

Up, Down, or Stable: Populations of Endangered Birds in Beach and Estuarine Areas in Southern California¹

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Abstract

The coastal beach-dune ecosystem in California supports two federally listed threatened or endangered species: California least tern (*Sterna antillarum browni*) and western snowy plover (*Charadrius alexandrinus nivosus*). This ecosystem has become highly stressed due to shoreline development, invasion of exotic plants, beach stabilization, and heavy recreational use. Least tern populations have increased significantly since the 1980s. Snowy plover populations, however, show continued decline along California's coast. Management practices to protect least tern nesting colonies appear to be successful for terns but do not offer protection for plovers. More research is needed to monitor reproductive success and survival of snowy plovers in order to improve management practices and preservation of nesting areas. Impacts to estuarine ecosystems have been severe and include loss, degradation, and fragmentation. The most imperiled species within this system is the endangered light-footed clapper rail (*Rallus longirostrus levipes*). Rail populations have ranged from a low of 142 pairs in 1985 to a high of 325 pairs in 1996 during the 22-year period they have been monitored. Most alarming is that only one estuary consistently supports more than 50 percent of California's rails, and only three sites support more than 80 percent. Although Belding's savannah sparrow (*Passerculus sandwichensis beldingi*) is not federally listed as endangered, populations in estuaries are stable or declining, but monitoring is erratic at best. Belding's savannah sparrows are area-sensitive, and reproductive success appears to be low in fragmented marshes. Research on productivity and survival of rails and sparrows is needed. Habitat enhancement and creation should be the highest priority for beach and estuarine birds as well as migratory shorebirds, but predator management and restrictions on recreation beach use are also necessary.

Key words: Belding's savannah sparrow, California least tern, endangered, estuarine, light-footed clapper rail, western snowy plover

Introduction

The beach and estuarine ecosystems of southern California have suffered significant degradation and loss of natural habitats. Beach ecosystems are altered by heavy recreational use, urban development, beach stabilization efforts, river channelization, and non-indigenous plant species (Federal Register 1993, Page and Stenzel 1981, Powell 1998, U.S. Fish and Wildlife Service 1985, Veirs and others 1998). Loss of beach habitats resulted in declines of beach-nesting birds, including the California least tern. In 1970, the California least tern was listed as federally endangered, with the California population estimated at 600 pairs (U.S. Fish and Wildlife Service

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1985). More recently, in 1993, the Pacific Coast population of western snowy plover was federally listed as threatened (Federal Register 1993).

California has lost an estimated 91 percent of its wetlands since pre-settlement times, and remaining estuaries are fragmented. Estuarine systems in southern California have been highly altered by urban development, filling, river channelization, changes in freshwater flow, and invasion of exotic species. Loss of total wetland area and degradation of remnant estuaries have caused many wetland-dependent species to be listed as *special concern* by the State and Federal governments (Veirs and others 1998). These include the light-footed clapper rail, federally listed as endangered in 1970 (U.S. Fish and Wildlife Service 1979), and the Belding's savannah sparrow, listed as endangered by the State of California in 1974 (State and Federal endangered and threatened animals of California and their listing dates, unpublished report, State of California, 1994).

What do we know about the populations of these bird species that depend on beach and estuarine ecosystems? How are resource agencies using population information to manage these endangered and threatened birds? Although three of the four species mentioned above were listed more than 25 years ago, information on population status varies in quality, quantity, and availability. This paper summarizes the current knowledge of the four species' populations in the south coast ecoregion of California. In addition, I include recommendations for future management and research for each species.

California Least Tern

Migratory California least terns are present in California from the Mexican border north to San Francisco Bay only during their breeding season, which is mid-April through September. Since being listed as endangered in 1970, management actions have included fencing colonies, limiting access to nesting areas, and, after the mid-1980s, managing predators. Monitoring of least tern colonies to track changes in population trends and productivity began in 1973; efforts to cover all areas have increased over the past 20 years (Patton 2002). Population monitoring, however, is not uniform at each colony, and methods range from non-invasive surveys of terns on nests to intensive efforts that include marking each nest and banding chicks. Monitoring is conducted by State and Federal personnel at some sites and by biological consultants at others. There has been statewide coordination of population data compilation since the mid-1970s (Ron Jurek, California Department of Fish and Game, personal communication).

