et al* 1997). Native and non-native predators can have significant effects on least tern reproductive success, and cause nest failure, re-nesting, and site

abandonment in addition to direct and indirect mortality (Massey and Fancher 1989). Single species and even single individuals become acclimated to the site (including human presence for predator control), and view it as a sole source of food during their own reproduction. These species and individuals can cause significant loss to a least tern colony in a matter of days or in a nesting season. For example, within a week, one or more kestrels killed approximately 100 chicks format the Venice tern colony in 1982 (Massey *et al.* 1992); one female kestrel took five tern chicks in an hour at Batiquitos Lagoon (WRA 1997). In another example, one red fox took eggs from 31 least tern nests at Huntington Beach in a few days. The presence and expansion of the red fox within the southern California coastal plain in the early 1980s led to breeding failures at Anaheim Bay, Bolsa Chica, and Huntington Beach in Orange County before measures to control avian and mammalian predators could be implemented (Fancher 1989, Jurek 1992).

Summary of Factor C

Disease is a concern for California least terns due to the dense flocking of individuals in small preserve areas that together with stressors that may reduce their ability to fight parasites and disease. Though predation has been marginally reduced due to intensive management, it remains a serious threat to the California least tern. At intensively managed locations, the use of fencing and lethal/non-lethal predator control measures have reduced the potential for high levels of predation; however numerous tern mortalities still occur during the breeding season.

2.3.2.4. Inadequacy of existing regulatory mechanisms:
State Laws

The California least tern is listed as an endangered species and fully protected species under the California Endangered Species Act of 1984 (CESA). This legislation requires State agencies to consult with the California Department of Fish and Game (CDFG) on activities that may affect a State-listed species. Fully Protected species may not be taken or possessed at any time and no licenses or permits may be issued for their take except for collecting these species for necessary scientific research and relocation of the bird species for the protection of livestock.

The California Environmental Quality Act (CEQA) requires review of any project that is undertaken, funded, or permitted by the State or a local governmental agency. If significant effects are identified, the lead agency has the option of requiring mitigation through changes in the project or to decide that overriding considerations make mitigation infeasible (CEQA Sec. 21002). In the latter case, projects may be approved that cause significant environmental damage, such as destruction of listed endangered species or their habitat. Protection of listed species through CEQA is, therefore, dependent upon the discretion of the lead agency involved.

Occupied habitat of a federally listed species, occurring within the coastal zone, is considered an "environmentally sensitive area" under the California Coastal Act (section 30107.5). The California Coastal Act requires that environmentally sensitive habitat areas "shall be protected against any significant disruption of habitat values" (section 30241). Therefore, the California Coastal Act can provide protection to California least tern in those cases where they would be affected by a proposed project requiring a coastal development permit.

The California Coastal Management Program, administered by the California Coastal Commission in accordance with the Coastal Zone Management Act includes a system of: (1) Coastal permits and appeals; (2) planning and implementation of local coastal programs; and (3) Federal consistency review. It is likely that the California least tern has benefited from actions, such as limiting development, regulated by the California Coastal Commission in some areas.

Federal Protections

The National Environmental Policy Act (NEPA) provides some protection for the California least tern. For activities undertaken, authorized, or funded by federal agencies, NEPA requires the project be analyzed for potential impacts to the human environment prior to implementation (42 U.S.C. 4371 et seq.). Instances where that analysis reveals significant environmental effects, the federal agency must propose mitigations that could offset those effects (40 CFR 1502.16). These mitigations are usually developed in coordination with the Service during Section 7 consultation and should provide some protection for listed species. However, NEPA does not require that adverse impacts be fully mitigated, and so some impacts could still occur. Additionally, NEPA is only required for projects with a federal nexus, and therefore, actions taken by private landowners are not required to comply with this law.

Under section 404 of the Clean Water Act, the U.S. Army Corps of Engineers (Corps) regulates the discharge of fill material into waters of the United States, which include navigable and isolated waters, headwaters, and adjacent wetlands (33 U.S.C. 1344). In general, the term "wetland" refers to areas meeting the Corps criteria of having hydric soils, hydrology (either sufficient flooding or water on the soil surface), and hydrophytic vegetation (plants specifically adapted for growing in wetlands). Any actions within California least tern habitat that has the potential to impact waters of the United States would be reviewed under the Clean Water Act as well as NEPA and the Endangered Species Act (Act). These reviews would require consideration of impacts to the terns and their habitat, and when significant impacts could occur, mitigations would be recommended.

The Endangered Species Act is the primary Federal law providing protection for the California least tern. Since its listing, the Service has analyzed the potential effects of many projects under section 7(a)(2) of the Act, which requires Federal agencies to consult with the Service prior to authorizing, funding, or carrying out activities that may affect listed species. A jeopardy determination is made for a project that is reasonably expected, either directly or indirectly, to appreciably reduce the likelihood of both the survival and recovery of a listed species in the wild or reducing its reproduction, numbers or distribution (50 CFR § 402.02). A non-jeopardy opinion may include reasonable and prudent measures that minimize the amount or extent of incidental take of California least tern from a project. Incidental take refers to taking that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by a Federal agency or applicant (50 CFR § 402.02). While projects that are likely to result in adverse effects often include minimization measures, the Service is limited to requesting minor modifications in the project description. In instances where some incidental take is unavoidable, the Service requires that

additional measures be performed by the project proponents to compensate for negative impacts.

