3. Refuge Management

3.1 Overview of Refuge Goals, Objectives, and Strategies

The development of Refuge goals and objectives is one of the most important components of the CCP process. It is through this process that we establish the desired future conditions of the Refuge. Goals and objectives are the unifying element of Refuge management, intended to identify and focus management priorities and provide a link between management actions, Refuge purposes, and the National Wildlife Refuge System mission and goals. Goals, which define general targets in support of the Refuge vision, are ". . . descriptive, open-ended, and often board statements of desired future conditions that convey a purpose but do not define measurable units" (Service Manual, 602 FW 1). Full achievement of Refuge goals may or may not be feasible within the 15-year time frame of the CCP, but the management actions and programs described in this chapter are intended to move us closer to realizing the Refuge vision.

The path toward achieving Refuge goals is defined by the objectives and strategies developed during the CCP process. The objectives, which are derived from the goals and provide the basis for determining strategies and monitoring, are concise statements of what will be achieved to meet a particular goal. Objectives should be specific, measurable, achievable, results oriented, and time fixed; and they should be feasible within the 15-year lifespan of the CCP. Refuge strategies describe specific actions, tools, and techniques that can be used to meet Refuge objectives. In some cases, strategies describe specific projects in enough detail to assess funding and staffing needs. In other cases, further site-specific detail is required to implement a strategy. This additional detail can take the form of a step-down plan, restoration plan, or site plan.

The goals presented in this CCP will not change until they are reevaluated as part of a formal CCP revision process; however, objectives and strategies may be revised to better address changing environmental conditions and/or resource needs, or to take advantage of increased knowledge of Refuge resources.

3.2 Goals for the Refuges of the Sonny Bono Salton Sea NWRC

The goals that follow provide the context for the management actions that will be implemented on the Sonny Bono Salton Sea NWR and the Coachella Valley NWR.

3.2.1 Sonny Bono Salton Sea NWR

The goals for the Sonny Bono Salton Sea NWR include:

Goal 1: Protect, manage, enhance, and restore foraging, loafing, and nesting habitats on the Refuge to support migratory birds.

Goal 2: Protect, manage, and, where appropriate, enhance or restore habitat to support the recovery of federally and State listed threatened and endangered species and other species of concern known to occur on the Refuge.

Goal 3: Manage and protect remnant native desert scrub habitat, tree rows, and riparian areas on the Refuge to support resident bird and other wildlife species, as well as nesting habitat for Neotropical bird species.

Goal 4: Work in partnership with other Federal, State, and local agencies and tribes to restore, enhance, and adaptively manage habitat functions that support fish and bird life, as well as to protect other resources of region-wide significance, in and around the Salton Sea.

Goal 5: Enhance the public's awareness, appreciation, and enjoyment of the Refuge's biological resources by providing opportunities for compatible wildlife-dependent recreational uses.

3.2.2 Coachella Valley NWR

The goals for the Coachella Valley NWR include:

Goal 1: Protect, restore, and enhance Refuge lands to contribute to the recovery of the federally threatened Coachella Valley fringe-toed lizard and endangered Coachella Valley milk-vetch, as well as to conserve other species of concern supported on the Refuge.

Goal 2: Through participation in a coordinated management effort involving all of the Coachella Valley Multiple Species Habitat Conservation Plan (CVMSHCP) partners, sustain the ecological and evolutionary processes necessary to maintain the viability of the natural communities and habitats that support the species identified in the CVMSCP and manage these communities and habitats adaptively to be responsive to short- and long-term environmental change.

Goal 3: Enhance the public's awareness, appreciation, and support for the Refuge's listed and sensitive species, as well as the ecological functions and geological processes that sustain these species, through compatible opportunities of environmental interpretation.

3.3 Refuge Objectives and Strategies

3.3.1 Sonny Bono Salton Sea NWR

The objectives established for meeting the goals of the Sonny Bono Salton Sea NWR and the strategies to be implemented to achieve these objectives are presented here.

Goal 1: Protect, manage, enhance, and restore foraging, loafing, and nesting habitats on the Refuge to support migratory birds.

***Objective 1.1*: Managed Agricultural Lands**
Throughout the 15-year life of the CCP, continue to provide approximately 2,650 tons of green forage on approximately 870 acres of agricultural lands within the Refuge to support approximately 30,000 geese annually.

Rationale:
Managing a portion of the Refuge to provide forage for wintering waterfowl, primarily geese, addresses two of the Refuge purposes (i.e., protecting wildlife, reducing crop depredations by wintering waterfowl by providing adequate foraging opportunities within the boundaries of the Refuge). To accomplish the latter purpose, the Service has grown crops on the Refuge to

provide food for wintering waterfowl since the 1940s (USDOI 1972). In addition, other lands on the Refuge are managed to provide freshwater areas where waterfowl can rest, loaf, and forage. A number of different crops have been cultivated for this purpose over the years, but today, the primary forage crop provided in the managed agricultural fields is rye grass.

Although the diversity and abundance of migratory waterfowl present on the Refuge has changed over the years, the need to reduce crop depredation has not. In the 1960s, supplemental food was provided for both ducks and geese. Today, the managed agricultural fields on the Refuge are intended to support primarily geese, including lesser snow geese, Ross' geese, white-fronted geese, and some Great Basin Canada geese. Individuals that make up the Lower Colorado population of greater sandhill cranes also frequent these managed fields in the winter.

During the winter of 2011/2012, an estimated 25,000 geese (primarily lesser snow geese and Ross' geese) overwintered on the Refuge (Ducks Unlimited at http://in.ducks.org/conservation/where-we-work/sonoran-and-mohave-deserts/more-information, accessed on 5/10/12) and foraged on approximately 870 acres of managed agricultural lands. Little information is available regarding the consumption of agriculturally grown grass (e.g., rye, wheat, barley) by lesser snow goose. However, a study by Hupp et al. (1996) provides some basis for determining how much green forage is required to support the current numbers of geese that winter in the vicinity of the Refuge. The Hupp et al. study determined that lesser snow geese consumed between about 662 grams per day of wet mass cotton-grass while staging at the Arctic NWR during autumn staging.