The California least tern population was estimated at 600 breeding pairs in 1970 (Fancher 1992). For removal from the endangered species list, there must be 1,200 breeding pairs distributed among at least 20 coastal areas and an average over 5 years of one fledgling produced per breeding pair per year (U.S. Fish and Wildlife Service 1985). The population of California least terns has increased dramatically since 1988, growing from approximately 1,000 pairs to more than 4,000 pairs within 10 years (*fig. 1*). Least terns nest at approximately 34-39 sites in southern California, and the number of breeding pairs has exceeded 2,000 since 1992 (Keane 2001, Patton 2002). Although estimates of fledgling production have fluctuated, particularly in El Niño years (Massey and others 1992), the total number of fledglings produced

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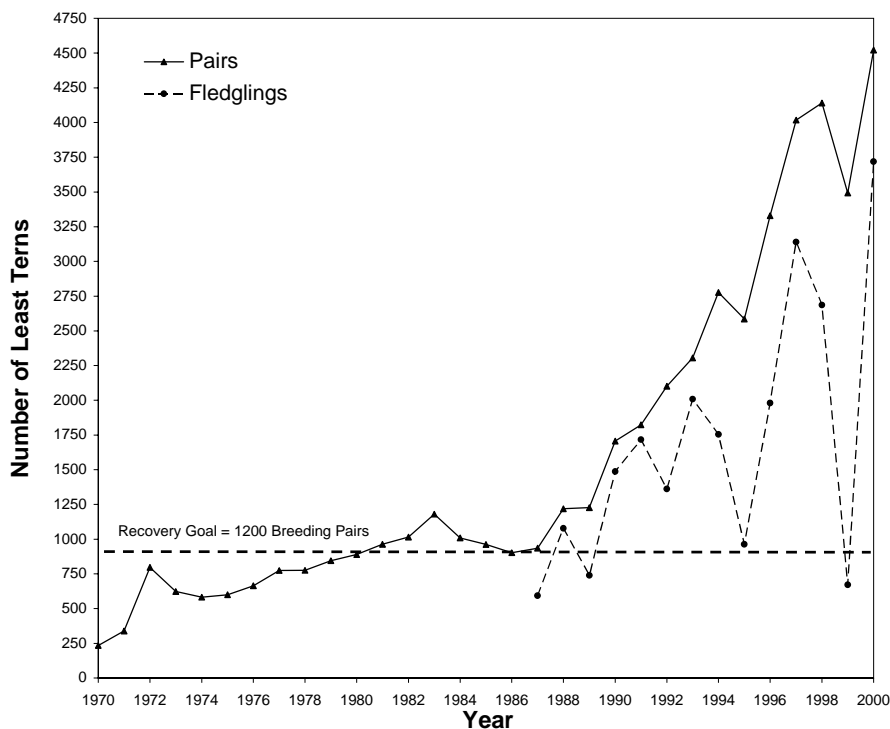


Figure 1—Number of breeding pairs and fledglings of California least terns in California, 1978-2000. Data are from Keane (1998) and from unpublished data on file from California Department of Fish and Game, Sacramento, CA.

increased in the same time period (*fig. 1*). However, dividing the estimated total fledglings by the estimated number of pairs per year reveals that the recovery goal of one fledgling per pair is not being met (mean fledglings/pair = 0.68 ± 0.21 SD, years 1987-2000). It is unknown what proportion of the population and productivity increases can be attributed to increased monitoring efforts over the same time period.

