

Appendix M

Final Predator Management Plan

Final

PREDATOR MANAGEMENT PLAN

San Diego Bay National Wildlife Refuge

(Sweetwater Marsh and South San Diego Bay Units)

I. Overview

Pursuant to its endangered species management responsibilities and in conjunction with other wildlife and habitat management activities, the U.S. Fish and Wildlife Service (Service) will implement, per available funding, predator management on the San Diego Bay National Wildlife Refuge (Refuge). Species to benefit from this action include the Federal endangered California least tern (*Sternula antillarum*) and light-footed clapper rail (*Rallus longirostris levipes*) and the threatened western snowy plover (*Charadrius alexandrinus nivosus*). Predator management is identified in the draft San Diego Bay National Wildlife Refuge (NWR) Comprehensive Conservation Plan (CCP)/Environmental Impact Statement (EIS) (USFWS 2005) as one of several actions to be implemented in support of the Refuge's listed species.

This predator management plan has been developed as a comprehensive wildlife damage control program that addresses a range of management actions from vegetation control and nesting habitat enhancement to non-lethal and lethal control. The most effective, selective, and humane techniques available to deter or remove individual predators or species that threaten nesting, breeding, or foraging least terns, snowy plovers, or clapper rails will be implemented.

II. Purpose

The San Diego Bay NWR was established to conserve Federal endangered and threatened species. The two Refuge Units share the common goal of “*supporting the recovery and protection efforts for Federal endangered and threatened species, other species of concern, and their habitats.*” The objectives of this predator management plan are intended to assist the Service in achieving this goal and meeting the purpose for which the Refuge was established.

The implementation of this predator management plan is intended to increase the productivity of the Refuge's federally-listed endangered and threatened seabird and shorebird species. Numerous incidents of predation on listed species by a variety of native and nonnative mammalian and avian predators are documented annually within the Refuge. The Refuge, along with most other habitat available to California least terns, western snowy plovers and light-footed clapper rails, represent some of the best remaining examples of coastal wetland habitats in southern California. As such, these remaining habitats act as magnets for the community of migratory and endemic wildlife that survive in the current landscape. Urbanization has led to increased numbers of many species of generalist, common predators. The potential impact of increased native and non-native predator densities on endangered species populations is a significant impediment to their recovery.

Reducing the number of California least tern, light-footed clapper rail, and western snowy plover adults, chicks, and eggs lost to predation is an important strategy in achieving the management objective of recovering and maintaining stable populations of these listed species on the Refuge. Other species that could indirectly benefit from predator management include the Federal endangered California brown pelican (*Pelecanus occidentalis californicus*), which roost along the salt pond levees of the South San Diego Bay Unit, and the State listed endangered Belding's

savannah sparrow, which nests in the pickleweed-dominated salt marsh habitat of both the Sweetwater Marsh and South San Diego Bay Units. Several species identified by the Service as Birds of Conservation Concern (USFWS 2002), including the black skimmer (*Rynchops niger*), elegant tern (*Sterna elegans*), and western gull-billed tern (*Sterna nilotica vanrossemei*), will also derive some benefits from the implementation of this plan.

The western gull-billed tern, however, is a special case in the context of this plan. Since the South San Diego Bay Unit was established in 1999, the gull-billed tern has benefited from various Refuge management activities including predator management and nest site enhancement. Due in part to these Refuge management actions, the breeding population of this species at the salt works has increased from an estimated 11 to 20 breeding pairs in 1999 (Patton 2001) to approximately 40 pairs in 2004 (Patton pers. comm.). During this same period, the number of least tern and snowy plover chicks lost to gull-billed tern predation has also increased (Patton 2004). This interaction between the gull-billed tern and the listed species that nest at the salt works cannot easily be addressed because of the extremely small population size of the western gull-billed tern. Various programs within the Service, including the Division of Migratory Bird Management, Ecological Services, and the National Wildlife Refuge System, are currently working together to identify appropriate actions that when implemented will ensure the recovery and conservation of all three of these trust species (least terns, snowy plovers, and gull-billed terns) throughout their range.

Predator Management Plan Objectives:

- Increase the productivity of California least tern and western snowy plover by reducing the loss of eggs and chicks to predation and reducing the number of adult birds of these species that are lost or driven away by predators;
- Reduce the loss of adult and juvenile light-footed clapper rails and eggs due to predation;
- Reduce the number of individual problem predators in localized areas within the Refuge (*Problem predators* are defined as individual predators that are exhibiting hunting behavior in listed species nesting areas or essential habitat areas or that have been identified as actually preying on a listed species.);
- Eliminate disturbance to roosting California brown pelicans by non-native mammalian predators; and
- Reduce disturbance and predation by mammalian predators within seabird nesting colonies on the South San Diego Bay Unit.

III. Background and Description of Problem

California's coastal wetlands provide essential habitat for a variety of avian species, including the Federal endangered and threatened species and other species of concern supported on the Refuge. The decline in the population of many of these species has been attributed to habitat loss, the introduction of exotic species populations, water and air pollution, habitat degradation, and human disturbance. The California Coastal Commission (1987) estimates that as much as 90 percent of California's original coastal wetlands have been lost to development. Additionally, the majority of California's sandy beaches that historically provided expansive habitat areas for seabirds, such as the California least tern, and shorebirds, like the western snowy plover, are now extensively utilized for human recreation and/or have been modified to support beachfront housing and other coastal development.

Today, coastal migratory birds are faced with two converging problems that seriously reduce reproductive success: limited viable nesting habitat and the concentration of native and non-native predators in proximity to nesting areas. The direct conversion of habitat to urban development and indirect losses of habitat resulting from increased human activity have greatly reduced the availability of suitable nesting areas. With fewer viable sites available, nesting seabirds and shorebirds are concentrated on fewer and more geographically limited nesting areas than previously occurred under more natural landscape conditions. Predation potential under current conditions has increased as predator foraging activities have become more intensely focused on the same remnant areas of coastal habitat that have been set aside for the protection of nesting migratory birds. Additionally, urban development has created conditions that are advantageous to many native, generalist predators resulting in larger populations of some predator species than were present historically. An abundance of non-native predators, such as feral dogs and cats and Virginia opossums, are able to enter the Refuge from adjacent urban areas. Their presence negatively impacts the viability of remaining coastal habitats for supporting endangered species.