Incidental take permits, pursuant to Section 10(a)(1)(B) of the Act, may be issued for projects without a Federal nexus. This section provides protection for California least tern through the approval of habitat conservation plans that detail measures to minimize and mitigate the potential impacts of the project to the maximum extent practicable.

The Migratory Bird Treaty Act (MBTA) (16 USC 703 *et seq.*) and its implementing regulations (50 CFR Parts 20 and 21) directly protect the California least tern, and their eggs and nests from being killed, taken, captured, or pursued. However, it does not protect habitat except to the extent that habitat alterations would directly kill birds.

The National Wildlife Refuge System Improvement Act of 1997 (Pub. L. 105–57) establishes the protection of biodiversity as the primary purpose of the national wildlife refuge system. This has lead to various management actions to benefit the tern, particularly in southern California, that are an important component of the recovery strategy for the California least tern.

Protection on Department of Defense Lands

The Sikes Act (16 U.S.C. 670) authorizes the Secretary of Defense to develop cooperative plans for conservation and rehabilitation programs on military reservations and to establish outdoor recreation facilities. The Act also provides for the Secretaries of Agriculture and the Interior to develop cooperative plans for conservation and rehabilitation programs on public lands under their jurisdiction. While the Sikes Act of 1960 was in effect at the time of the tern listing, it was not until the amendment of 1997 (Sikes Act Improvement Act) that Department of Defense (DOD) installations were required to prepare Integrated Natural Resource Management Plans (INRMP). Consistent with the use of military installations to ensure the readiness of the Armed Forces, INRMPs provide for the conservation and rehabilitation of natural resources on military lands. They incorporate, to the maximum extent practicable, ecosystem management principles and provide the landscape necessary to sustain military land uses. While INRMPs are not technically a regulatory mechanism because their implementation is subject to funding availability, they address the conservation of natural resources on military lands and can be an added conservation tool in promoting the recovery of endangered and threatened species.

In 2001, the Marine Corps Base Camp Pendleton (Base) adopted an INRMP. Like other INRMPs, it is largely ecosystem-based except where biological opinions direct species-specific actions. The Base's INRMP incorporated the Service's 1995 Biological Opinion on Programmatic Activities and Conservation Plans in Riparian and Estuarine/Beach Ecosystems on Marine Corps Base, Camp Pendleton (1-6-95-F-02) that addresses the majority of California least tern breeding habitat on the Base. Because of this consultation, the Base's INRMP provides specific direction regarding least tern management and conservation.

In 1997, the Service and the U.S. Navy/Marine Corps have signed a Memorandum of Understanding (MOU) for the conservation of California least tern subpopulations at Naval Air Station North Island (NASNI), Naval Amphibious Base Coronado (NAB), and Camp Pendleton. The MOU establishes standards and conditions to protect the tern from in-water construction activities conducted by the Navy at military facilities. The MOU includes a commitment by the Navy and Marine Corps to expend fund annually to: (1) ensure preparation of tern nesting colony sites, (2) hire predator management experts, (3) hire tern monitors, (4) gather biological information relative to the tern and (5) provide maintenance of existing fences, signs, substrate at individual nesting sites at NASNI, NAB and Camp Pendleton.

On January 10, 2001, Executive Order 13186 was issued to address the responsibilities of Federal Agencies to Protect Migratory Birds. The Executive Order directed Federal agencies whose actions have a measurable negative impact on migratory bird populations to develop MOUs with the Service to promote the conservation of migratory birds. Under a July 31, 2006, MOU between the Service and the Department of Defense, the tern, as a migratory bird species, will receive certain benefits on DoD lands. The MOU addresses certain DoD activities including natural resources management, installation support functions, industrial activities, routine construction or demolition activities, and hazardous waste cleanup. Through the MOU, the parties will strive to protect migratory birds, work with to protect habitat adjacent to DoD lands, and promote collaborative projects. Additionally, the DoD will follow migratory bird permitting requirements, incorporate or encourage incorporation of migratory bird conservation into INRMPs and other environmental documents, manage military lands and non-military readiness activities in a manner that supports migratory bird conservation, and develop and/or implement monitoring programs. The MOU provides that the management of DoD installations should be done in consideration to habitat protection (with specific attention to riparian habitats), fire and fuels management, and invasive species management. This MOU will further emphasize the importance of tern nesting habitat to decision makers on DoD installations and otherwise promote migratory bird conservation, which could directly or indirectly benefit tern recovery.

While the INRMP, MOUs, and the Executive Order will continue to provide protection of terns and nesting habitat from continued threats on DOD sites, these measures do not provide protection on non-DOD lands important for the recovery of the California least tern.