Regardless, increased breeding populations and productivity have been attributed to protection of nesting colonies and predator management (Fancher 1992). Fencing varies from site to site and may exclude people or both people and mammals. Predators are managed by exclusion and direct removal; however, information on the numbers of predators removed is difficult to obtain. Predators include, but are not limited to, common raven (*Corvus corax*), American crow (*C. brachyrhynchos*), American kestrel (*Falco sparverius*), peregrine falcon (*F. peregrinus*), burrowing owl (*Athene cunicularia*), coyote (*Canis latrans*), domestic cat (*Felis catus*), gray fox (*Urocyon cinereoargenteus*), long-tailed weasel (*Mustela frenata*), and raccoon (*Procyon lotor*). In addition, increased monitoring efforts facilitate adaptive management of tern colonies (Keane 1998, Patton 2002). Of the four species described in this paper, we know the most about California least tern populations, which have increased exponentially since 1988.

Western Snowy Plover

Although snowy plover habitat overlaps with the habitat of California least terns, there are several important differences in the biology, management, and population

status of these two species (Powell 1998, 2001). Unlike least terns, snowy plover populations in California are a mixture of migratory and resident birds (Powell and others 2002, Stenzel and others 1994); thus conservation is an issue year-round. In winter, snowy plovers from northern California migrate to southern California. In addition, a proportion of southern California breeders overwinter in the same region. Snowy plovers begin nesting in early March, well before least terns arrive from their wintering grounds in mid-April.

There are large information gaps about snowy plovers that breed and winter in southern California. The Pacific Coast population of western snowy plovers was federally listed as threatened in 1993 because statewide surveys showed overall declines in breeding and wintering populations (Federal Register 1993). Until 1994, data on numbers of plovers, productivity, and survival in the south coast region was sporadic at best. Page and others (1991) estimated the number of individual breeding plovers in California in 1989 (1,386) was 89 percent of the number found from 1977 to 1980 (1,565). Coastal lagoons in southern California historically supported breeding snowy plovers, but habitat loss and alteration of water flows have degraded these sites; they now only sporadically support breeding pairs. Snowy plovers no longer breed within Los Angeles County, and only one nesting area, Bolsa Chica Lagoon, remains in Orange County.

Most of what is known about breeding populations of snowy plovers in Ventura, Santa Barbara, and San Luis Obispo counties comes from “window” surveys conducted approximately every three years by the Point Reyes Bird Observatory. These surveys take place during a specific “window” of time, usually 1-2 days during peak nesting (last week of May). The most recent window survey in 2002 found 1,379 adult plovers in California (unpublished data on file, Point Reyes Bird Observatory, Stinson Beach, CA). The largest numbers of breeding plovers found in 1991, 1995, 2000, and 2002 were at Vandenberg Air Force Base (AFB; 242, 213, 106, and 179, respectively), the Channel Islands (199, 196, 89, and 79), San Francisco Bay (176, no data for 1995, 96, and 78), and northern San Diego County (48, 49, 63, and 80) (unpublished data on file, Point Reyes Bird Observatory, Stinson Beach, CA.). In addition, Point Reyes Bird Observatory has long-term data on snowy plovers in the Monterey Bay area. Their data indicate that the average number of fledglings per adult ranged from 0.85-0.86 annually, but after nests were actively protected from people and predators in 1992, fledging rates increased to over 1 fledgling per adult (unpublished data on file, Point Reyes Bird Observatory, Stinson Beach, CA). A comprehensive study on the population dynamics of snowy plovers in San Diego County was initiated in 1994 and continued through 1999 (Powell and others 2002), and the U.S. Fish and Wildlife Service began monitoring snowy plovers at Bolsa Chica Lagoon in Orange County in 1997. On average, 50 percent of all snowy plovers in San Diego and Orange counties nested at one site, Marine Corps Base Camp Pendleton. Overall reproductive success was low, with estimated nest success in San Diego County typically less than 55 percent with fewer than 0.5 fledglings produced per nest (Powell and others 2002).