Many populations of southern California coastal nesting bird species are declining and others are endangered or threatened with extinction. Without human intervention, it is likely that several of these species will not survive. Reproductive success is strongly influenced by food availability, quality of breeding habitat, and predation pressure. Controlling the numbers of predators in endangered and threatened species habitats is the main variable that humans can directly control in a localized context. Providing additional breeding areas (protected nesting sites) to give the protected species greater opportunity to successfully breed continues to be pursued by land management agencies, however, there are very limited opportunities for such efforts in Southern California's dense urbanizing environment. Therefore, management to reduce the potential for significant losses of threatened and endangered species due to predation on nesting grounds or other crucial habitat areas is an essential wildlife conservation goal.

Various conservation plans have been or are being developed that outline conservation priorities for specific assemblages, guilds, and communities of birds. Among the population conservation issues for waterbirds, as addressed in the North American Waterbird Conservation Plan (*Kushlan et al. 2002*), and the priority conservation actions for shorebirds, as outlined in the Southern Pacific Shorebird Conservation Plan (*Hickey et al. 2003*), is the need for appropriate predator management in waterbird and shorebird nesting areas.

The following are brief summaries of relevant information relating to species populations targeted for protection under this predator management plan.

California Least Tern

The California least tern is a loosely colonial, ground nesting, migratory seabird that returns from tropical latitudes to breed in southern California. Least tern nest sites are largely unvegetated, flat, open areas consisting of light colored, sandy surfaces near water bodies supporting abundant small fish. This tern once nested on beaches throughout southern California, south through Baja California, Mexico, and north to the San Francisco Bay area, however, increasing urbanization and habitat loss has led to the decline of its population with the majority of the remaining nesting colonies confined to San Diego and Orange Counties. With the loss of traditional beach nesting sites, this species has been forced to find alternative, less traditional nesting colony sites including landfills and airports (*Patton 2002*).

The Service published a rule, effective June 2, 1970, listing the California least tern as endangered under the Endangered Species Act of 1973, as amended (ESA). The California

least tern is endangered throughout its range as a result of the loss and degradation of nesting and foraging habitat and disturbance of nesting birds. Recovery actions described in the California Least Tern Recovery Plan (*USFWS 1985a*) include preserving and managing existing nesting colonies and providing new nesting sites in protected areas, maintaining adequate foraging habitat for nesting colonies, and minimizing disturbance and mortality by preventing human disturbance and minimizing predation.

Today, nest sites are largely fixed in their location and size, with two of seven San Diego Bay sites falling within Refuge management responsibility. Historically, least tern nesting success at the salt works within the South San Diego Bay Unit has been poor although little active predator management occurred on the property until the Refuge Unit was established in 1999. On the Sweetwater Marsh Unit, the nesting success on the D Street Fill nesting area has been seasonally variable, with site disturbance and predation being the primary factors in least tern breeding failure.

The least tern is vulnerable to a long list of predators, some of which are very abundant in urban environments, such as feral or domestic cats and dogs, American crows (*Corvus brachyrhynchos*), and American kestrels (*Falco sparverius*). In the 2000 nesting season, 20 species were observed preying on or taking a least tern egg, chick, fledgling, or adult in California. Twelve of these species are considered possible predators on the Refuge (*Patton 2002*); including feral dog, coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), opossum (*Didelphis virginiana*), peregrine falcon (*Falco peregrinus*), American kestrel, gull-billed tern, and various gull species. Between 1999 and 2002, there were numerous documented losses of California least tern chicks due to predation.

Under this plan, the nest site management actions presented below will be implemented to improve least tern reproductive success.

- Vegetation management to control weeds, avoid excessive plant growth, and maintain barren, sandy areas occurs annually at the D Street Fill in partnership with the Unified Port of San Diego (Port);
- Nesting substrate is periodically enhanced by adding clean, light sand to various salt pond levees;
- Signs and fencing are maintained in various areas to reduce human and mammalian disturbance in seabird nesting areas;
- Endangered species monitoring has been conducted annually in the nesting colonies to record reproductive success and document factors affecting success including disturbance and predation (monitoring will continue in accordance with available funding);
- Predator monitoring is conducted annually during the nesting season to provide current data regarding the presence of predators within the vicinity of the nesting colony and to document and address incidents of predation within the colony;
- Active nest sites are often protected using tiles, exclosures, and other physical devices to reduce accessibility of eggs and chicks to predators; and

- All mammalian predators observed in nesting areas are removed and individual problem avian predators may be controlled as appropriate to reduce loss of least tern eggs, chicks, and adults.

Western Snowy Plover

On March 5, 1993, the Pacific coast population of the western snowy plover was listed as threatened under the provisions of the ESA. The western snowy plover is threatened throughout its range as a result of the loss and disturbance of habitat and nesting sites. There are only a handful of snowy plover breeding locations currently used in southern California. Regularly used locations include Bolsa Chica (Orange County), Camp Pendleton, Baticuitos Lagoon, Naval Amphibious Base-Coronado, Silver Strand State Beach, and Tijuana Estuary in San Diego County. Within the South San Diego Bay Unit, snowy plover nesting occurs regularly at the salt works (six of the last nine years) with one to four nest attempts each year. Unfortunately, reproductive success has been poor. No nest attempts were observed at the salt works in 2003. Between two and ten snowy plover nesting attempts with poor reproductive success have historically occurred at the D Street Fill on the Sweetwater Marsh Unit, however, since 2000, there have been no known nesting attempts by snowy plovers in this area. Disturbance and predation are the most likely reasons for this poor history of reproductive success.

The list of potential predators of snowy plover eggs and chicks is long. During extensive surveys of breeding and wintering snowy plovers conducted in San Diego County between 1994 and the winter of 1999, it was determined that most nest failures in 1994, 1996 and 1997 were the result of predation (*Powell et al. 2002*). Documented egg predators included corvids (ravens and crows), coyotes, Argentine ants and gulls. Although the causes of chick mortality are more difficult to determine, several species were determined to be likely causes of mortality during these surveys including great horned owl (*Bubo virginianus*), burrowing owl (*Athene cunicularia*), gull-billed tern, and American kestrel. Due to high densities in surrounding urban areas, corvids, kestrels, and feral dogs and cats represent significant threats to the snowy plover population on this Refuge.