Summary of Factor D

A number of State and Federal laws exist that provide some degree of protection of California least tern and its habitat. However, the extent to which these laws provide protection varies with each individual action and may not always be adequate to prevent the loss and degradation of California least tern habitat. Additionally, actions without a State or Federal nexus may not be required to comply with these laws and could result in adverse impacts to the tern.

2.3.2.5. Other natural or manmade factors affecting its continued existence:

Human Disturbance
Ruhlen *et al.* (2003) indicate that human disturbances have reduced shorebird chick survival. Humans have been responsible for losses of all three life-history categories of terns, either through ignorance or apparently deliberate acts, and observers have accidentally stepped on fertile eggs and chicks during nest site observation (Munoz del Viejo and Vega 2002, Zuria and Mellink 2002, Hayes pers. com.).

Exotic species incursion/invasion
Non-native plant species such as iceplant (*Carpobrotus edulis*) have invaded potential "natural" tern nesting sites. These sites can be rendered useless to nesting least terns if iceplant density becomes too great. Terns have nested in at least one site infested by non-native plants for one season (i.e., Seal Beach NWR, 1997), but the site was already established and protected by fencing and predator control. The vegetation management protocol was changed in the following year and least terns continue to successfully utilize the site.

Food shortages
During past nesting seasons, the death of chicks from emancipation has been reported (Marschalek 2005, 2006; Pagel pers. com.). Large numbers of starving chicks have been attributed to apparent food shortages (Caffrey 1995, 1997, Keane 1998, 1999, 2001, Marschalek 2006, Pagel pers. com.). These non-predation events have recently become the highest cause of mortality and exceed predation in impact to reducing hatching and subsequent fledging; in 2005, 3034 eggs, 2681 chicks, and 78 fledglings died of non-predation events (Marschalek 2006).

Environmental contamination
California least tern populations can be negatively impacted by oil spills. Oiled terns lose their ability to regulate their body temperature and often die of hypothermia or exposure. Additionally, oiled adults can pass oil onto eggs if they are incubating. Oil on eggs limits their ability to breathe, and introduces toxic hydrocarbons. Likewise, oiled adults that attempt to preen inhale and ingest hydrocarbons. Invertebrate populations are likely reduced as a result of beaches being oiled, reducing the available least tern prey base. Oiled invertebrates may also be another source of hydrocarbon ingestion for least terns (NOAA no date).

California least terns may also be affected by chronic oil pollution not easily attributable to specific spills. Hays (pers. com.) has reported tar balls and globules consistently proximal to the Huntington Beach tern colony. Intermittent oil spills from unknown sources have been noted on southern and central California beaches for decades (Carter 2003). The cause of some of these spills, such as those related to periodic oil leakages from the sunken vessel S. S. Jacob Luckenbach, have recently been identified, while the source of others remains a mystery (Carter 2003, Hampton *et al.* 2003).

2.4. Synthesis

The California least tern population has increased from 600 in 1973 to roughly 7,100 pairs in 2005. The number of California least tern sites have nearly doubled since the time of listing, with most of the tern colonies occurring in Southern California. While the number of terns has increased at the San Francisco Bay colonies, there has not been an increase in the number of colonies in Bay area, as required by the recovery plan's delisting criteria. The level of production (fledged young per pair) has declined and continues on a downward trend (Marschaleck 2006). However, new information suggests even at these production levels, the tern populations are continuing to increase (refer to Section 2.3.1 – Abundance).

The impact of habitat threats to the species has been ameliorated, but not eliminated. Habitat for the species is degraded throughout its range, and competing human activities continue to threaten the California least tern. The remaining nesting colonies are concentrated in five southern California counties and located on small sites within wildlife refuges, military installations, and other public lands requiring intensive management. Within these managed sites, the species remains vulnerable to predation, invasive non-native plants, and human-related disturbance (see Factors A, C, and E above). Without continued intensive management of these sites, we anticipate that the threats of habitat loss and predation would reverse the population recovery that has been seen since the species was listed.

In summary, the least tern recovery effort has ameliorated threats to the population so that it is no longer endangered, but has not removed those threats to the point where the species is secure without intensive, site-specific management. To date, cooperative actions have; 1) increased the breeding population of California least tern in California since 1987 and 2) reduced threats through nest site management.

3. RESULTS

3.1. Recommended Classification

_X_ Downlist to Threatened

____ Uplist to Endangered

____ Delist (Indicate reasons for delisting per 50 CFR 424.11):

- ____ Extinction
- ____ Recovery
- ____ Original data for classification in error

____ No change is needed

3.2. New Recovery Priority Number: 18C

The recovery priority number "18" indicates that the degree of threat to the subspecies is low and the potential for recovery is low. The reduction in threat is due to the intensive management that is occurring at California least tern sites to protect the species and habitat from human disturbance and predators. The opportunity for recovery is considered low

because breeding sites are concentrated in Southern California where little opportunity for expansion exists and because little expansion appears to be occurring in the San Francisco Bay area. The "C" indicates that conflict exists with construction or other development projects or other forms of economic activities.