The creation of nesting habitat for least terns from dredged materials has been a popular component of habitat restoration to partially compensate for wetland loss in southern California. Five new nesting areas were created at Batiquitos Lagoon in 1994 and 1995. This restoration project provided a unique opportunity to study natural recolonization and subsequent success of snowy plover populations from 1994 to 1998 (Powell and Collier 2000). Snowy plovers traditionally nested at the

lagoon along its perimeter (5 nests in 1994 prior to construction). After the creation of new least tern nest sites, snowy plovers began to use these areas immediately. Although the number of nesting attempts at Batiquitos Lagoon increased from 5 in 1994 to a high of 38 in 1997, fledge rates and nest success declined after peaking the first year the created sites were used, suggesting that the area attracted nesting plovers but ultimately became a habitat sink (Pulliam 1988). Predation pressure and quality of habitat were important in determining habitat use and reproductive success on the newly created areas. As more birds, including least terns, used the created sites, more predators were observed there. In addition, the amount of cover on the created sites may have contributed to lowered nest and chick survival. Areas devoid of cover provided little visual or thermal protection, while other areas became covered with invasive weeds, which made sites less attractive to nesting plovers (Powell and Collier 2000). In summary, snowy plovers easily colonized newly created sites and were highly productive immediately after colonization. However, productivity decreased with time and was related to habitat quality and predation pressure.

More monitoring and research on the effects of California least tern management on snowy plovers is needed in the region. Plovers are more vulnerable to human disturbance than least terns. In addition, estimating population growth by monitoring nests or pairs of breeding plovers is not enough to determine population status, because some areas may serve as population sinks (Pulliam 1988). It is necessary to obtain information on annual productivity in addition to number of breeding plovers. No area in San Diego County or Orange County produces enough snowy plovers to be considered a source population, and knowledge about survival and productivity of snowy plovers north of these counties is sparse.

Light-Footed Clapper Rail

In the United States, this subspecies of clapper rail is a year-round resident of salt marshes from Tijuana Estuary on the Mexican border north to Santa Barbara County (U.S. Fish and Wildlife Service 1985). Considerable research has been done on habitat requirements and behavior of light-footed clapper rails (Massey and others 1984, Massey and Zembal 1987, Zembal and Fancher 1988, Zembal and others 1985, 1989). In addition, genetic analysis of the subspecies indicated there was low genetic variability and a metapopulation with local populations that experienced extirpation, recolonization, and limited dispersal (Fleischer and others 1995).

Light-footed clapper rail populations have been monitored annually since 1980. Marshes that potentially support clapper rails are visited in spring, and clapper rail calls are counted. Clapper rails use several distinct calls during the breeding season that can be used to distinguish single males, single females, and mated pairs (Massey and Zembal 1987). During a census, people walk slowly through the marsh at dawn or dusk and mark locations of calls on a map. In addition, taped calls may be played to elicit responses (Zembal 1998). Each year a breeding survey report is submitted to the California Department of Fish and Game. In 1980, the first year of the survey, the light-footed clapper rail population consisted of an estimated 203 breeding pairs; a high of 325 breeding pairs was counted in 1996. The number of estimated pairs has varied around the 22-year mean of 231 pairs, but there has been no overall pattern of decline or increase during this period (*fig. 2*).

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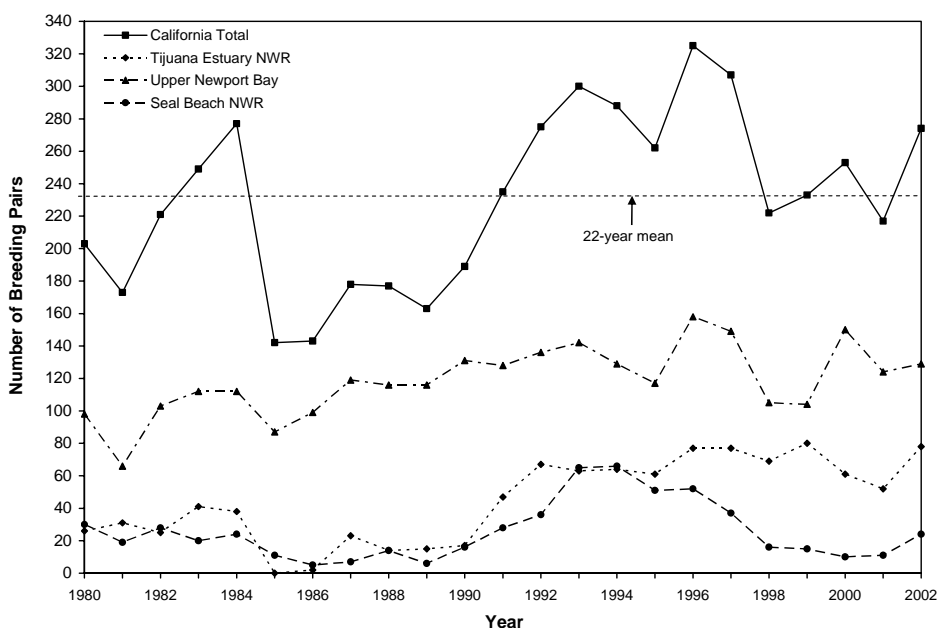