The Western Snowy Plover Pacific Coast Population draft Recovery Plan (*USFWS 2001*) includes the prevention of excessive predation of snowy plover as one of the recovery tasks requiring implementation to maximize the survival and productivity of this species. The draft plan encourages the employment of an integrated approach to predator management that considers a full range of management techniques and recommends seeking assistance from U.S. Department of Agriculture (Wildlife Services Branch) biologists, State wildlife agency biologists, and others. Specific management techniques addressed by the plan include manual removal of litter and garbage from nesting areas, removal of predator perches and unnatural habitats, use of predator exclosures where appropriate, removal of predators where warranted, and removal of bird and mammal carcasses in nesting areas. These actions, as well as those described for the California least tern, will be implemented on the Refuge under this plan.

Light-footed Clapper Rail

Light-footed clapper rails are year-round residents of coastal salt marshes and lagoons, although they may also occasionally be found upstream in freshwater marsh habitat. Generally, they nest in the lower littoral zone of a salt marsh where dense stands of cordgrass (*Spartina foliosa*) are present (*USFWS 1985b*). As a result of the destruction of coastal wetlands throughout southern California, the total population of light-footed clapper rails became so seriously low that on October 13, 1970, this species was added to the Federal list of endangered species and was designated as endangered within the United States.

The leading threats to clapper rails are salt marsh habitat loss, degradation, and fragmentation. These rails are also threatened by disturbance, diseases, contaminants, and predation. Potential predators of clapper rail eggs, nestlings, and adults include California ground squirrel (*Spermophilus beecheyi*), rats (*Rattus* spp.), long-tailed weasels (*Mustela frenata*), garter snakes (*Thamnophis* sp.), striped skunk (*Mephitis mephitis*), feral dogs and cats, opossum, and a variety of hawks and owls (*USFWS 1985b*). The Recovery Plan for the Light-Footed Clapper Rail (*USFWS 1985b*) includes as a recovery action the need to identify and control predators within marshes where predation is believed to be a significant problem.

Clapper rails within the Refuge suffer from a lack of adequate high-tide refugia which limits the rails' ability to hide when forced out of the salt marsh during high tide events. It is a goal the Refuge to restore and manage a fully functional coastal salt marsh/coastal sage scrub transitional habitat for the protection of the rail during its entire life cycle. However, this is a long-term commitment and will take many years to achieve. The rail will need additional management measures intended to protect and restore its populations including predator management. The FWS is currently working with several partner agencies to develop a captive breeding protocol development program for the light-footed clapper rail. This program seeks to bolster the genetic and demographic diversity of the species within isolated wetlands in the United States. As salt marshes are restored, it is hoped that various management actions taken now, will give the species the best possible chance to remain viable within coastal salt marshes in southern California well into the future.

The following actions will be implemented to protect the Refuge's clapper rail population:

- Regulatory signage and periodic patrol by the Refuge law enforcement office is provided to minimize human disturbance in clapper rail habitat;
- Nesting platforms are maintained in the marsh to provide chicks and eggs with enhanced protection from avian predators; and
- Year-round predator monitoring is conducted to identify and control native and non-native mammalian predators that pose a threat to the rails.

California Brown Pelican

The California brown pelican was listed as endangered on June 02, 1970 because of widespread pollutant-related reproductive failures. This bird is extremely sensitive to bioaccumulation of the pesticide DDT (and other organochlorine pesticides), which causes reproductive failure by altering calcium metabolism and thinning eggshells (*USFWS 1983*). Although California breeding populations have rebounded since the elimination of DDT use, the continued presence of DDT and its byproducts in the ecosystem, as well as other factors, still threaten this species. Delisted in 1985 in the areas of the U.S. Atlantic coast, Florida, and Alabama, this species is still considered endangered within California, Louisiana, Mississippi, Oregon, Puerto Rico, Texas, Virgin Islands, Washington and Central and South America.

Today, the availability of adequate food supplies is a major concern for the long-term recovery of this species. Commercial over-harvesting of Pacific mackerel, Pacific sardine, and the northern anchovy has resulted in less food availability for these birds, particularly during the breeding season. Pelicans are also threatened by human development along the coast, which increases disturbance to these birds in their breeding and resting habitats. The availability

and quality of roosting and loafing areas influence the energy budgets and reproductive potential of these birds (*Jaques and Anderson 1987*). Management of these essential habitats to minimize disturbance is therefore important for both breeding and non-breeding birds. The South San Diego Bay Unit, particularly the levee between Pond 10 and 11 within the salt works, is an important roosting area for brown pelicans during the non-breeding season. Feral and domestic dogs, coyotes and human disturbance represent the largest threats to these roosting pelicans. Roosting opportunities within the South San Diego Bay Unit were recently expanded to include a floating platform within the salt works. The use of this platform will be monitored and if adequate numbers of pelicans are using the platform for night roosting, additional platforms may be installed.

Birds of Conservation Concern

The 1988 amendment to the Fish and Wildlife Conservation Act mandates the Service to “identify species, subspecies, and populations of all migratory non-game birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act of 1973.” To meet this mandate, the Service has prepared Birds of Conservation Concern 2002 (*USFWS 2002*), which is intended to accurately identify the migratory and non-migratory bird species (beyond those already federally designated as threatened or endangered) that represent our highest conservation priorities and draw attention to species in need of conservation action. The goal of the Service is to preclude the need for additional bird listings under the Endangered Species Act by implementing proactive management and conservation actions. Within the Sweetwater Marsh Unit, four of the shorebirds that frequent the marsh have been identified as Birds of Conservation Concern; these include the whimbrel, long-billed curlew, marbled godwit, and short-billed dowitcher. Six shorebirds and three colonial nesting seabirds included on the list of Birds of Conservation Concern 2002 are supported by the habitats within the South San Diego Bay Unit. These species include the whimbrel, long-billed curlew, marbled godwit, black turnstone, red knot, short-billed dowitcher, gull-billed tern, elegant tern, and black skimmer. The elegant tern and black skimmer could indirectly benefit from the implementation of this predator management plan.