In another study conducted in Texas by Alisauskas et al. (1988), lesser snow geese wintering in a harvested rice field consumed approximately 919 grams per day of forage, which consisted mainly of germinated green vegetation (i.e., 28 percent graminoids, 70 percent forbs). Extrapolated out, a snow goose at the Sonny Bono Salton Sea NWR likely consumes between about 80 to 111 kilograms (662 grams per day x 121 foraging days foraging and 919 grams per day x 121 foraging days, respectively) of grass forage during the winter season, which extends from about November 1 to February 28. As a result, if the Refuge hosts 25,000 geese during the winter season, between 2,002,500 and 2,780,000 kilograms (2,207 to 3,064 tons) of green forage would be needed to adequately support the current numbers of snow geese that winter at the Refuge.

In a study at the University of California Imperial Valley Field Station, rye grass growth was monitored to determine total production of fields supplemented with fertilizer (Worker 1978). In this case, standard rates of ammonium nitrate fertilizer (120 pounds of nitrogen per acre pre plant with 40 pounds per acre applied after each cutting) were applied to the site. Between early October, when the crop was planted, and March 1, the total production was nearly 3 tons per acre dry weight. If the Refuge produced an average crop of rye grass with fertilization similar to the above referenced study on 870 acres, the anticipated production for the season would be approximately 2,610 tons of dry matter goose forage. Dry matter in rye grass normally is only about 16 percent of the total wet weight, therefore, the total yield of rye grass expected within the Refuge's managed fields would exceed the tonnage required to support snow geese on the site throughout the winter. Additionally, the Refuge's managed wetland areas produce watergrass (*Echinochloa crus-galli*), swamp-timothy (*Crypsis schoenoides*), alkali bulrush (*Scirpus robustus*), cattail (*Typha* sp.), and other seed, vegetative and tuberous plants to help waterfowl meet their nutritional and caloric requirements throughout the winter.

Managed Agricultural Lands Strategies

- Continue to implement no till methods on approximately half of the managed agricultural fields.
- Continue to inspect and maintain the tile drain system within the managed agricultural fields to provide optimum soil conditions for forage crops.
- Laser level the managed agricultural fields to improve water distribution throughout the fields, with the intent of increasing total crop yields.
- Explore methods and potential new crops to optimize forage opportunities for geese.
- Explore the use of soil microbes and/or soil amendments to enhance crop productivity.
- Control invasive weeds to improve forage crop productivity for geese in managed fields by implementing an integrated approach to pest management that includes a combination of mechanical and chemical control, and occasional use of prescribed fire.
- Investigate using cooperative farming agreements on the Refuge that are compatible with Refuge purposes to reduce costs and labor.

***Objective 1.2*: Managed Seasonal Shallow Wetlands**

Throughout the 15-year life of the CCP, annually produce wetland plants (e.g., watergrass [Echinochloa crus-galli], swamp timothy [Crypsis schoenoides], alkali bulrush [Scirpus robustus]) to provide green forage and seeds for migrating waterfowl on approximately 700 acres of seasonally flooded managed ponds using moist soil management techniques to achieve at least 80 percent coverage of the desired green forage plants.

Rationale:

Migratory birds are Federal trust species under the jurisdiction of the Service, and their conservation and management are among the purposes for which the Sonny Bono Salton Sea NWR was established. Waterbird surveys conducted at the Salton Sea and adjacent areas in 1999 identified 107 species of native birds, including 19 species of waterfowl and more than 25 species of shorebirds (Shuford et al. 2002). As the Salton Sea continues to recede, the shallow seasonal wetlands managed on the Refuge will serve a continuously greater role in supporting migrating and wintering waterfowl and shorebirds that travel along the Pacific Flyway.

The seasonal shallow wetlands managed on the Refuge are provided to supplement the foraging opportunities for migratory waterfowl that are provided within the Refuge's managed agricultural fields. The foliage and seeds of wetland plants such as watergrass, swamp timothy, and alkali bulrush, as well as aquatic invertebrates, that thrive in the moist soil areas of these seasonal wetlands provide waterfowl with the additional nutrients needed for a balanced diet (Smith et al. no date). Providing wetland forage for wintering waterfowl requires that seasonal wetland areas be flooded annually in October to a depth of between four and 10 inches and maintained until about March, when the fields are drained. Shorebirds also benefit from these wet areas, particularly in the spring when the water in the ponds is drawn down.

Providing seasonal wetlands to meet the needs of the species that travel along the Pacific Flyway supports the general principle of the North American Waterfowl Management Plan (North American Waterfowl Management Plan Plan Committee 2004), which is "to maintain or restore traditional distributions of waterfowl in North America, consistent with long-standing patterns of waterfowl utilization." Providing these wetlands is also consistent with the Intermountain West Regional Shorebird Plan (Oring et al. 2000) goal of maintaining and enhancing diverse landscapes that sustain thriving shorebird populations.