Figure 2—Number of breeding pairs of light-footed clapper rails in California, 1980-2002. Data are from Richard Zembal, U.S. Fish and Wildlife Service, personal communication, unpublished data on file, California Department of Fish and Game, Sacramento, CA.

Predator management to remove non-native red foxes (*Vulpes vulpes*) resulted in growth of the population at Seal Beach National Wildlife Refuge (NWR) from a low of 5 pairs in 1986 to 65 pairs in 1993 (Zembal and others 1998). In addition to predator management, nesting rafts have been deployed at this site to increase nest site availability since the late 1980s. However, the population at Seal Beach appears to be lower (range 5-24 pairs) from 1995-2002 than in the early 1990s (fig.2). It is postulated that rafts may increase the incidence of raptor predation on clapper rails at this site (Zembal and others 1998).

Upper Newport Bay Ecological Reserve consistently supported more than 50 percent of California's light-footed clapper rails, and together three sites (Upper Newport Bay Ecological Reserve, Tijuana Estuary NWR, and Seal Beach NWR) supported more than 80 percent of breeding pairs in any given year. These three estuaries are the second, third, and fourth largest in size within the range of the clapper rail. Mugu Lagoon, the largest wetland, supported on average only four pairs of rails. Of the remaining 21 sites where light-footed clapper rails are found, none supported more than 4 percent of the metapopulation, and 15 each supported less than 1 percent of the metapopulation.

Light-footed clapper rails are associated with cord grass (*Spartina foliosa*) habitats within coastal marshes in southern California (U.S. Fish and Wildlife Service 1979). Although it is unlikely that new estuaries will be created in this region, it is possible to improve and expand cord grass coverage in existing marshes. Foin and Brenchley-Jackson (1991) suggested that cord grass habitat improvement within existing marshes could potentially triple the rail population. Despite the severe limitation of available habitat, there are captive breeding and reintroduction efforts

currently being initiated (unpublished data, California Department of Fish and Game, Sacramento, CA). It has been well documented that the key predictors of successful translocations are habitat quality and the number of animals released. In general, endangered species translocations are unsuccessful more than 50 percent of the time (Griffith and others 1989). Likewise, if animals are released into habitats that are in poor condition or have insufficient area, they are unlikely to persist (Wolf and others 1996, 1998). Fleischer and others (1995) cautioned that translocations of light-footed clapper rails should be avoided until there is documentation that inbreeding depression is a problem for this species. Finally, more information is needed on natural recruitment into light-footed clapper rail subpopulations. Given the small number of light-footed clapper rails remaining in southern California and the limited and degraded condition of estuarine habitat, efforts to increase populations should emphasize habitat creation and enhancement rather than costly translocations with low potential for success.

Belding's Savannah Sparrow

Like light-footed clapper rails, Belding's savannah sparrows are non-migratory and endemic to southern California salt marshes. Unlike rails, however, Belding's savannah sparrows are associated with pickleweed (*Salicornia* sp.) habitats, which are much more expansive than cord grass habitats (Powell 1993). Pickleweed habitats have been degraded by changes in tidal flow and freshwater inputs, invasion of non-indigenous plants, and fragmentation by trails and roads. Restoration of this habitat type is difficult and may not result in suitable nesting habitat for sparrows (Keer and Zedler 2002).