Gull-Billed Tern (*Gelochelidon nilotica vanrossemi*)

Management for the suite of avian species that utilize the Refuge is complex and difficult. The species conflicts inherent in managing the changing community of organisms utilizing coastal wetlands in southern California today present challenges that traditional wildlife managers may never have encountered historically. A case in point is the western gull-billed tern in San Diego Bay.

The gull-billed tern is designated as a Bird of Conservation Concern (BCC) at the national, regional (USFWS Pacific Region), and local scale (Southern Coastal California Bird Conservation Region). The Fish and Wildlife Conservation Act (1988 Amendment) requires that the Service “*identify species, subspecies, and populations of all migratory non-game birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act of 1973*”. BCC 2002 is the 3rd edition of this congressionally-mandated list and represents the most comprehensive effort thus far to identify species in need of active conservation measures. The gull-billed tern was included in the list because of its declining population trends and threats to breeding birds. At the subspecies level, the western gull-billed tern is of increased concern due to its extremely small population size (<600 known nesting pairs range-wide), limited distribution (ten sites range-wide), suspected population declines, and threats during the breeding season. The BCC designation does not impose regulatory conditions; however,

birds included on the BCC 2002 list are deemed priorities for conservation actions. In addition, under Executive Order 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds," Federal agencies are to avoid and/or minimize adverse impacts on birds, and BCC species in particular, while conducting agency actions and are encouraged to restore and enhance habitat for migratory birds. Additionally, one of the Service's primary goals is to conserve avian diversity in North America. Conserving ecosystem diversity is one of the goals of the National Wildlife Refuge System.

The western gull-billed terns that nest at the salt works benefit from a number of recovery actions implemented to conserve the California least tern and western snowy plover. These recovery actions include habitat protection, habitat enhancement, reduced human disturbance, and predator management. In addition to the benefits of refuge management and management for endangered species recovery, the Service has also been monitoring the gull-billed terns at the salt works and throughout its range to better understand the population size, nesting ecology, and conservation needs of this species. In 2003, the Service joined with biologists in Mexico to conduct comprehensive surveys of gull-billed terns in western Mexico. The results of these surveys were reported in Palacios and Mellink (2003).

Based on the information available to date, the estimated population of this subspecies in western Mexico is 376 breeding pairs, with 80 percent of the population occurring within two relatively large colonies (Cerro Prieto, Baja California and Laguna de Pericos, Nayarit) (Palacios and Mellink 2003). Within the United States, this subspecies only nests in two locations: the Salton Sea and the salt works within the South San Diego Bay Unit. The combined population of these two colonies in 2003 is estimated at about 190 breeding pairs (Seto pers. comm.). Ongoing monitoring of gull-billed tern colonies by the Service and others will improve our understanding of the breeding biology and distribution of the gull-billed tern range-wide. Information provided by these studies will also assist in developing management actions to conserve this species. Further, we will be able to better assess how conservation of the gull-billed tern can be coordinated with ongoing endangered species recovery actions in Southern California.

Gull-billed tern nesting on the South San Diego Bay Unit was first documented in 1987 (Terp and Pavelka 1999). Between 1999 and 2004, the number of breeding pairs at the salt works has slowly increased from between 11 and 20 in 1999 (Patton 2001) to approximately 40 in 2004 (Patton pers. comm.). Unlike the other colonial nesting seabirds at the salt works, the gull-billed tern is an opportunistic feeder, foraging on a variety of terrestrial and aquatic animals. A recent study conducted in San Diego Bay by Molina and Marschalek (2003) found small invertebrates (primarily mole crabs, *Emerita analoga*) and small fish to be the primary prey items delivered by adults to chicks. Lizards (*Uta stansburiana* and *Sceloporus occidentalis*), insects, and small black-necked stilt (*Himantopus mexicanus*), killdeer (*Charadrius vociferus*), western snowy plover and California least tern chicks were also part of the gull-billed tern's diet. The first report of gull-billed tern predation on a least tern chick occurred in 1988 in Mississippi (Densmore 1990). Predation of least tern and western snowy plover chicks by gull-billed terns has been documented at the San Diego Bay NWR since 1999 (Patton pers. comm.).

Over the past few nesting seasons, gull-billed terns nesting at the salt works have become effective predators of young least tern and western snowy plover chicks. The largest losses occurred in 2003, when 54 chicks were known to be lost to gull-billed tern predation. During the 2004 nesting season, 43 chicks were lost to gull-billed terns. It should be noted

that these are minimum numerical estimates of listed species chick losses due to the fact that observers are only present at certain times. Biologists monitoring these nesting populations infer that depredation by gull-billed terns on snowy plover and least tern chicks is ongoing when observers are not present, therefore, the impacts that gull-billed terns have had on the productivity of nesting sites throughout San Diego Bay and the Tijuana Estuary are not insignificant (*Brian Collins pers. comm.*).

Since 2001, the Service has met with private biologists, land managers, and Service staff prior to each nesting season to discuss strategies for addressing gull-billed tern predation. Based on input from these meetings, the Service has chosen to refrain from conducting predator control actions on the gull-billed tern. The question of whether or not the Refuge should manage the size of the gull-billed tern colony at the salt works in an effort to reduce the loss of least tern and snowy plover chicks to gull-billed tern predation was raised again during the preparation of this predator management plan. Based on the desire to maintain/enhance the numbers of breeding gull-billed terns in Southern California, it was determined that no lethal control of this species will be considered at this time. Instead, over the next few years, the Service will implement several actions to address gull-billed tern predation of least terns and snowy plover chicks including the initiation of a pilot project to experiment with different types of chick shelters for California least terns and developing an experimental design to better document avian predation on both least terns and snowy plovers. In addition, during the 2005 breeding season a limited monitoring program of the gull-billed tern colony at the salt works will be implemented to evaluate nesting activity, reproductive success, and predation activities. The Service's Migratory Birds Program will also continue to work with partners in Mexico to complete year two of a range-wide survey for gull-billed terns.