Although the system-wide mission of the NWRS highlights the importance of maintaining the biological integrity, diversity, and environmental health of a refuge for future generations, it also recognizes that individual refuges may at times find it necessary to compromise elements of biological integrity, diversity, and environmental health at the refuge scale in support of those components at larger landscape scales (FWS Manual 601 FW3). In the case of the Sonny Bono Salton Sea NWR, restoring the biological integrity (which at the highest measure is viewed as those intact and self-sustaining habitats and wildlife populations that existed during historic conditions) of the lands within the Refuge would not achieve Refuge purposes, nor would it address the loss of migratory bird habitat that is presently occurring within the Salton Sea. In evaluating an adaptive framework for the NWRS that addresses refuge vulnerability to climate change, in conjunction with other anthropogenic drivers, Magness et al. (2011) recognized the need for an adaptive management approach that allows for flexibility at various landscape scales throughout the reserve network in an effort to moderate harm to trust resources, as well as exploit beneficial opportunities. The strategies for this Refuge that involve highly managed habitat areas are intended to support a diversity of species that have been compromised by the extensive loss of wetland habitat at an international (Pacific Flyway) landscape scale.

Managed Seasonal Shallow Wetlands Strategies

- Continue to maintain shallow wetland areas between October and March when the highest numbers of migratory waterfowl are present on the Refuge.
- Work with the IID to identify and develop water management practices that will improve water use efficiency in shallow seasonal wetland areas and throughout the Refuge.
- Direct spill water from seasonal wetland areas to managed agricultural lands and/or areas that support tree rows in an effort to optimize water use on the Refuge.
- Hire a full-time position (WG 6) responsible for irrigation and water movement throughout the Refuge that is necessary to achieve the objectives for seasonal shallow wetlands, as well as managed agricultural lands, managed cattail marsh, and permanent open water wetlands.
- Continue to develop the soils within the ponds to achieve optimum vegetative productivity.
- Using an integrated approach to pest management, continue to control salt cedar in and around the perimeter of these wetlands.
- Continue the practice of delaying drawdown in some ponds to provide shallow wetland habitat for migratory shorebirds that spend part or all of the spring and summer months on the Refuge.

***Objective 1.3*: Permanent Open Water Wetlands**

Throughout the life of the CCP, continue to manage approximately 110 acres of existing permanent, unvegetated, brackish open water areas with water depths ranging from one to three feet within Units 1 and 2 and maintain at least 10 unvegetated islands of various sizes within these permanent open water areas to provide nesting and roosting habitat for gull-billed terns, black skimmers, and other nesting seabirds.

Rationale:

The results of the comprehensive waterbird surveys conducted in 1999 (Shuford et al. 2002) in and around the Salton Sea demonstrate the importance of open water wetlands in this area to more than 100 species of birds, including pelecaniformes (i.e., pelicans, cormorants), wading birds (e.g., herons egrets, ibis, storks), shorebirds, and larids (e.g., gulls, terns). Providing open water habitat to support these birds is consistent with North American Waterbird

Conservation Plan (Kushlan et al. 2002) goal of protecting, restoring, and managing sufficient high quality habitat and key sites for waterbirds throughout the year to meet species and population goals.

These permanent open water areas, which receive a continuous flow of freshwater from IID supplied water, as well as water that is drained into these areas from other wetlands on the Refuge, are maintained at depths of from one to three feet to support rafting and foraging waterbirds and deter access by mammals to nesting islands. The salinity levels within these areas are not managed, but due to evaporation and existing salts in the soil, salinity levels are generally high enough (brackish) to minimize the potential for invasion by freshwater wetland vegetation.

Minimal disturbance and lack of predators are important determinants of successful seabird breeding (USFWS 2005); therefore, the small islands provided within the Refuge's permanent open water wetlands provide greater protection for these ground nesting birds than would unvegetated areas around the perimeter of open water areas. Protected roosting sites are also important for seabirds and other waterbirds. The maintenance of unvegetated nesting islands within these open water wetlands supports the habitat management goal of the Pacific Region Regional Seabird Conservation Plan to "maintain, protect, and enhance seabird habitats (breeding, roosting, foraging, migrating and wintering) in sufficient quantity and quality to meet seabird needs" (USFWS 2005).

Permanent Open Water Wetlands Strategies

- Continue to manage and maintain the existing permanent open water wetland areas within Units 1 and 2 by providing a continuous flow of freshwater water into these wetland areas.
- Continue to implement maintenance actions (e.g., erosion control around island perimeters, vegetation control, nesting substrate enhancement), as necessary, on the existing islands within the permanent open water areas to provide quality nesting habitat for seabirds.
- To minimize the growth of freshwater emergent vegetation, particularly cattails, and maintain open water areas, sustain slightly elevated salinity levels within these wetlands.
- Using an integrated approach to pest management, continue to control salt cedar and other invasive plants in and around the perimeter of these wetlands.
- Work with the IID to identify and develop water and habitat management actions that will improve water use efficiency in permanent open water wetlands and throughout the Refuge.

***Objective 1.4*: Restored Salton Sea Wetlands**

By 2015, actively begin the phased restoration of Red Hill Bay to provide a total of 420 acres of shallow (six inches to one foot in depth), unvegetated wetlands with salinity levels ranging from 20 to 30 ppt to support foraging and loafing habitat for shorebirds, long-legged wading birds, waterfowl, and seabirds; and continue to work cooperatively with the USACOE and California Resources Agency on efforts to restore up to 1,600 acres of unvegetated, saline (typically 20 to 40 ppt, occasionally up to 50 ppt) wetlands on the Refuge (part of a larger restoration effort in Bruchard Bay involving the construction of independent pond and cascading pond units totaling approximately 3,770 acres) with water depths generally ranging from 0 and 6 feet, but also including excavated holes of greater depths (up to 12 feet) to accommodate a range of foraging needs for fish-eating birds and other migratory birds.

Rationale:
The Sonny Bono Salton Sea NWR was established in 1930 "as a refuge and breeding ground for birds and wild animals," and additional lands were acquired or leased for the management of migratory birds under the Migratory Bird Treaty Act and the Lea Act. As the Salton Sea recedes, the Refuge's open water areas of the Salton Sea, areas that support or have supported a range of migratory birds from fishing-eating birds to shorebirds and waterfowl - are being eliminated both by the direct loss of water due to evaporation and through the degradation of water quality (e.g., increased salinity levels, temperature extremes, eutrophication, anoxia, and increase algal productivity) (USACOE and California Natural Resources Agency 2011).