3.3. Listing and Reclassification Priority Number, if reclassification is recommended

The priority for reclassifying California least tern from endangered to threatened is "6." This indicates that reclassification would be an unpetitioned action with low management impact.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

- **Revisit and revise current California least tern recovery plan**
  Current estimates of population and productivity necessary for downlisting and delisting may not be practicable or applicable, per advances in tern ecology, habitat management, and population viability analysis.

- **Continued management of existing nest sites**
  Continuation of protection and management at nest sites is imperative to ensure the increases in numbers of birds persist. Pre-season site inspection, fence construction or repair, weed removal, posting signs, and patrolling to minimize human disturbance have been done annually at most sites. Many sites also have been provided with clay roof tiles that serve as chick shelters. Fencing has been installed at many sites and maintenance is done by the various agencies responsible for the sites. Warning signs posted around nest sites have helped prevent human intrusions. The use of fencing and lethal/non-lethal predator control measures has reduced levels of predation. Binding, site-specific management plans should be developed in concert with state and federal wildlife agencies to provide long-term protection for nest sites.

- **Monitoring of nesting sites**
  Monitoring has been implemented at all known sites, but coverage has ranged widely from one to two visits per season to three to four visits per week. Overseeing the monitors and producing an annual report has been the primary responsibility of CDFG per an agreement with the Service. Further inter-agency coordination and increased financial assistance are necessary to ensure that field monitoring continues and is conducted in a rigorous and timely manner.

- **Creation of new nest sites and site expansion at existing sites**
  Available habitat for expansion of resurging population is limited. The creation of new locations and the expansion of current sites are for maintaining long-term populations of California least tern. Protection measures need to be created and implemented for all current and new colonies. All future site restorations or colony creations should, if at all possible, ultimately result in the creation of appropriate nesting, loafing, and foraging habitat for the terns.

5.0 REFERENCES

Allen, A. 1934. The season: San Francisco region. Bird-Lore 36:316.

Altman, S.A. 1956. Avian mobbing behavior and predator recognition. Condor 58:241-253.

Atwood, J.L. 1986. Delayed nocturnal occupation of breeding colonies by least terns (*Sterna antillarum*). Auk 103:242-244.

Atwood, J.L. and D.E. Minsky. 1983. Least tern foraging ecology at three major California breeding colonies. Western Birds 14:57-72.

Atwood, J. L., P. D. Jorgensen, R. M. Jurek, and T. D. Manolis. 1977. California least tern census and nesting survey, 1977. Calif. Dept. of Fish and Game, Endangered Wildl. Program, E-1-1, Final Rept., Job V-2. 11.

Atwood, J.L. R.A. Erickson, P.R. Kelly and P. Unitt. 1979. California Least Tern census and nesting survey, 1978. Endangered Wildlife Program E-W-2, Nongame Wildlife Investigations, Calif. Dept. Fish and Game, Job V-2. 13.

Bancroft, G. 1927. Breeding birds of Scammons Lagoon, Lower California. Condor 29:29-57.

Banks, R.C., C. Cicero, J.L. Dunn, A.W. Kratter, P.C. Rasmussen, J.V. Remsen, Jr., J.D. Rising, and D.F. Stotz. 2006. Forty-seventh supplement to the American Ornithologists' Union Checklist of North American Birds. Auk 123:926-936.

Barrantes, G. and A. Pereira. 1992. Abundancia y fluctuaciones de aves limícol (Charadriiformes) en una playa fangosa de Chomes, Costa Rica. Rev. Biol. Trop., 40(3): 303-307.

Becker, B.H. and S.R. Beissinger. 2006. Centennial decline in the trophic level of an endangered seabird after fisheries decline. Consrv. Biol. 20:470–479.

Bender, K. 1974a. California least tern census and nesting survey, 1973. Nongame Wildlife Invest. Final Rpt. Calif. Dept. Fish and Game.

Bender, K. 1974b. California least tern population and nesting survey, 1974. Nongame Wildlife Invest. Final Rpt. Calif. Dept. Fish and Game.

Bent, A. C. 1921. Life histories of North American gulls and terns. U.S. Natl. Mus. Bull. 113.

Bildstein, K.L., G.T. Bancroft, P.J. Dugan, D.H. Gordon, R.M. Erwin, E. Nol, L.X. Payne, and S.E. Senner. 1991. Approaches to the conservation of coastal wetlands in the western hemisphere. Wilson. Bull. 103:218-254.

Birdsall, A. 2002. A woman's nature: Attitudes and identities of the bird hat debate at the turn of the 20th century. Senior Thesis; Haverford College

Bolger, D.T., T.A. Scott, and J.T. Rotenberry. 1997. Breeding bird abundance in an urbanizing landscape in coastal southern California. Consv. Biol. 11:406-421.

Bridge, E.S., A.W. Jones and A.J. Baker. 2005. A phylogenetic framework for the terns (Sternini) inferred from mtDNA sequences: implications for taxonomy and plumage evolution. Molecular Phylogenetics and Evol. 35:459-469.

Brodkorb, P. 1940. New birds from southern Mexico. Auk 57:542-549.