IV. Existing Predator Management Efforts in the San Diego Bay Region

San Diego National Wildlife Refuge Complex. The San Diego National Wildlife Refuge Complex (Complex) currently conducts a variety of management activities on the Tijuana Slough NWR, Sweetwater Marsh Unit, and South San Diego Bay Unit for the purpose of protecting colonies and/or pairs of California least tern, western snowy plover, light-footed clapper rail, and other Federal trust species of migratory birds. Management activities currently conducted to minimize attractants to predatory populations include: trash management, installation and maintenance of perimeter fencing in some locations, removal or trimming of large shrubs and trees in proximity to nesting areas to reduce the availability of resting and perching areas, and the use of various forms of exclosures over the nests of some species such as the western snowy plover. Another activity, public education and outreach, is an important component of the predator management program conducted at the Tijuana Slough NWR. This involves ongoing education programs relating to endangered species, the annual distribution of educational materials to the local community just prior to the nesting season. These materials address the problems associated with intended or unintended feeding of feral populations of domestic animals, clearly identify wildlife protected areas, and explain the importance of responsible control of household pets to the Refuge's wildlife species. Special emphasis, usually in the form of door-to-door distribution of materials, is placed on getting these materials to those residents who live immediately adjacent to the Refuge.

Predator management activities are closely coordinated with regular biological monitoring of nesting colonies in part to provide evidence of the identity of problem predators and the magnitude of the predation impacts to listed species populations. When indirect means do not provide

adequate protection based upon data gathered through biological monitoring, direct predator management actions, including non-lethal and if necessary lethal control, are implemented.

Unified Port of San Diego. The Unified Port of San Diego (Port) manages two sites surrounding the Bay, including tern nesting areas within Lindbergh Field (San Diego International Airport) and the Chula Vista Wildlife Reserve. The D Street Fill portion of the Sweetwater Marsh Unit is co-managed by the Port and the Service, which each owns a portion of this fill area. Management is similar to that conducted on the San Diego Bay NWR and includes site preparation, annual monitoring, and predator control. USDA APHIS-WS currently conducts active predator management on these areas under contract with the Port.

United States Navy. The United States Navy manages three of the six current least tern and snowy plover nesting areas surrounding San Diego Bay. These three locations are located within the Naval Air Station North Island and Naval Amphibious Base Coronado. Management is similar to that conducted on the San Diego Bay NWR and includes site preparation, annual monitoring, and predator control. However, some nesting areas occur within heavily used training areas and the Navy's training needs may influence the timeliness of these programs. The Navy has historically contracted with USDA APHIS-WS for predator management implementation at these sites.

Interagency Coordination. Coordination among agencies is ongoing and statewide pre and post-breeding season least tern and western snowy plover meetings are held annually to discuss plans and results of the various management programs for that season. These meetings provide the opportunity to discuss what actions are most effective in achieving the recovery goals for the various endangered and threatened species covered by these programs. Additionally, interagency meetings are periodically scheduled to address species-specific issues related to predation and recovery. Interagency meetings to address issues related to gull-billed terns have been conducted since 2001. These meetings have led to support for continuing population assessments for the species, as well as support by some for the candidacy as threatened or endangered for the western North American population of the gull-billed tern.

V. Management Plan

The predator management plan for the San Diego Bay NWR will be implemented to reduce damage by predators to Federal threatened or endangered species populations. The threat may be to adults, chicks, or eggs. A range of management actions, including non-lethal and lethal control, will be implemented. As such, the plan represents a comprehensive wildlife damage control program that will integrate and apply practical methods of prevention and control to reduce damage by wildlife while minimizing the harmful effects of the control measures on humans, other species, and the environment. The activities conducted on the Refuge will vary depending upon the specific wildlife damage problem that is occurring. A particular predator problem may be addressed through the implementation of activities related to resource management, physical exclusion, wildlife management, or any combination of these.

For most predatory species, removal will be accomplished primarily by hazing or live trapping and secondarily by lethal control. In all cases, the most humane methods available will be used. Efforts will be made to avoid and minimize losses of non-target native wildlife and all uninjured non-target species inadvertently captured will be immediately released near the site of capture or at a suitable location at the discretion of the Refuge Manager.

Direct control methods will include live-capture and translocation of individual predators; the intentional hazing (scaring off) of predatory species from nesting areas; and in some cases the lethal removal of problem predators. Lethal removal, which may involve shooting or the use of body grips or gas cartridges, may be used to remove predators that are identified as known and immediate threats to endangered or threatened species within the Refuge. Only licensed and authorized agencies or individuals will implement predator management actions.

Without continued management of mammalian and avian predators, the Refuge's population of light-footed clapper rails could be eliminated and the population size and nesting success of snowy plovers and least terns could decline dramatically. As a result, the Service believes that the following approach to predator management within the various areas of the Refuge will achieve the goals, objectives, and legal mandates of the Service on the San Diego Bay NWR.

D Street Fill

This 40-acre area on the Sweetwater Marsh Unit will continue to be jointly managed by the Service and the Port. Management will include the removal of weedy vegetation and control of shrubs and other potential perching or hiding areas for avian and mammalian predators. To reduce accessibility to the site by large mammals, the Service will continue to maintain the fence and gate at the eastern edge of the property. Roof tiles, exclosures, and other nest shelters will also be used when deemed appropriate to minimize take of eggs and chicks by avian predators. Under this plan, predator monitoring on the D Street Fill will be conducted during the nesting season. Endangered species monitoring within the nesting colony will also be conducted provided that adequate funding is available. Throughout the nesting season (March through September), the colony will be monitored for signs of specific predators, tracks, or other indicators of the presence of mammalian predators in the vicinity of nesting areas. The area will also be monitored for evidence of losses due to avian predators. Endangered species monitoring of nesting colonies will provide hatch and fledge rates, as well as adult survivorship and population size.