Despite its origins, the Salton Sea has for many years been considered one of the most important wetlands to wintering, migratory, and breeding waterbirds in North America (Jehl 1994, Shuford et al. 2002), in part because the Sea provides habitat for species displaced by the loss of wetlands elsewhere within the Pacific Flyway, including within California where approximately 91 percent of the historic wetland habitat has been lost to agriculture and other forms of development (Yuhas 1996).

As the salinities within the Salton Sea continue to rise, the availability of adequate forage species to sustain fish-eating birds has declined sharply. The variety of marine sport fish once available for pelicans, double-crested cormorants, and black skimmers are no longer present in the Salton Sea and the remaining populations of tilapia and several smaller nonsport fish species are dwindling (USACOE and California Natural Resources Agency 2011). In addition, pileworms and barnacles, primary components of the Salton Sea food web, also appear to be impacted by deteriorating water quality (USACOE and California Natural Resources Agency 2011).

The State of the Birds report for 2011 (North American Bird Conservation Initiative 2011) identifies continued investment in wetland conservation and management as an important component of addressing the conservation challenges of maintaining healthy populations of birds. To address the changing conditions at the Salton Sea, which pose a threat to tens of thousands of migratory and wintering shorebirds and waterfowl, as well as breeding seabirds and other waterbirds, a range of Federal, State, local, and tribal governments are designing projects in and around the Salton Sea to reestablish habitat needed to support the diversity of waterbirds (e.g., pelicans, shorebirds, seabirds, waterfowl) that rely on the Salton Sea as a migratory stop-over, wintering ground, breeding area, or year-round foraging site.

Consistent with the purposes for which the Sonny Bono Salton Sea NWR was established, the Refuge proposes to participate in a variety of Salton Sea restoration efforts, including the restoration of permanent open saline water areas.

Restored Salton Sea Wetlands Strategies

- Restore approximately 420 acres of shallow, saline water habitat in Red Hill Bay in an effort to maintain recent historical Salton Sea wetland values on this part of the Refuge.
- Coordinate with IID to divert water from the Alamo River to blend with Salton Sea water for the restoration of Red Hill Bay.
- To protect the health of the avian species supported by restored open saline water habitat, partner with USGS to monitor selenium levels within the restored habitat areas, and develop measures that can be implemented to reduce selenium levels should monitoring indicate the need for such measures.

- Incorporate measures into the design of the water delivery and pumping systems needed to maintain managed saline water habitat that will avoid loss and injury to desert pupfish.
- Include habitat features within proposed saline water habitats to support desert pupfish should they enter these managed habitat areas.
- Create and maintain islands within these managed habitats to support gull-billed tern and black skimmer nesting.
- As part of the Red Hill Bay restoration project, implement a multiple year monitoring program to monitor selenium and pesticide levels and the effect, if any, of these constituents on the biotic and abiotic functions of the created habitat.
- Encourage research projects that can help guide the future management of currently proposed and future managed habitat systems in the Salton Sea basin.
- Continue to partner with others in the planning and implementation of the Salton Sea SCH Project, which proposes to restore habitat values within some 3,770 acres of permanent ponded wetlands (potentially including 1,600 acres within the Refuge boundary) at the southern edge of the Salton Sea.

Goal 2: Protect, manage, and, where appropriate, enhance or restore habitat to support the recovery of federally and State listed threatened and endangered species and other species of concern known to occur on the Refuge.

Objective 2.1: Managed Cattail Marsh
By 2016, work with partners to secure a source of water of sufficient quantity and quality to provide for the long-term (i.e., minimum 25 years) continued active management of at least 180 acres of cattail marsh habitat - consisting of a mosaic of emergent vegetation averaging greater than six feet (2 meters) high (Anderson and Ohmart 1985, Eddleman 1989) with varying stem densities (Smith 1975, Bennett and Ohmart 1978, Conway et al. 1993), shallow open water areas with minimal daily water fluctuation, and open dry ground (slightly higher than the water level) (Anderson and Ohmart 1985, Eddleman 1989, Conway et al. 1993) to support the endangered Yuma Ridgeway's rail at a density of 0.50 rails or more per acre.

Rationale:
Natural cattail/bulrush marshes in the Colorado River Delta are thought to be the primary habitat that historically supported the federally listed endangered Yuma Ridgway's rail. Unfortunately, diversion of water from the lower Colorado River has all but eliminated freshwater flows down into the Delta, and as a result, this native habitat has been lost (USFWS 2009a). Today, the Yuma Ridgway's rail exists primarily in managed cattail ponds, such as those on the Refuge, or other similar habitat areas created as a result of human activity (e.g., effluent-supported marshes, behind dams and diversion structures).

Generally, low stem densities and low residual vegetation coverage are indicative of suitable Yuma Ridgway's rail habitat (Conway et al. 1993), with lower stem densities (less than 75 to 80 stems per square meter) supporting significantly more rails during the breeding seasons (Smith 1975, Bennett and Ohmart 1978). The rails use areas with slightly higher stem densities during the late summer and fall (Anderson and Ohmart 1985, Eddleman 1989).

Other features with significant changes in seasonal use included distance to the adjacent uplands and vegetative edge and percent residual vegetation (the accumulation of fallen cattails) from previous years. The presence of too much residual vegetation adversely affects

habitat quality and overall rail use (Conway and Nadeau 2005). Active management actions, largely through use of prescribed burning, eliminate the residual vegetation and restore the appropriate stem densities (Conway and Nadeau 2005); however, additional research is needed to define the proper cycle of burns.