Burleigh, T.D., and G.H. Lowery, Jr. 1942. An inland race of *Sterna albifrons*. Museum of Zooloogy, Occasional Papers, number 10:173-177, Louisiana State University.

Caffrey, C. 1993. California least tern breeding survey, 1992 season. California Department of Fish and Game, Wildlife Management Division, Nongame Bird and Mammal Section Report 93-11, Sacramento, CA. 35 pp.

Caffrey, C. 1994. California least tern breeding survey, 1993 season. California Department of Fish and Game, Wildlife Management Division, Nongame Bird and Mammal Section Report 94- 07, Sacramento, CA. 39 pp.

Caffrey, C. 1995. California least tern breeding survey, 1994 season. California Department of Fish and Game, Wildlife Management Division. Bird and Mammal Conservation Program Report 95-3, Sacramento, CA.

Caffrey, C. 1997. California least tern breeding survey, 1995 season. California Department of Fish and Game, Wildlife Management Division. Bird and Mammal Conservation Program Report 97-6, Sacramento, CA.

Caffrey, C. 1998. California least tern breeding survey, 1996 season. California Department of Fish and Game, Wildlife Management Division. Bird and Mammal Conservation Program Report 98-2, Sacramento, CA.

Carter, H.R. 2003. Oil and California's seabirds: an overview. Marine Ornithol. 31:1-7.

Carvacho, A., R. Ríos, C. León and A. Escofet. 1989. *Sterna antillarum browni* en el Golfo de California: Observaciones sobre una colonia reproductora en una zona vulnerable al impacto turistico. Southwestern Nat. 34:124-130.

Chambers, W. L. 1908. The present status of the least tern in southern California. Condor 10:237.

Chandik, T., and A. Baldridge. 1967. Nesting season, middle Pacific Coast region. Audubon Field Notes 21:600-603.

Chase, T., and R.O. Paxton. 1965. Middle Pacific Coast region. Audubon Field Notes 19:574-576.

Collins, C.T. 1984. End of year report California least tern field study, 1984 field season. California Department of Fish and Game. Unpubl. Report. 15 pp.

Collins, C.T. 1986. End of year report California least tern field study, 1986 field season. California Department of Fish and Game. Unpubl. Report. 19 pp.

Collins, C.T. 1987. End of year report California least tern field study, 1987 field season. California Department of Fish and Game. Unpubl. Report. 20 pp.

Collins, C.T., K.E. Bender and D.D. Rypka. 1979. Report on the feeding and nesting habits of the California least tern in the Santa Ana River marsh area, Orange County, California. Unpubl. report to U.S. Army Corps of Engineers, Los Angeles, California.

Collins, C.T., P.H. Baird, B.W. Massey, L.M. Kares and C.I. Adamson. 1991. Banding of adult California Least Terns at Marine Corps Base, Camp Pendleton between 1987 and 1991. Unpubl. summary report prepared for the Natural Resources Management Branch, Southwestern and Western Divisions Naval Facilities Engineering Command San Diego and San Bruno, CA.

CNDDB. 2006. Californian Natural Diversity Database. California Department of Fish and Game. Accessed on September 14, 2006.

Craig, A.M. 1971. Survey of California least tern nesting sites. State of California Department of Fish and Game. Special wildlife investigations W-54-R.

Dawson, W.L. 1924. The birds of California. South Moulton Company, San Diego, California.

De Benedictis, P. and T. Chase, Jr. 1963. Middle Pacific Coast region. Audubon Field Notes 17:480-483.

Densmore, R.J. 1990. Gull-billed tern predation on a least tern chick. Wilson Bull. 102:180-181.

Draheim H.M. 2006. Phylogeography and population genetic structure least terns (*Sterna antillarum*). M.S. Thesis, Oregon State University, Corvallis, OR.

Fancher, J. 1989. 1988 nesting activity of the California least tern at Huntington State Beach adjacent to the Santa Ana River Mouth, Orange County, California. Unpublished U.S. Fish and Wildlife Service report. March 1989. 18 pp.

Fancher, J.M. 1992. Population status and trends of the California least tern. Trans. West. Sect. Wildl. Soc. 28:59-66.

Fancher, J. M. 1994. A synopsis of 15 years of nesting by California least terns at Bolsa Chica, Orange County, California. Report prepared by U.S. Fish and Wildlife Service, Carlsbad Field Office. 16 pp.

Fancher, J., K. Foerster, and R. Bransfield. 1988. 1986 and 1987 nesting activities and individual histories of the California least tern at Huntington Beach State Beach, Orange County, California. Unpublished report to the U.S. Army Corps of Engineers, Los Angeles, California. January 1988, 38 pp.

Garrott, R.A., P.J. White, and C.A. Vanderbilt-White. 1993. Overabundance: an issue for conservation biologists? Consv. Biol. 7:946-949.

Goss-Custard, J.D., R.T. Clarke, S.E.A. Le V. Dit Durrel, R.W.G. Caldow, and B.J. Ens. 1995. Population consequences of winter habitat loss in a migratory shorebird. II. Model predictions. J. Appl. Ecol. 32:337-351.