The predators that will be most commonly targeted for control include feral cats and dogs, California ground squirrels, Virginia opossums, Norway and black rats, striped skunks, common raven, American crow, and western gull. Prior to each nesting season ground squirrels will be lethally removed from the site to reduce the loss of tern and plover eggs. Coyotes, foxes, and other native mammalian predators will be trapped or shot when found within the nesting colony.

Non-lethal methods will be emphasized as the preferred tool for controlling avian predators. During the nesting season only, individual problem avian predators may be live-captured and later released in a suitable location. In cases where trapping is unsuccessful and an individual predator has learned to depredate tern or plover eggs and chicks, the predator may be lethally removed upon approval of the Refuge Manager.

Salt Pond Levees

Management actions to protect nesting least terns and western snowy plovers on the salt pond levees of the South San Diego Bay Unit will be similar to those described for the D Street Fill. Levee tops and other nesting areas will be maintained annually as needed. Fencing will be installed as needed to reduce access into the area by mammals, and predator monitoring will occur during the nesting season. During monitoring, dead animals that might attract predators to the area will be removed from the site.

Paradise Marsh/Sweetwater Marsh/Otay River Floodplain

Predator management will also be implemented within those areas of the Refuge that support the endangered light-footed clapper rail. The clapper rail is a year-round resident of the Refuge; therefore, predator management will also be conducted year-round. Various actions will be taken to reduce clapper rail predation. A public outreach program will be conducted annually to inform nearby residents of the adverse effects that cats and dogs can have on the species. Unauthorized access by the public into sensitive marsh areas will be controlled through signs, fencing, and patrol by law enforcement personnel. Nesting platforms will be installed and maintained where appropriate to protect eggs and young clapper rail chicks. Mammalian predators are the primary predators of concern for this species. These include domestic and feral cats, raccoons, and the non-native red fox, among others. Predator monitoring will be implemented throughout the year to look for signs of specific predators, tracks, or other indicators of the presence of mammalian predators in the marsh that could pose a threat to the rails. Avian predators are documented to take light-footed clapper rails. Avian predators will be treated on a case-by-case basis. Non-lethal methods will be tried first before implementing lethal removal.

VI. Direct Control of Predators - Species Specific Protocols

The direct control of predators on the Refuge has historically been implemented by U.S. Department of Agriculture (USDA), Animal and Plant Health Inspection Service, Wildlife Services (APHIS – WS) through an interagency agreement with the Service. It is likely that this arrangement will continue in the future, provided funds are available. Contracts will be issued annually and will include detailed descriptions of approved control methods, disposition procedures for captured predators, and species-specific protocols. Predator management will be implemented year-round, although the majority of the contracted activities will occur during the breeding season. During the non-breeding season for endangered species, APHIS – WS will concentrate on the control of feral dogs and cats and mammalian predators such as skunks and opossums, which pose a threat to the light-footed clapper rail.

Various types of equipment and techniques will be used to implement predator management on the Refuge and all such implementation will occur in accordance with federal and state regulations. The preferred control methods include live trapping and hazing. Knowledge of the particular predator's habits, particularly the habits of avian predators, will determine which trapping technique is employed.

Live trapping may include the use of box type mammal traps, Bal-chatri traps [a type of baited monofilament line leg-hold/cage trap], scent baited padded leg-hold traps and perch pole traps. Manual capture methods may also be employed using hand held capture poles or other manual techniques. Traps are inspected in accordance with State Fish and Game Code and Service policy. Specifically, traps set out overnight for mammalian predators are checked within two hours of sunrise and traps left out during daylight hours are monitored regularly and checked a minimum of four times per day. Traps set for avian predators may be left out overnight if nocturnal predation is considered a threat to protected species. The use and monitoring of pole traps will be conducted in accordance with Service policy.

Hazing may be used to deter particular predators at the discretion of the Refuge Manager, and can include the use of firearms, pyrotechnics, and/or audio or visual stimuli.

When deemed necessary, lethal removal by shooting, body grip traps, and gas cartridges may be used to take predators that are identified as known and immediate threats to endangered or

threatened species. Lethal removal of avian predators is most often employed when an individual problem predator has focused its foraging activities on the nesting colony. In this case, an entire colony's productivity or even survival can be jeopardized in a short time frame. One such example occurred in 1997. A pair of burrowing owls was observed preying on adult and chick California least terns at the Tijuana Estuary. Refuge staff determined that live trapping was the preferred method of control because of a concern for the sensitivity of the local burrowing owl population. Over about a 12-day period (the time it took to locate and live-capture the owls), this pair of owls had taken between 70 and 80 breeding adult least terns and an unknown number of chicks. This one event resulted in the loss of approximately 18% of all breeding individuals in the colony during that nesting season (*Patton 1998*). Under this plan, selective removal of individual problem predators will be permitted for all avian predators with the exception of gull-billed terns.

Routine predator monitoring will be conducted in the nesting colonies. Problem predators may be identified through direct observation of predators in the act of hunting or preying on listed species. The presence of predators in the colony can also be established through the identification of tracks of birds, reptiles, or mammals in the nesting colony, dissection of raptor pellets (disgorged undigested material from previous meals), observations of preyed-upon individuals, eggs, or other material. In many cases these observations can be used to identify, at least to species, the predator impacting the site.

Some problem predators will defeat all attempts at hazing or live trapping and will be removed by lethal methods. Prior approval from the Refuge Manager is required for all actions involving the lethal removal of a predator. This approval for lethal removal may be in the form of blanket discretionary removal of certain species found within the confines of the breeding colony site (such as for corvids, feral dogs, or feral cats where live trapping has been ineffective and nesting has begun) or on a case-by-case basis (such as for identified individual raptors).

Although not approved for use on these Refuges at this time, the avicide DRC 1339, a pesticide used to control corvid populations, may be approved for use in the future if deemed necessary, to control corvids. DRC 1339 is injected into chicken eggs, which are then secured onto strategically placed elevated bait stations in the vicinity of endangered species nesting areas. Ingestion of the pesticide is lethal to the crow or raven. Specific baiting and pre-baiting activities are conducted to eliminate the possibility of attracting non-target species.