In considering water quality issues that could affect the Yuma Ridgway's rail, Eddleman (1989) identified selenium as a potential threat to the survival and recovery of the rail. Although the lower Colorado River (including the Salton Sea and Mexico) does not contain local sources of selenium that contribute to selenium levels in the biological environment, selenium from the seliniferous soils of the Mancos shale formations in the Upper Basin (Utah, Wyoming, and Colorado) are transported via the river water to the lower Colorado River where evaporation concentrates the selenium in the water. At present, the selenium level in the Colorado River water coming into the Imperial Valley is somewhat higher than 2.0 μg/L, which is the maximum desirable level recommended by the Department of the Interior. To ensure the highest possible habitat quality for the Yuma Ridgway's rail, the Refuge should strive to maintain the lowest selenium concentration practicable within areas managed for rail habitat.

The draft revised recovery plan for the Yuma Ridgway's rail states that "to achieve recovery, the Yuma Ridgway's rail must reach and maintain a viable population level and have sufficient protected and managed marsh habitat [including movement corridors that connect these habitats] to provide for long-term persistence of populations in the three major core areas" (i.e., the lower Colorado River, Salton Sea, Cienega de Santa Clara) (USFWS 2009a). The draft recovery plan also stresses the importance of water availability, water quality, and ongoing habitat management in maintaining suitable conditions for rails (USFWS 2009a). The strategies presented below would assist in achieving these stated recovery goals.

Management of the Refuge's freshwater cattail marsh habitat to support the Yuma Ridgway's rail also provides benefits to other secretive marsh birds, including the California black rail, a State-listed species (CDFG 2008) and a Service-recognized Bird of Conservation Concern (USFWS 2008a), and the least bittern, a California Bird Species of Special Concern (CDFG 2008) and a Service-recognized Bird of Conservation Concern (USFWS 2008a).

Managed Cattail Marsh Strategies

- Continue to manage at least 180 acres of cattail marsh in a manner that will provide suitable habitat conditions to support the Yuma Ridgway's rail.
- Continue to conduct annual spring surveys of the Refuge's cattail marsh habitat to monitor the Refuge's Yuma Ridgway's rail population size and review current and past survey data to identify any changes in population status that may warrant reevaluation of current management practices.
- Control the establishment of common reed within managed cattail marsh habitat and salt cedar around the perimeter of the marsh through the implementation of an integrated approach to pest management.
- Work with the IID to ensure that the Refuge will be provided with an adequate supply of water of appropriate quality to continue to provide managed cattail marsh habitat to support the current population of Yuma Ridgway's rails on the Refuge.
- By 2016, prepare a Yuma Ridgway's rail habitat management plan, per the direction provided in the draft Yuma Clapper Rail (now referred to as the Yuma Ridgway's Rail) Recovery Plan (USFWS 2009a), to address the long-term management needs of the Refuge's Yuma Ridgway's rail population.

- Seek funding to support research projects that can provide data necessary to: 1) refine suitable habitat parameters for this species in various seasons; 2) assist in identifying appropriate management techniques for maintaining suitable rail habitat over the long-term; 3) maintain adequate water quality within managed areas; 4) evaluate potential threats related to selenium accumulation; 5) evaluate the role of prescribed fire in offsetting vegetation maturity and other habitat degradation; 6) understand rail response and dispersal into new habitat areas as a result of the use of prescribed fire; and safely and effectively controlling invasive plant species in managed habitat areas.

***Objective 2.2*: Desert Pupfish (Cyprinodon macularius)**
In coordination with CDFW and the Palm Springs Fish and Wildlife Office, develop and by 2015 begin to implement a desert pupfish management strategy for the Refuge that includes annual monitoring for the presence of desert pupfish within Refuge wetlands and identifies conservation measures to be implemented to avoid adverse effects to desert pupfish as a result of Refuge management actions implemented to achieve Refuge purposes.

Rationale:
The desert pupfish, which was first documented in the vicinity of the Salton Sea in 1859, currently occurs in two streams tributary to, and in shoreline pools and irrigation drains of, the Salton Sea (Lau and Boehm 1991). Desert pupfish are not currently managed on the Sonny Bono Salton Sea NWR and until recently, this species was not known to occur in the managed habitats on the Refuge. Inadvertent connections to managed habitat areas from adjacent irrigation drains can result in the establishment of desert pupfish within one or more of the Refuge's managed wetland areas. To avoid the unintentional take of desert pupfish during habitat maintenance, it is important to know if pupfish are present in an area that may be drained or otherwise significantly disturbed prior to taking any action. In addition, conservation measures should be in place that can be implemented to avoid adverse effects if the species is present.

According to the Service's 5-year review of the desert pupfish, "the desert pupfish population as a whole is presently stable, though still small, disjunct, and vulnerable to stochastic events that could result in local extirpations. Local populations may be far more variable due to a variety of factors such as amount of habitat, presence of nonnative species, and other threats" (USFWS 2010b). Critical habitat has been established for this species; however, it does not include any areas within the Sonny Bono Salton Sea NWR.

Lau and Boehm (1991) found desert pupfish to be widely distributed in drains that gravity flow into the Salton Sea. Pupfish also have been documented in at least one of the managed habitat areas on the Refuge, where they could be at risk due to the high level of management activity that occurs within these habitats. Examples of such management activities include removing accumulated silt from irrigation drains to facilitate proper drainage and drawing down permanent open water areas to implement repairs on nesting islands. These activities, which are necessary to achieve Refuge purposes, can result in adverse effects to desert pupfish, if they are present. A potential conservation measure may involve the relocation of pupfish found to be occupying highly managed areas of the Refuge to appropriate habitat in the Salton Sea, adjacent drainage ditches, or other parts of the Refuge. By implementing this measure, the potential harm to pupfish would be minimized and the Refuge could continue to manage habitats in accordance with its migratory bird purposes.