Grinnell, J. 1898. Birds of the Pacific Slope of Los Angeles County. Pasadena Academy of Science, Publ. 2.

Grinnell, J. 1928. A distributional summation of the ornithology of Lower California. Univ. Calif. Publ. Zool. 32:1-300.

Grinnell, J., and A. Miller. 1944. The distribution of the birds of California. Pacific Coast Avifauna 27:1-608.

Grinnell, J., and M. W. Wythe. 1927. Directory of the bird-life of the San Francisco Bay region. Pacific Coast Avifauna 18:1-160.

Gustafson, J. 1986. Summary of the California least tern seasons for 1979-83 (5 years). California Department of Fish and Game. Unpubl. Report. 7 pp.

Hagar, J.A. 1937. Least tern studies-1935 and 1936. Bull. Massachusetts Audubon Society 21:5-8.

Hampton, S., R.G. Ford, H.R. Carter, C. Abraham, and D. Humple. 2003. Chronic oiling and seabird mortality from the sunken vessel S.S. Jacob Luckenbach in central California. Marine Ornith. 31:35-41.

Hanson, B. 2001. Shorebirds and avian influenza viruses. Wader Study Group Bulletin 96:4

Holterhoff, G. 1884. Occurrence of the least tern at San Diego, California. Auk 1: 294.

Hooper-Bui, L.M., M.K. Rust, and D.A. Reierson. 1998. Using bait to suppress the southern fire ant on an ecologically sensitive site (Hymenoptera: formicidae). Sociobiol. 31:283-289.

Hooper-Bui, L.M., M.K. Rust, and D.A. Reierson. 2004. Predation of the endangered California least tern, *Sterna antillarum browni* by the southern fire ant, Solenopsis xyloni (Hymenoptera, Formicidae_. Sociobiol. 43:xx-xx.

Hothem, R. and S. Zador. 1995. Environmental contaminants in eggs of the California least tern. Bull. Environ. Contam. Toxicol. 55: 658-665.

Hubbard, D. M. and J.E. Dugan. 2003. Shorebird use of an exposed sandy beach in southern California. Estuarine, Coastal and Shelf Science58:169-182.

Hunn, E. S., and P.W. Mattocks, Jr. 1979. The autumn migration. Northern Pacific Coast Region. Am. Birds 33: 206-209.

Johnston, S.M, and B.S. Obst. 1992. California least tern breeding survey, 1991 season. California Department of Fish and Game, Nongame Bird and Mammal Section Report, 92-06. 19 pp.

Jurek, R.M. (ed). 1977. California least tern census and nesting survey, 1976. California Least Tern Recovery Team and California Department of Fish and Game, Nongame Wildl. Investigations, E-1-1. 5 pp. + app.

Jurek, R.M. 1992. Nonnative red foxes in California. Nongame bird and mammal section report 92-04.

Keane, K. 1998. California least tern breeding survey, 1997 season. California Department of Fish and Game, Wildl. Manage. Div., Bird and Mammal Conservation Program Rep. 98-12, Sacramento, CA. 46 pp.

Keene, K. 1999. California least tern breeding survey; 1998 season. Calif. State Univ. Long Beach foundation.

Keane, K. 2000. California least tern breeding survey, 1998 season. California Department of Fish and Game, Habitat Conservation and Planning Brach Rep., 2000-01, Sacramento, CA. 43 pp.

Keane, K. 2001. California least tern breeding survey, 1999 season. California Department of Fish and Game, Habitat Conservation and Planning Brach, Species Conservation and Recovery Program Rep., 2001-01, Sacramento, CA. 16 pp. + app.

Lafferty, K.D. and L.R. Gerber. 2002. Good medicine for conservation biology: the intersection of epidemiology and conservation theory. Consv. Biol. 16:593-604.

Lafferty, K.D. and R.D. Holt. 2003. How should environmental stress affect the population dynamics of disease? Ecology Lett. 6:654-664.

Lamb, C. C. 1927. Notes on some birds of the southern extremity of Lower California. Condor 29:155-157.

Lange, C.B., S.K. Burke, and W.H. Berger. 1990. Biological production off Southern California is linked to climate change. Climatic Change 16:319-329.

Lesson, R.P. 1847. Histoire Naturelle des Colibris, Suive D'un Supplement a L'histoire Naturelles des Oiseaux-mouches. Bertrand.

Makarova, N.V., N.V. Kaverin, S. Krauss, D. Senne, and R.G. Webster. 1999. Transmission of Eurasian avian H2 influenza virus to shorebirds in North America. J. Gen. Virology 80:3167-3171.

Marschalek, D.A. 2005. California least tern breeding survey, 2004 season. California Department of Fish and Game, Habitat Conservation and Planning Branch, Species Conservation and Recovery Program Report, 2005-01. Sacramento, CA. 24 pp. + app.

Marschalek, D.A.. 2006. California least tern breeding survey, 2005 season. Cal. Dept. Fish and Game. Sacramento.