Species Specific Protocols

Procedures for intervention with predators will be dependent upon several factors, including, but not limited to: 1) the degree of threat the individual predator poses to protected populations; 2) the native or non-native status of the predator; 3) the conservation status of specific predator species populations; and 4) the general condition of a particular protected species nesting colony including; species, nest colony phenology, relative disturbance levels from other sources, numbers of vulnerable individuals on site, and other factors.

The following species may be trapped or otherwise removed if observations, tracks, or other indicators of the presence of the species are found within the vicinity of protected species' nesting areas during the nesting season, or if it is determined that the species poses a threat to light-footed clapper rails or roosting California brown pelicans: domestic and feral dogs and cats, coyote, red fox, gray fox, California ground squirrel, Virginia opossum, striped skunk, raccoon, Norway rat, black rat, common crow, common raven, or injured gulls.

The following native avian species will be live trapped from the immediate vicinity of nesting terns and plovers, when they are determined to pose a threat to these species by USDA

APHIS-WS in consultation with the Refuge Manager: American kestrel, loggerhead shrike, barn owl, great horned owl, burrowing owl, red-tailed hawk, sharp-shinned hawk, Cooper's hawk, and various gull species.

The following species require prior consultation with the Refuge Manager before lethal or non-lethal control actions can be taken: peregrine falcon, northern harrier, and short-eared owl.

Disposition of Captured Animals

All raptors and other avian predators that are live captured will be removed and held in a licensed/permitted rehabilitation/holding center until they can be released back into the wild. Release will be at a suitable location after the endangered species nesting season is completed. Holding facilities and the location of all release sites must be approved by the Refuge Manager.

All non-native mammalian predators, other than dogs and cats, will be euthanized using approved humane methods. Target and non-target predators that are injured during trapping will be treated on a case-by-case basis. These animals may be euthanized or taken to an approved rehabilitation/veterinary care facility depending on species and extent of injuries.

All non-target wildlife (animals determined not to be a threat to protected species) that is captured unharmed will be immediately released near the capture site or at another suitable location. All domestic or feral dogs and cats, when feasible, will be taken to an approved shelter facility operated by a cooperating local unit of government, humane society or a veterinary care facility.

VI. Monitoring and Reporting

Implementation of this predator management plan will be monitored and a report will be issued annually describing the actions taken to control predation and the numbers and types of predators controlled. In addition, the report will include documented incidents of predation on listed species, recommendations on how predation might be further reduced, and an evaluation of how the current year's predator management actions relate to the objectives established for this plan.

VII. Cooperators

This plan will be implemented in cooperation with the following agencies and organizations, as appropriate:

- Fish and Wildlife Service, Carlsbad Ecological Services Field Office
- Fish and Wildlife Service, Division of Migratory Birds and Habitat Programs, Region 1
- California Department of Fish and Game
- U.S. Department of Agriculture, Animal Plant Health Inspection Service -Wildlife Services
- Unified Port of San Diego
- San Diego County Department of Animal Control
- Project Wildlife

VIII. Other Recovery Actions to be Implemented on the Refuge

Predator management is just one of several strategies that will be implemented to achieve the management goal of recovering and maintaining stable populations of the Federal threatened and endangered species and species of concern that occur within the Refuge. Other strategies described in detail in the San Diego Bay NWR Comprehensive Conservation Plan (CCP) include

expanded habitat and wildlife management activities, habitat enhancement, and habitat restoration strategies are described below.

Various management strategies are proposed in the CCP to minimize human disturbance of sensitive habitat areas, including fencing, signage, and public education and outreach. Habitat enhancement is proposed to improve tidal circulation within existing marsh habitat, improve the quality of the nesting substrate for ground nesting birds, and expand the availability of cordgrass-dominated salt marsh habitat to support the clapper rail.

The CCP also includes a variety of habitat restoration proposals that would provide additional nesting, foraging, and resting habitat for endangered and threatened species and other species of conservation concern. Within the Sweetwater Marsh Unit, coastal salt marsh restoration is proposed that would provide additional nesting and foraging habitat for the light-footed clapper rail and additional habitat for foraging least terns and a variety of migratory shorebirds. Large areas of coastal salt marsh restoration are proposed within the South San Diego Bay Unit that would benefit the clapper rail, least tern, and various Birds of Conservation Concern. Also proposed is the creation of additional nesting areas that could benefit the least tern and snowy plover, as well as several colonial nesting seabirds. Water management proposals within the salt ponds could also provide additional nesting and foraging habitat for the western snowy plover.

IX. Alternatives Considered

In addition to the predator management plan presented above, various alternative methods for addressing predation of listed species on the Refuge were considered. These included:

- Non-lethal Control Only
- Indirect Control Only (implement management activities that reduce predation without non-lethal or lethal removal of predators)
- No Predator Management

Proposed Plan

The proposed predator management plan combines direct actions to control predation along with indirect actions related to reduced disturbance and improved habitat quality. The Service believes this proposal represents the most effective and most humane alternative.

Non-lethal Control Only

A predator plan that relies on the control of all predators using only non-lethal methods could have devastating effects on the Refuge's least tern and snowy plover populations. This is particularly true if an avian predator learns to prey on the eggs or young of a listed species. In some cases, considerable time can pass before a problem predator is trapped; as was the case in 1997 involving a pair of burrowing owls at the Tijuana Slough NWR (refer to Section IV.). Because lethal removal was not implemented in this case, the offending burrowing owls took a large number of chicks and more importantly, breeding adults. These events had a lasting effect on productivity at the site since losses of breeding adults can have population effects for many seasons. Least terns can be quite long-lived birds and may make many nesting attempts in their lives.

Indirect Control Only

Indirect control of predation would involve implementing management activities that reduce predation without lethal or non-lethal removal of predators. Instead, measures such as the use of visual and auditory repellents and physical barriers would be employed. Visual and auditory repellents are limited by several factors, including: 1) unintentional hazing of protected

species while attempting to haze predatory species; 2) reduced effectiveness over time as some predatory species become accustomed to particular stimuli and begin to ignore them; 3) difficulties in effectively deploying such repellents in the field; and 4) limited effectiveness of repellents on particular species. Physical barriers are a part of an integrated predator management program and will be used for some purposes such as keeping most off-leash dogs out of the nesting colonies. However, physical barriers in the absence of the ability to remove a predator are ineffective in controlling avian predation, as well as some forms of mammalian predation. The use of exclosures over nesting plovers has been effective in protecting eggs, but once the chicks leave the exclosure, they are once again vulnerable to predation. Although predation reduced to some extent through indirect control, this reduction in loss is not considered adequate to achieve the goals and objectives of the Refuge for listed species.