Desert Pupfish Strategies

- Work with CDFW and others to monitor water areas within the Refuge, including proposed Salton Sea and Red Hill Bay restoration areas, for the presence of desert pupfish.
- Develop a desert pupfish strategy in coordination with CDFW and the Palm Springs Fish and Wildlife Office that would set forth conservation measures for protecting desert pupfish from adverse effects as a result of ongoing Refuge management actions, including the potential for relocation of desert pupfish from highly managed areas to appropriate habitat within or in the vicinity of the Refuge.
- Incorporate appropriate habitat features to support desert pupfish within the Red Hill Bay restoration site.
- To support the genetic diversity of the desert pupfish population, partner with CDFW to relocate desert pupfish to appropriate locations on or off the Refuge.

***Objective 2.3*: Western Gull-billed Tern (Gelochelidon nilotica vanrossemi)**
Throughout the life of the CCP, continue to maintain approximately 0.5 acres of unvegetated, fine gravel-surfaced islands of variable sizes surrounded by water depths ranging from one to three feet within the permanent open water areas in Units 1 and 2 to provide nesting habitat for the western gull-billed tern; and by 2018 provide at least eight similarly designed and maintained islands (totally approximately two acres) as part of the Red Hill Bay restoration project.

Rationale:
The western gull-billed tern, designated as a Bird of Conservation Concern by the Service (USFWS 2008a) and identified as a Bird Species of Special Concern by the State of California, has nested in the vicinity of the Salton Sea since at least the 1920s (Molina 2008). Until 1986, this was the only breeding site for western gull-billed terns in the U.S. Today, western gull-billed terns also breed within southern California, primarily within the South San Diego Bay Unit of the San Diego Bay NWR (USFWS 2006a).

For many years, the Sonny Bono Salton Sea NWR supported large numbers of nesting western gull-billed terns; however, recently, the total number of nesting birds and birds fledged on the Refuge has been decreasing. Potential causes include depredation by raccoons (*Procyon lotor*) and coyotes (*Canis latrans*), over-crowding due to the presence of Caspian terns (*Hydroprogne caspia*) and California gulls (*Larus californicus*), and limited nesting areas. Opportunities for providing additional defensible nesting sites on the Refuge are limited by water availability, however, the Red Hill Bay and Salton Sea SCH projects will provide an opportunity to create new nesting islands suitable for use by western gull-billed terns.

Gull-billed Tern Strategies

- Improve nesting conditions in Unit 1 by augmenting silty nesting substrates on the nesting islands with barnacle shells and depositing rock around the island perimeters to minimize erosion.
- Annually remove vegetation on and near all nesting islands.
- To minimize take of gull-billed tern eggs and chicks, implement an integrated predator management program using non-lethal (e.g., electric fencing) and, where necessary, targeted lethal predator control measures in accordance with the Predator Management Plan prepared for the Refuge (Appendix H).

- Construct and maintain new nesting islands in appropriate locations within the Red Hill Bay restoration project.
- Working with Federal and State partners, incorporate the creation of new nesting islands within the Salton Sea SCH project.
- Annually monitor use and productivity within potential western gull-billed tern nesting areas.
- Ensure the adequate availability of water around nesting islands to protect the health and survival of nesting gull-billed terns.

***Objective 2.4*: Monitoring Waterbird Abundance and Diversity**
To facilitate the ongoing assessment of trends in abundance, diversity, and distribution of migratory and resident waterbirds at the Salton Sea and within the managed areas of the Refuge, as well as to provide information necessary to address flyway management needs now and into the future, continue to participate in aerial waterfowl surveys monthly between November and February; sandhill crane surveys monthly between October and March; Yuma Ridgway's rail surveys three times a year (March through May); annual western gull-billed tern nesting surveys between April and August; and partner with CDFW to conduct monthly waterbird surveys on the Salton Sea.

Rationale:
Currently, the wetland habitats present at the Salton Sea and within the Sonny Bono Salton Sea NWR support a number of waterbird species that are of regional or continental importance, including at least 16 species identified by the Service as Birds of Conservation Concern (USFWS 2008a) and 14 species of waterfowl of high or moderately high continental priority per the Sonoran Joint Venture Bird Conservation Plan Waterfowl Management Supplement (Beardmore 2007). These habitats provide wintering, stop-over, and breeding areas for a range of waterbirds, and although the species present in the area varies with the seasons, the number of birds and diversity of species present remain high throughout the year (Shuford et al. 2002).

The combination of a receding Salton Sea with continually rising salinity levels and uncertainty regarding the long-term availability of water to support the Refuge's managed habitat areas has raised concerns regarding future waterbird abundance and diversity at the Salton Sea. To better understand how changes at the Salton Sea are affecting past and present bird abundance and diversity, it is necessary to continue on-going monitoring efforts.

The U.S. Shorebird Conservation Plan (Brown et al. 2001), Sonoran Joint Venture Bird Conservation Plan Waterfowl Management Supplement (Beardmore 2007), and Intermountain West Regional Shorebird Plan (Oring et al. 2000) all address population and habitat objectives for healthy waterbird populations. Sharing the information obtained as a result of these ongoing waterbird surveys and monitoring efforts will allow the Refuge, other agencies, and flyway partners to assess any changes in diversity and/or abundance at the Salton Sea, to evaluate how these changes relate to current population objectives, to make predictions for how trends could progress over time, and to begin to develop proposals for offsetting the effects of any adverse trends associated with the changing environment at the Salton Sea.

Migratory and Resident Waterbird Strategies
- Continue to conduct gull-billed tern breeding surveys that also include incidental counts of associated breeding seabirds, annually between April and August.
- Continue to conduct annual aerial waterfowl surveys monthly between November and February.