Massey, B.W. 1974. Breeding biology of the California least tern. Proc. Linnaean Soc. 72:1-24.

Massey, B.W. 1975. California Least Tern census and nesting survey, 1975. The Resources Agency, California Dept. of Fish & Game.

Massey, B.W. 1977. Occurrence and nesting of the least tern and other endangered species in Baja California, Mexico. Western Birds 8:67-70.

Massey, B.W. 1981. A least tern makes a right turn. Nat. Hist. 90:62-71.

Massey, B.W. 1987. California least tern foraging study, Los Angeles Harbor, 1986/1987. Port of Los Angeles, Environmental Div./Marine Ecological Consultants, Encinitas, CA.

Massey, B.W. 1988. California Least Tern field study, 1988 breeding season. State of California. The Resources Agency. Cal. Dept. Fish & Game. Unpubl. rep..

Massey, B.W. 1989. California Least Tern field study, 1989 breeding season. State of California. The Resources Agency. Cal. Dept. Fish & Game. Unpubl. rep.

Massey, B.W., D. Bradley, and J. Atwood. 1992. Demography of a California least tern colony including effects of the 1982-1983 El Niño. Condor 94:976-983.

Massey, B.W. and J.M. Fancher. 1989. Renesting by California least terns. J. Field Ornith. 60:350-357.

McCormick, A.I. 1899. Breeding habits of the least tern in Los Angeles County, California. Bull. of the Cooper Ornithological Club 1:49-50.

Mearns, E. A. 1916. Description of a new subspecies of the American least tern. Proc. of the Biol. Soc. of Wash. 24:71-72.

Mellink, E. and E. Palacios. 1993. Notes on breeding coastal waterbirds in northwestern Sonora. Western Birds 24:29-37.

Mendes, L., T. Piersma, and D. Hasselquist. 2006. Two estimates of the metabolic costs of antibody production in migratory shorebirds: low costs, inter reallocation, or both? J. Ornith. 147:274-280.

Munoz del Viejo, A. and X. Vega. 2002. Efectos de disturbios en la reproduccion del charrantcito Americano (*Sterna antillarum*) en ecosistemas costeros de sinaloa, Noroeste de Mexico. Ornithologia Neotropical 13:235-245.

NatureServe. 2006. NatureServe Explorer: An online encyclopedia of life [web application]. Version 5.0. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: September 13, 2006).

NOAA. Date Unknown. Damage Assessment and restoration planning For Marine Birds. Available http://www.nmfs.noaa.gov/habitat/restoration/publications/DARP_Birds.pdf. National Oceanic and Atmospheric Agency, NOAA Fisheries Restoration Center. (Accessed: September 14, 2006).

Obst, B.S., and S.M. Johnston. 1992. California least tern breeding survey, 1990 season. California Department of Fish and Game, Nongame Bird and Mammal Section Report, 92-05. 13 pp.

Palacios C.E. 1988. Requerimientos y hábitos reproductivos de la Golondrina Marina de California (Sterna antillarum browni Mearns, 1916) en la Ensenada de La Paz. Tesis, Universidad Autonoma de Baja California Sur, La Paz, B.C.S.

Palacios, E. and L. Alfaro. 1993. Evaluacion del status poblacional de la Golondrina Marina y el Chorlito Nevado en la peninsula de Baja California, Mexico. Report de pro esteros y CICESE. Ensenada, Baja California, Mexico.

Palacios, E. and E. Mellink. 1993. Additional records of breeding birds from Montague island, northern Gulf of California. Western Birds 24:259-262.

Palacios, E. and E. Mellink. 1996. Status of the least tern in the Gulf of California. J. Field Ornithol. 67:48-58.

Parmesan, C. and G. Yohe. 2003. A globally coherent fingerprint of climate change impacts across natural systems. Nature 421:37-42.

Patten, M.A. and R.A. Erickson. 1996. Subspecies of the least tern in Mexico. Condor 98:888-890.

Patton, R.T. 2002. California least tern breeding survey, 2000 season. California Department of Fish and Game, Species Conservation and Recovery Program Report, 2002-03. 24 pp. + app.

Pray, R. H. 1954. Middle Pacific Coast region. Audubon Field Notes 8:326-327.

Redfern, C. 2006. Recovery of the California least tern: An Endangered Species Act success story. Sketches 57(7):2-3.

Reisen, W.K., Y. Fang, H.D. Lothrop, V.M. Martinez, J. Wilson, P. O'Connor, R. Carney, B. Cahoon-Young, Marzie Shafii, and A.C. Brault. 2006. Overwintering of West Nile virus in southern California. J. Medical Entom. 43:344-355.

Rimmer, D.W. and R.D. Deblinger. 1990. Use of predator exclosures to protect piping plover nests. J. Field Ornithol. 61-217-223.

Ruhlen, T.D., S. Abbott, L.E. Stenzel, and G.W. Page. 2003. Evidence that human disturbance reduces snowy plover chick survival. J. Field Ornithol 74:300-304.