No Predator Management

Under this alternative, no actions would be taken on the Refuge for the specific purpose of controlling predators. Mammalian and avian predators would not be harassed or specifically deterred from traveling or flying through the Refuge or entering the nesting colonies. Based on previously documented losses of listed species to predation, it is likely that the Refuge's population of least terns, snowy plovers, and light-footed clapper rails would no longer be able to achieve sustainability goals for fledging success. In addition, a dramatic reduction in nest productivity could cause least terns and snowy plovers to abandon the existing nesting areas on the Refuge. A management strategy that excludes any form of predator management would place the viability of the Refuge's listed species at risk and would be inconsistent with the purposes for which this Refuge was established.

X. Justification

The implementation of this predator management plan will result in temporary localized reductions in populations of some mammalian and native avian predators around the Refuge. In recent years, the California ground squirrel, Norway rat, and black rat were the mammalian species most affected by predator management, while ravens and western gulls were the avian species most often removed from nesting areas. The lethal removal of some raptors and large native mammalian predators will occur annually on the Refuge, however the numbers of individuals lost will be low (one to three annually). Lethal removal will generally only be implemented after other non-lethal methods for removal and relocation have proved to be unsuccessful. For the most part, avian predators, with the exception of corvids and some gulls, will be trapped and released into suitable habitat elsewhere, and only those avian predators that are foraging within nesting areas will be removed.

The Federal endangered and threatened avian species supported by these Refuges were once more widely distributed throughout southern California and the sizes of the various populations throughout the region were much larger. The loss of coastal habitat, displacement of nesting areas due to increasing human use of beaches and surrounding wetlands, increases in non-native predators in proximity to natural areas, and the concentration of native predators into smaller, more isolated natural areas have all contributed to significant declines in the populations of California least tern, western snowy plover, and light-footed clapper rail. The recovery plans prepared for the Refuge's Federal endangered and threatened species (*USFWS 1985a, 1985b, 1998, 2001, 2002*), as well as the conservation plans prepared to address declines in the populations of shorebirds and waterbirds (*Page et al. 2003 and Kushlan et al. 2002*), all include predator control in the list of recovery and conservation actions that must be considered if reversal of these population declines is to be achieved. However, predator control alone cannot achieve the recovery goals established for these species, which is why this predator management plan is just one

component of a larger overall management plan for the Refuge. The CCP for this Refuge includes habitat enhancement and restoration proposals, as well as additional actions directed at reducing disturbance to sensitive species. Through this combination of efforts, the Refuge's populations of endangered and threatened species are expected, at a minimum to sustain their current sizes, and ideally to increase as these various actions are implemented.

X. References Cited

California Coastal Commission. 1987. The California Coastal Resource Guide. University of California Press.

Densmore, Robin J. 1990. Gull-billed Tern Predation on a Least Tern Chick. *Wilson Bulletin* 102(1): 180-181.

Hickey, C., W.D. Shuford, G.W. Page, and S. Warnock. 2003. Version 1.1. The Southern Pacific Shorebird Conservation Plan: A strategy for supporting California's Central Valley and coastal shorebird populations. PRBO Conservation Science, Stinson Beach, CA.

Jaques, D. and D. Anderson. 1987. "Conservation Implications of Habitat Use and Behavior of Wintering Brown Pelicans (*Pelecanus occidentalis californicus*).” Final Report to Public Service Research and Dissemination Program University of California, Davis, California.

Kushlan, J.A., J. Steinkamp, K.C. Parsons, J. Capp, M. Acosta Cruz, M. Coulter, I. Davidson, L. Dickson, N. Edelson, R. Elliot, R. M. Erwin, S. Hatch, S. Kress, R. Milko, S. Miller, K. Wheeler, and K. Wohl. 2002. Waterbird Conservation for the Americas: The North American Waterbird Conservation Plan, Version 1. Waterbird Conservation for the Americas, Washington, DC, U.S.A.

Palacios, Eduardo and Eric Mellink. 2003. Status, Distribution, and Ecology of Nesting Larids in Western Mexico, with Emphasis on Vanrossemi Gull-billed Terns and Caspian Terns – Final Report. (Draft, November 2003)

Patton, Robert. 2001. The Status of Western Gull-billed Terns at South San Diego Bay National Wildlife Refuge in 2001.

Patton, Robert. 2002. California Least Tern Breeding Survey 2000 Season. Final Report to the State of California Department of Fish and Game.

Patton, Robert. 2004. The Status of Western Gull-billed Terns at South San Diego Bay National Wildlife Refuge in 2003.

Powell, A.N., C.L. Fritz, B.L. Peterson, and J.M. Terp. 2002. "Status of Breeding and Wintering Snowy Plovers in San Diego County, California, 1994 – 1999." *Journal of Field Ornithology* 73(2):156-165.

U.S. Fish and Wildlife Service. 1983. The California Brown Pelican Recovery Plan.

U.S. Fish and Wildlife Service. 1985a. California Least Tern Recovery Plan.

U.S. Fish and Wildlife Service. 1985b. Light-footed Clapper Rail Recovery Plan.

U.S. Fish and Wildlife Service. 2001. Western Snowy Plover (*Charadrius alexandrinus nivosus*) Pacific Coast Population Draft Recovery Plan. (May 2001)

U.S. Fish and Wildlife Service. 2002. Birds of Conservation Concern 2002. Division of Migratory Bird Management, Arlington, Virginia (December 2002).

U.S. Fish and Wildlife Service. 2003. Draft Comprehensive Conservation Plan/Environmental Impact Statement for the Sweetwater Marsh National Wildlife Refuge and the South San Diego Bay Unit of the San Diego National Wildlife Refuge. San Diego National Wildlife Refuge Complex, Carlsbad, CA.