Belding's savannah sparrows are censused in spring by counting singing males and observing breeding pairs. They have been censused sporadically in 26 to 30 coastal salt marshes in southern California, and intensity of efforts to count them varied among wetlands and years. All 30 marshes were surveyed in 1986, 1991, 1996, and 2001, and the total estimated number of breeding pairs ranged from 1,844 to 2,902 (Zembal and Hoffman 2002, Zembal and others 1988,). Mugu Lagoon, the largest salt marsh in southern California, supported the largest subpopulation of sparrows, followed by Tijuana Estuary NWR, Upper Newport Bay Ecological Reserve, and Seal Beach NWR. Except in Mugu Lagoon, these sites also supported the largest subpopulations of light-footed clapper rails despite the differences in habitat associations of the two species.

There is evidence that Belding's savannah sparrow has limited dispersal and exists as a metapopulation with extirpation and recolonization of local populations (Bradley 1994, Burnell 1996, Zembal and others 1988). Like grassland savannah sparrows (*P. sandwichensis*), Belding's savannah sparrows are area-sensitive: there is a positive relationship between size of wetland and indices of population size, and sparrows are unlikely to occur in marshes less than 10 ha in size (Powell and Collier 1998). Recent research on reproductive success of Belding's savannah sparrows in different-size wetlands suggested that small, isolated salt marshes supported breeding birds but functioned as population sinks because they supported little or no productivity at those sites (Powell and Collier 1998). Finally, recent work on breeding biology of Belding's savannah sparrows indicates that the effective population size is likely much smaller than the number of males present; less than 50

percent of males establish territories, and only 43 percent of the territorial males manage to attract mates (Burnell 1996).

Ecosystem Importance

There is considerable overlap of the estuaries and associated beaches most important to these four species, and many of the important areas are on federal or State lands (*table 1*). Mugu Lagoon, for example, is among the top five breeding areas for both snowy plovers and Belding’s savannah sparrows, and Santa Margarita River estuary and beach areas are critical breeding areas for California least terns and snowy plovers. Both Mugu Lagoon and the Santa Margarita River estuary are within Federal lands managed by the military (Mugu Naval Air Station (NAS), Camp Pendleton MCB). Vandenberg AFB supports the largest number of breeding snowy plovers in southern California. Other important federal lands include National Wildlife Refuges (Tijuana Estuary NWR, Seal Beach NWR, and Bolsa Chica Lagoon) and National Park Service (Channel Islands) lands. Upper Newport Bay, which is managed as an Ecological Reserve by the California Department of Fish and Game, supports the most light-footed clapper rails in the state as well as being the third most important site for Belding’s savannah sparrow.

Table 1—*Top five sites, listed in descending order of population size, for breeding California least terns, western snowy plovers, light-footed clapper rails, and Belding’s savannah sparrows in southern California.*

Species	Site	Management ¹
California least tern	Santa Margarita Estuary	Camp Pendleton MCB
	Venice Beach	CDFG
	Huntington Beach	CDPR, City of Costa Mesa
	Coronado	NAB Coronado
	Mission Bay	City of San Diego
Western snowy plover	Vandenberg	Vandenberg AFB
	Channel Islands	NPS, TNC
	Santa Ynez River	USAF
	Mugu Lagoon	Mugu NAS
	Santa Margarita Estuary	Camp Pendleton MCB
Light-footed clapper rail	Upper Newport Bay	CDFG
	Tijuana Estuary	NWR, CDPR
	Seal Beach	NWR
	Kendall-Frost Reserve	Univ. of California
	Carpenteria Marsh	Univ. of California, CDPR
Belding’s savannah sparrow	Mugu Lagoon	NAS
	Tijuana Estuary	NWR, CDPR
	Upper Newport Bay	CDFG
	Seal Beach	NWR
	Bolsa Chica	FWS

¹ AFB = Air Force Base, CDFG = California Department of Fish and Game, CDPR = California Department of Parks and Recreation, FWS = U.S. Fish and Wildlife Service, MCB = Marine Corps Base, NAB = Naval Amphibious Base, NAS = Naval Air Station, NPS = National Park Service, NWR = National Wildlife Refuge, TNC = The Nature Conservancy, USAF = U.S. Air Force.