Schulenberg, T. S., T. A. Parker, III, R. A. Hughes. 1987. First records of Least Terns, *Sterna antillarum*, for Peru. Le Gerfaut 77: 271–273

Scott, J.M. and D.D. Goble. 2006 Ongoing threats to edemic species. Science 321:526.

Scott, J.M., D.D. Goble, J.A. Weins, D.S. Wilcove, M. Bean, and T. Male. 2005. Recovery of imperiled species under the Endangered Species Act: the need for a new approach. Frontiers Ecol. Environ. 3:363-389.

Shepardson, D. I. 1909. Notes on the least tern. Oologist 26:152.

Sibley, C.G. 1952. The birds of the South San Francisco Bay region. 42 pp. Typewritten copy at Oakland Public Museum.

Stiles, G.F. and A.F. Skutch. 1989. A Guide to the Birds of Costa Rica. Comstock Publ. Co. Cornell Univ., Ithaca, NY. pp. 161-162.

Suarez, A.V., P. Yeh, and T.J. Case. 2005. Impacts of Argentine ants on avian nesting success. Insectes Sociaux 52:378-382.

Thompson, B. C., J. A. Jackson, J. Burger, L. A. Hill, E. M. Kirsch, and J. L. Atwood. 1997. Least Tern (*Sterna antillarum*). *In* The Birds of North America, No. 290 (A. Poole and F. Gill, eds.). The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, D.C.

Thompson, B.C., M.E. Schmidt, S.W. Calhoun, D.C. Morizot, and R.D. Slack. 1992. Subspecific status of least tern populations in Texas: North American implications. Wilson Bull. 104:244-262.

Turell, M.J., M.L. O'Guinn, D.J. Dohm, J.P. Webb Jr., and M.R. Sardelis. 2002. Vector competence of *Culex tarsalis* from Orange County, California, for West Nile virus. Vector Borne Zoonotic Dis. 2:193-196.

Turell, M.J., D.J. Dohm, M.R. Sardelis, M.L. O'Guinn, T.G. Andreadis, and J.A. Blow. 2005. An update on the potential of North American Mosquitoes (Diptera:Culicidae) to transmit West Nile Virus. J. Med. Entomol 42:57-62.

U.S. Fish and Wildlife Service. 1985. Revised California least tern recovery plan. U.S. Fish and Wildlife Service, Region 1, Portland, Oregon.

Van Rossem, A. J., and M. Hachisuka. 1937. A further report on birds from Sonora, Mexico, with descriptions of two new races. Trans. San Diego Soc. Nat. Hist. 8:321-326.

Vaucher, G.L. 1988. Christmas count, Pacific Canal Area, R.P. Panama. Amer. Birds 42:1154-1155.

Walker, A. 1972. The least tern in Oregon. Murrelet 53:52.

Whittier, J.B. 2001. Management implications of population genetics and demographics of least terns (*Sterna antillarum*) Dissertation, Okalahoma State University, Stillwater, Ok.

Whittier, J.B., D.M. Leslie, and R.A. Van Den Bussche. 2006. Genetic variation among subspecies of least tern (*Sterna antillarum*): Implications for conservation. Waterbirds 29:176-184.

Willett, G. 1933. A revised list of the birds of southwestern California. Pac. Coast Avifauna #21.

WRA (Wetlands Research Associates). 1997. California least tern breeding survey for Batiquitos Lagoon, San Diego County, California, 1994-1996 seasons. Unpublished report for the Batiquitos Lagoon Enhancement Project. 32 pp.

Yocom, C. F., and S. W. Harris. 1975. Status, habits and distribution of birds of northwestern California. Unpubl. Humboldt State Univ., Arcata, California.

Zink, R. M. 2004. The role of subspecies in obscuring avian biological diversity and misleading conservation policy. Proc. R. Soc. Lond. B 271:561–564.

Zuria, I. and E. Mellink. 2002. Natural and human impacts on two least tern colonies in northwestern Mexico. Southwest. Nat. 47:617-623.

Personal communications

Collins, Charles, Ph.D., Professor, Department Of Biological Sciences, California State University, Long Beach, California.

Fancher, Jack, Wildlife Biologist, US Fish and Wildlife Service, Carlsbad, California.

Hayes, Loren, Staff Ornithologist (Retired), US Fish and Wildlife Service, Carlsbad, California. Currently residing in Orange County, California.

Massey, Barbara, (Retired), California State University, Long Beach, California. Currently residing in Ashland, Oregon.

Pagel, Joel, Wildlife Biologist, US Fish and Wildlife Service, Carlsbad, California.

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of California least tern (*Sternula antillarum browni*)

Current Classification: endangered

Recommendation resulting from the 5-Year Review:

_X_ Downlist to Threatened

____ Uplist to Endangered

____ Delist

____ No change needed

Appropriate Listing/Reclassification Priority Number, if applicable: 6

Review Conducted By: Jim Bartel

FIELD OFFICE APPROVAL:

Lead Field Supervisor, Fish and Wildlife Service

Approve _____ Date 9-21-06

REGIONAL OFFICE APPROVAL:

Lead Regional Director, Fish and Wildlife Service

Approve _____ Date 9/26/2006