- Continue to conduct annual sandhill crane surveys monthly between October and March.
- Continue to conduct annual secretive marsh bird surveys, with particular focus on the Yuma Ridgway's rail, three times a year between March and May.
- Continue to partner with CDFW to conduct monthly Salton Sea waterbird surveys.
- Continue to monitor for evidence of avian disease on the Salton Sea throughout the year.
- Consistently disseminate survey and monitoring data to interested agencies, flyway partners, and other partners in bird conservation, encouraging assessment of the trends occurring at the Salton Sea on regional and/or flyway populations.
- Support management-oriented research related to waterbirds.
- Manage areas of seasonal wetlands and permanent shallow open water wetlands to support a range of waterbirds, including shorebirds, wading birds, gulls/terns, and waterfowl, as described under Objectives 1.2 and 1.3.
- Restore shallow, open water habitat in Red Hill Bay, as described under Objective 1.4.
- Partner with others to restore deep water habitat in the Salton Sea to support fish-eating birds, as described under Objective 1.4.
- Manage areas of cattail marsh habitat to support secretive waterbirds and migratory and resident songbirds, as described under Objective 2.1.

Goal 3: Manage and protect remnant native desert scrub habitat, tree rows, and riparian areas on the Refuge to support resident bird and other wildlife species, as well as nesting habitat for Neotropical bird species.

***Objective 3.1*: Native Trees and Shrubs**
To support a range of native upland birds and other native wildlife: by 2018, restore native riparian habitat on 80 acres of refuge land near Bruchard Bay by removing invasive salt cedar and replacing the salt cedar with plantings of Goodding's black willow (Salix gooddingii), screwbean mesquite (Prosopis pubescens)and blue palo verde (Parkinsonia florida); over the life of the CCP as funding permits, restore native riparian habitat in the Hazard Tract, incrementally replacing areas dominated by non-native vegetation with screwbean mesquite and Goodding's black willow; and over the life of the CCP maintain approximately 60 acres of existing tree rows consisting of native honey mesquite (Prosopis glandulosa), blue palo verde, and desert ironwood (Olneya tesota), and some specimens of non-native Mexican palo verde (Parkinsonia aculeate).

Rationale:
Desert wash habitat has broad positive effects on bird species diversity, abundance, and nesting success (CalPIF 2009), and microhabitat characteristics can influence nest-site selection by breeding birds. Desert wash habitat, which occupies less than five percent of the Colorado Desert, supports 90 percent of the Colorado Desert's bird life (Dimmitt 2000), as well as various wildlife species. This habitat, as well as the tree rows present on the Refuge provide habitat for a range of resident birds, as well as a number of migratory songbirds.

Region-specific conservation actions for the Colorado Desert Region included within the California Wildlife Action Plan (CDFG 2007) include development and investment in restoration and protection efforts for regional wildlife habitats and identification and protection of critical avian habitats. The Desert Bird Conservation Plan (CalPIF 2009) also addresses the need in some areas to design and implement cultivated restoration projects that mimic the diversity and structure of a natural desert plant community. The Partners in Flight

North American Landbird Conservation Plan (Rich et al. 2004) and the Desert Bird Conservation Plan (CalPIF 2009) also include objectives related to the need to remove and replace invasive species with native species to increase habitat value for avian species. The Refuge management strategies for supporting native upland birds and animal species address these objectives and conservation actions.

Native Trees and Shrubs Strategies

- Replace approximately 80 acres of invasive salt cedar near Bruchard Bay with native desert riparian species, including Goodding's black willow, screwbean mesquite, and blue palo verde.
- Continue to maintain the existing tree rows (i.e., honey mesquite, blue palo verde, Mexican palo verde, and desert ironwood) in Unit 1 along existing fields, as well as in the vicinity of the Refuge headquarters and at the south end of the Hazard Tract in Unit 2.
- Implement incremental control and removal of invasive non-native woody species, particularly salt cedar, from the Hazard Tract, per available funding, and revegetate these areas with native trees and shrubs (e.g., Goodding's black willow, screwbean mesquite, blue palo verde).
- Optimize water use on the Refuge by irrigating tree rows and desert wash habitat with spill water from the managed agricultural fields whenever possible.

***Objective 3.2*: Burrowing Owls**
Throughout the life of the CCP, maintain approximately 45 burrowing owl nest boxes in appropriate locations throughout the Refuge and provide information regarding burrowing owl conservation at the Refuge visitor contact station to annually reach 10,000 visitors.

Rationale:
The burrowing owl is protected by the Migratory Bird Treaty Act, is considered by the Service to be a Bird of Conservation Concern (USFWS 2008a), and is listed as a Bird Species of Special Concern by the State of California. Bird count data compiled between the late 1980s and early 2000s suggest that the burrowing owl has been extirpated as a breeding species from approximately eight percent of its former range in California (Klute et al. 2003). Nevertheless, California continues to support one of the largest year-round populations of burrowing owls, including both resident and wintering migrants, in the U.S. In the late 1990s, an estimated 71 percent of the burrowing owls in California occurred in the Imperial Valley (Klute et al. 2003).

Based on data from burrowing owl surveys conducted in 1992 and 1993, an estimated 5,600 pairs of burrowing owls (95 percent confidence interval: 3405-7795) were present in the early 1990s in the Imperial Valley (DeSante et al. 2004). In recent years, population estimates have varied. In 2007, the number of burrowing owl pairs was estimated at 4,879 (95 percent confidence interval: 4,692-5,065), and in 2008, the number was 3,557 territories (95 percent confidence interval: 3,370-3,743) (Manning 2009). In 2011, the number was estimated at between 4,589 (95 percent confidence interval: 4,019-5158) and 5,058 (95 percent confidence interval: 4,450-5,666) (Harbin-Ireland 2011). It is unclear from the available data if the variability in population estimates is the result of changes in the actual number of burrowing owl pairs present in the Valley or on differences in the model detection probabilities used to estimate population size. Even with these annual variations, the Imperial Valley continues to support the largest population of burrowing owls in the State.