In addition to providing habitat to these four threatened and endangered species, these sites are important to wetland-dependent birds in general, particularly migratory species such as shorebirds. For example, Mugu Lagoon supports more than 65,000 shorebirds during spring migration and more than 10,000 in fall (Page and Shuford 1999). Seal Beach NWR, Bolsa Chica Lagoon, and Upper Newport Bay Ecological Reserve all support more than 5,000 shorebirds in fall and winter, and Santa Margarita River estuary and Tijuana Estuary NWR each hold more than 1,500 shorebirds during parts of the year (Page and Shuford 1999). The beaches associated with these wetlands provide habitat for snowy plovers, least terns, and other species of shorebirds. Restoration, enhancement, and creation of habitat at these sites and all remaining coastal wetlands will support biodiversity of beach and estuarine birds within the region.

Conclusions

Habitat degradation includes increased rates of predation related to human causes. Nonnative red foxes have expanded their ranges and populations in California and impact coastal ecosystems (Lewis and others 1999). There is evidence that common raven (*Corvus corax*) populations have increased substantially in California since the 1960s (Boarman and Berry 1995). Likewise, the proliferation of feral and domestic cats in urban areas has a significant impact on native birds (Ogan and Jurek 1997). A predator management plan is necessary to identify problem areas and control predation rates.

In addition, the dense human population in southern California coupled with popular recreational beach use has led to high levels of human disturbance within breeding and foraging areas for terns and plovers and surrounding marshes. Humans can impact bird populations through direct (for example, destruction of nests by trampling, vehicles, and vandalism) and indirect disturbance (for example, causing birds to abandon nests, separating parent birds from their young, bringing pet dogs into nesting areas, leaving trash that attracts predators). Limiting human access to nesting areas during the breeding season is essential for the conservation of these species.

Habitat preservation and enhancement of both beach and estuarine systems are essential for both long-term persistence of endangered birds and biodiversity along the southern California coast. Estuaries are natural islands of habitat, and principles of island biogeography and conservation biology should be applied to planning and management efforts. Light-footed clapper rail and Belding's savannah sparrow populations have experienced isolation and local extirpations, and the smallest and most isolated marshes are unlikely to contribute to productivity or overall recruitment for either species. Degradation and loss of surrounding native habitats have likely affected survival and productivity by increasing predation rates and limiting dispersal of these wetland birds. Nevertheless, these sites may still attract birds and thus behave as ecological traps.

To date there has been no organized effort to characterize existing estuaries across the region according to habitat type, patch size and shape, connectivity, and isolation (Zedler 1996). This information is critical, especially for the management of the year-round residents (light-footed clapper rails and Belding's savannah sparrows). Both subspecies are metapopulations endemic to southern California and Baja California, Mexico, and should be managed as such. Planners and managers

need to ask the following questions before designing habitat restoration and enhancement projects: (1) Are wetlands large enough to support self-sustaining populations over time? (2) Are patches of specific habitat types (for example, cord grass or pickleweed) large enough to support self-sustaining populations over time? (3) Are poor dispersers able to move between wetlands (will source/sink populations even out) over time? Restoration and management planners need to consider these issues to maximize habitat quality and reduce the potential for creating ecological traps.

Finally, a regional approach to wetland restoration is needed to enhance metapopulations of sparrows and rails as well as migratory species such as snowy plovers, least terns, and other shorebirds. For example, given the limited overall area within each wetland, increasing cord grass habitat to benefit clapper rails may be at the expense of pickleweed habitats required for Belding's savannah sparrows and vice versa. Converting salt pan or dredged areas to salt marsh may reduce the amount of habitat available to least terns, snowy plovers, and other shorebirds. Considerations should be giving to the status of the target species, probability of success of habitat restoration, and overall ecosystem functioning.

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