The primary threats to burrowing owls across its range relate to habitat loss due to land conversion associated with agriculture and urban development; habitat degradation; and reductions in burrowing mammal populations. Of these threats, the loss of burrowing mammal populations has been identified as the primary factor responsible for the decline in the overall burrowing owl population (Klute et al. 2003). With the extent of agricultural activity occurring in the Imperial Valley, opportunities for mammals to establish burrows are limited and often focus on disturbed areas associated with irrigation drains, canals, and ditches (Manning 2009). It is within these burrows that burrowing owls often establish nests. Unfortunately, these areas can be unstable and are subject to disturbance from ongoing activities associated with irrigation maintenance, overhead utility maintenance, and adjacent crop production.

To reduce the potential for the loss of burrowing owl nests due to inadvertent or intentional disturbance along existing roads and irrigation drainages, artificial burrows have been established in various locations throughout the Imperial Valley, including on the Refuge. Studies conducted in California indicate that burrowing owls readily occupy these artificial burrows and initial nesting success is followed by successful nesting in subsequent years (Trulio 1995). According to the CDFW, the best available science indicates that along with suitable foraging, wintering, and dispersal habitat, including an abundant and available prey base, essential habitat for the burrowing owl in California must include the presence of burrows, burrow surrogates, or presence of fossorial mammal dens (CDFG 2012). The artificial nesting burrows provided on the Refuge therefore address one of the important components needed to maintain a self-sustaining population of burrowing owls within the Imperial Valley.

Burrowing Owls Strategies

- Work with partners to annually inspect, clean, and maintain, as necessary, the existing nesting boxes on the Refuge.
- Prior to replacing an existing nesting box, conduct a literature search of current research related to nesting box design and maintenance needs in order to optimize nesting success and to reduce the need for annual maintenance.
- Continue to provide signage in the vicinity of nesting boxes to alert construction and utility workers of the presence of a nesting box.
- Periodically monitor the condition of the area around nesting box sites and if unauthorized disturbance has occurred, make any necessary repairs and implement measures to minimize the potential for any further disturbance.
- Continue to provide information at the visitor contact station about burrowing owls and the need to avoid disturbance to their burrows, particularly during the breeding season, expand public outreach about burrowing owls elsewhere in the community, and develop at least one interpretive sign for the interpretive trail in Unit 1 that addresses the importance of conserving areas to support burrowing owls.

***Objective 3.3*: Invasive Non-native Species**

Over the 15-year life of the CCP, implement an integrated approach to pest management to annually: control 95 percent of the non-native weedy species in managed agricultural lands; remove sufficient coverage of non-native, invasive vegetation in the water distribution system (e.g., water conveyance channels, irrigation ditches) to optimize water delivery and distribution on the Refuge throughout the year; and control at least 50 percent of the non-native woody species (e.g., salt cedar, common reed) present around the perimeters of the Refuge's managed wetland habitats.

Rationale:
The annual costs associated with invasive species, including environmental damage, agricultural impacts, and invasive species control are estimated at almost $120 billion per year in U.S. and approximately 42 percent of all threatened and endangered species are at risk primarily because of non-native species (Pimentel et al. 2005). Economic effects are easier to calculate than ecological consequences that are sometimes difficult to perceive, let alone quantify (Hanson and Sytsma 2001). According to the Service, invasive species have become the single greatest threat to the Refuge System. Rare species with limited ranges, small numbers, and restricted habitat requirements, such as the Yuma Ridgway's rail, are often particularly vulnerable. Invasive species can alter ecosystem structure and function, disrupt food chains and other ecosystem characteristics vital to wildlife, and alter key ecosystem processes such as hydrology, productivity, nutrient cycling, and fire regime (Randall 1996, Brooks and Pyke 2001).

A National Strategy for Management of Invasive Species (USFWS NWRS 2003) has been developed for the NWRS within the context of the National Invasive Species Management Plan, as called for by Presidential Executive Order 13112. This plan functions as the internal guidance document for invasive species management throughout the Refuge System. The plan has four goals: 1) increase the awareness of invasive species issues, both internally and externally; 2) reduce the impacts of invasive species to allow the Refuge System to more effectively meet its fish and wildlife conservation mission and purpose; 3) reduce invasive species impacts on the Refuge System's neighbors and communities; and 4) promote and support the development and use of safe and effective integrated management techniques to deal with invasive species. The proposal to address the problem of invasive species within the Refuge Complex will support these goals, and assist in achieving Statewide Conservation Action F in the California Wildlife Action Plan (CDFG 2007).

Invasive Non-Native Species Strategies

- Continue to control non-native weedy species in managed agricultural areas to optimize green forage production to support wintering geese.
- Continue no till practices in a portion of the managed agricultural areas to reduce the need for chemical control of invasive species.
- Control the emergence of cattails in seasonal wetland areas by temporarily increasing salinity levels.
- Implement an integrated approach to pest management that includes the use of physical, mechanical, and chemical controls, including the aerial application of herbicides in agricultural fields and dense salt cedar stands to improve overall coverage and effectiveness of control.
- Implement mechanical and chemical control of non-native woody species (e.g., salt cedar, common reed) in accordance with the Refuge IPM Plan to reduce the percent coverage of these species within the water distribution system.
- Implement best management practices, such as cleaning boots, tires, mower decks, and truck undercarriages following completion of activities in weed infested areas and mow weedy areas prior to seed set, to reduce the distribution of weed seeds into other areas of the Refuge.
- Opportunistically monitor Refuge areas for the presence of new invasive plant species in an effort to facilitate early eradication, avoiding the need for significant long-term control of the species on the Refuge, and share this information with other agencies in the region.